EXPLAINING VARIATIONS IN THE GULF - KANSAS CITY HARD-RED WINTER WHEAT BASIS

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Bachelor of Science

Texas A & M University

College Station, Texas

1983

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1985

EXPLAINING VARIATIONS IN THE GULF - KANSAS CITY

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Thesis Approved:

Thesis Adviser

Dean of Graduate College

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to the many people who assisted me in the research and writing of this thesis. First, I would like to thank the members of my committee. I am indebted to Dr. Leo Blakley for providing the overall guidance and encouragement for this project as my committee chairman. I am likewise indebted to Dr. Kim Anderson for his understanding and support, and for helping me collect the data used in my research. I would like to thank Dr. Dan Tilley for his fresh ideas and new approaches to get me over or around the brick walls I often found myself facing.

Second, I would like to thank the Department of Agricultural Economics for providing the financial assistance without which I could not have pursued this Master's Degree. I am also grateful to the Computer Services Staff for their data entry assistance, and especially to James Alexander for his programming assistance.

Third, I would like to thank Libby Whipple for deciphering my rough draft and making it presentable. Thanks also to Betty Harris for her formatting suggestions and to Marsha Speer for typing the final draft.

Finally, I would like to thank Joyce Grizzle, Dale Stemple, Pat McColloch, Jeff Dale, Kitty Hawk, Bruce Bainbridge, and the many others in the department who have provided friendship, encouragement, and the timely breaks from the routine of being a student. Thanks

also to my brother Mike, who encouraged me to come to Oklahoma State University. Without all of you, my education would have been incomplete. Thank you for the assistance and the memories.

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CHAPTER I

INTRODUCTION

Problem Situation

Wheat marketing decisions are complex. And, as additional alternatives are offered by the grain trade, marketing decisions could become even more difficult. Forward contracting, deferred pricing, hedging, speculation, or participation in a government program must be weighed against the cash sale alternative. When to store, when to sell, when to place or lift a hedge, and what price can be expected in the future are other decisions facing wheat traders. All these decisions require knowledge and understanding of the relationship between the current cash price and the commodity futures price for wheat. This relationship is known as the basis.

The basis may be the most important price relationship for a wheat trader to understand. Without a knowledge of a particular commodity's basis pattern, it is impossible to make fully informed decisions. Knowing the normal basis patterns will allow wheat traders to analyze current price offers against future price expectations, and base marketing decisions on better information. If an equation for a normal basis pattern can be determined, wheat traders will have a useful instrument to help reduce the complexity of marketing decisions.

Because a basis is the difference between a cash price and a particular futures price, any factor affecting either price may also cause a change in the basis. Any analysis of basis patterns should, therefore, begin with an understanding of the determinants of cash and futures prices.

Price Characteristics

Cash Price

The cash (or spot) price is the result of the market supply and demand situation at a particular location at a given time. Factors that affect wheat supply and demand at a specific location on a particular day include the price offered the previous day, seasonality, changes in government wheat programs, the availability of storage at the location, competitor's actions, and the activity of buyers higher in the marketing channel. For a local elevator, the cash price offered to producers is often derived by subtracting transportation and handling charges, plus a profit margin, from an offer it has received. Thus, the market conditions at the location in question, storage conditions, and handling costs contribute to the determination of the cash price for wheat.

Cash prices for wheat normally follow a seasonal pattern. Cash prices are expected to be lowest at harvest time when new-crop supplies enter the market. The cash price then increases throughout the year, peaking prior to the next harvest, and falling into the next crop year. This seasonal pattern usually exists for any seasonally produced, storable commodity. However, changing economic events can cause deviations from this pattern.

Futures Price

The futures price for a commodity is a consensus, based on available information, of what buyers and sellers expect the cash price to be in a future month. Supply and demand expectations reflected in the wheat futures price are subject to rapid change. Thus, the futures price may be volatile.

Because the futures price is based on expectations, it is difficult to predict exactly what a price may do in any changing situation. The outlook for future exports, future domestic demand forecasts, production estimates, government program changes, and many other factors can have an impact on the futures price for a commodity.

On the Kansas City Board of Trade, there are five contracts for a Hard-Red Winter wheat crop year: July, September, December, March and May. These five contracts offer wheat traders price expectation information throughout the upcoming year. Because buyers may be willing to pay a higher price for an assured supply at a future date and sellers may demand a storage premium for holding the grain until delivery, the more distant futures contracts often have higher prices than the nearby contracts. But, this is not always the case. A market in which distant prices are lower than a nearby price (an inverse carrying charge) is referred to as an "inverted market". An inverted market usually indicates a current shortage of the commodity at the cash market location. Thus, holders of the cash commodity stocks are being encouraged to release stocks into the market and not store until a later time.

Basis

Basis is the number of cents per bushel that, on any given day, the local cash price of a commodity is above or below the current price for a particular futures delivery month. This simple definition, though correct, is an incomplete explanation of "basis". The above definition describes the calculation of a basis, but it stops short of describing what determines the basis. Of what is a basis composed? Why might a cash price be more than (or less than) a futures prices on a given day? A more complete basis definition should define more than what a basis is; it should define why it is as well.

According to Bailey (1983), there are two major components of a cash price minus futures price basis. The first component is the difference between the local cash price and the delivery point cash price for a particular day, which is essentially due to transportation costs between the markets. This can be thought of as a "transportation basis". The second component of a basis is the difference between the delivery point cash price and the price of a particular futures contract for delivery to that location. This price difference usually reflects the expected cost of holding the cash commodity until the delivery date. This is the carrying charge component of a basis. Figure 1 illustrates the theoretical price relationships and both components of the basis.

In Figure 1, the July 2, 1983, number 1 Hard-Red Winter wheat cash prices for a Gulf location and Kansas City are shown with the closing price for the March, 1984 Kansas City Hard-Red Winter wheat

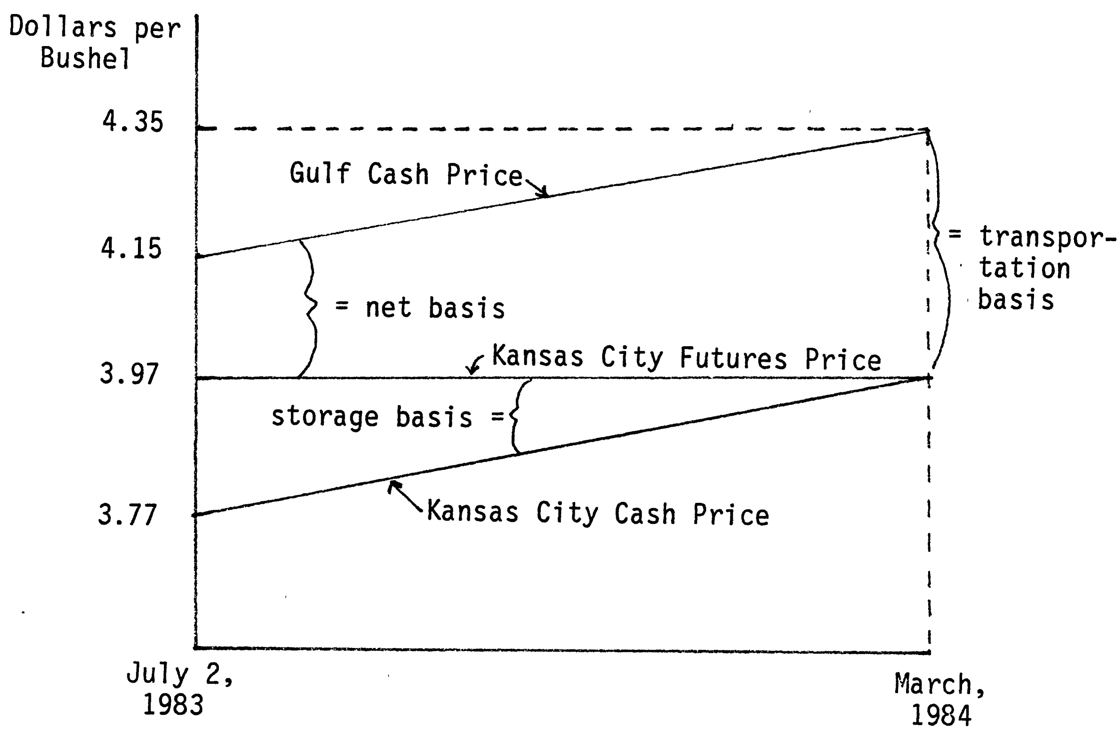


Figure 1. Theoretical Price Relationships and Basis Components

futures contract for the same day. On this day, the Kansas City cash price was $3.77 per bushel, the settlement price for the March contract was $3.97 per bushel, and the Gulf cash price was $4.15 per bushel. The transportation basis (the premium offered for wheat at the Gulf as opposed to at Kansas City) was $0.38 per bushel. The storage basis (reflecting the cost of holding grain in Kansas City until the March delivery date) was -$0.20 per bushel. The net Gulf minus Kansas City basis is the sum of the two components of the basis, or $0.18 per bushel.

If the futures price is assumed to be a perfect predictor of the supply and demand situation in Kansas City when the March contract expires, the cash price in Kansas City and the futures price should converge as the delivery date approaches. This convergence is due to the reduction of the total charge of carrying the wheat until the delivery date in March. Therefore, over time, the storage basis should decrease to zero by the delivery date. If the storage basis were not zero on the delivery date, profit potential would lead to arbitrage between the futures and cash markets. Arbitrage is the process of taking opposite positions in two markets with the intention of making a profit from the price differences. At the same time, if no change occurs in the costs associated with transporting wheat from Kansas City to the Gulf, the transportation basis will remain constant. On the contract expiration date, the net basis should equal the transportation costs between Kansas City and the Gulf.

In the real world, however, expectations and economic conditions are constantly changing, thus prices are constantly changing. Changing prices will often cause basis change. For example, on March

18, 1984, the cash price at Kansas City was $4.20 per bushel, the closing March Kansas City futures price for the expiring contract was $4.04 per bushel, and the cash price at the Gulf was $4.48. The transportation basis had changed to $0.28 per bushel (down 10 cents), the storage basis had changed to $.16 per bushel (up 36 cents), and the net basis was $0.44 per bushel (up 26 cents).

Unless changing market conditions have an equal impact on both the cash and futures markets, the net basis will change. The purpose of this study will be to analyze the Gulf minus Kansas City Hard-Red Winter wheat basis with the goal of identifying why the basis is what it is.

Objectives

Previous wheat price studies have dealt with price analysis and prediction, but few studies have been conducted on basis patterns. This study will attempt to identify and quantify the economic components of the basis.

What is a normal basis pattern? What economic events will cause the basis to fluctuate from an expected pattern? How can a wheat trader, given particular economic events, use basis information for hedging decisions? These are the fundamental questions this project will address.

The first objective of this study is to determine whether a predictable basis pattern exists and, if so, to identify the nature of an expected pattern for each contract month. The second objective involves the study of market and economic variables affecting the cash or futures prices and to identify those factors which can cause variations of the basis from the expected pattern.

Hypothesis

The hypothesis is that economic variables that accurately predict the Gulf minus Kansas City Hard-Red Winter wheat basis can be identified. Furthermore, basis variations can be associated with variations in one or more of the identified variables.

Analysis Procedures

To accomplish the first objective, a time series analysis will be conducted for historical basis data. The seasonality of basis patterns will be identified. The second objective will be accomplished by using linear regression techniques to estimate a model for the basis. Variables which can cause the basis to vary from an expected pattern will be identified through the regression analysis, and the quantitative relationship of the variables to the basis will be determined.

CHAPTER II

LITERATURE REVIEW

There have been many studies conducted on prices and price behavior for seasonally produced, storable commodities. Many noted authors have advanced theories of price relationships and hedging. Studies of hedging have almost always concluded that "basis" is the most important determinant of the success of a hedge. Most books and articles about futures markets and futures trading discuss hedging and basis, but few attempts have been made to analyze or explain basis patterns with historical data.

This chapter is organized into three sections. The first section is devoted to previous work conducted in hedging theory. The second section will discuss work conducted in price theory and price relationships. The final section of this chapter reviews work conducted in basis patterns and analysis.

Hedging

Hedging has been described in many ways. Johnson (1960) defined hedging as, when a position consisting of a number, x_i, of physical units is held in market i, a "hedge" is the taking of a position in market j of size x_j units such that the "price risk" of holding x_i and x_j from time t_1 to time t_2 is minimized. Heifner (1966) referred to hedging as the holding of a short position in a futures contract as a means of reducing the price risk associated with storing a commodity over a period of time. Typically, wheat producers are "short" hedgers. The producer has possession of the physical commodity either in storage or in production and sells (takes a short position) on the futures market to initiate the hedge. Wheat merchants would be either long or short hedgers, depending on their position in the futures market. The process of taking a position in the futures market equal and opposite of a cash position is the traditional description of a hedge.

Holbrook Working has conducted some of the most in-depth work in hedging theory. Working (1953a) described hedging as a form of arbitrage. By this definition, a hedger would be a trader who takes opposite positions in the cash and futures markets, and when able to predict basis fluctuations, closes the hedge and makes a profit from the favorable change in the basis. The description of hedging as arbitrage causes a conflict of definitions. Speculation, by definition, is the holding of a net long or net short position in a commodity with the intention of profiting from price change. Because the traditional purpose of hedging is to reduce cash price risk, a "hedger" who is actually arbitraging the cash and futures markets would be better described as a basis speculator. Cox (1972) pointed out that most hedgers usually begin as speculators in a cash commodity for which there is a futures market, and hedge to limit the potential loss from possible adverse cash price changes before the cash position is acquired.

It is possible for basis fluctuations to lead to speculation. If a trader feels the current basis for two markets (either cash minus futures, or between two futures contracts) is wider or narrower than justified, he may choose to take opposite positions in the two markets, expecting to profit when the basis returns to normal. Such a transaction would not be hedging, but a form of speculation, according to the traditional definition of hedging. The best definition of a hedge would describe the act of a holder of a cash commodity position (or an expected position) taking an opposite position in the futures market to reduce the cash price risk of holding the cash commodity position over a period of time.

Working (1953b) went on to describe the purposes of hedging. Hedging facilitates buying and selling decisions by changing the focus of decision making from price levels to relative price levels, which are considered to be much more predictable. Hedging also can reduce marketing risks associated with changing cash prices for stored commodities, thus giving greater freedom for business actions. Another purpose of hedging is that by taking advantage of price relationships, a grain trader can have a reliable method for making storage decisions by comparing the expected basis with his storage costs. Such a hedge would be intended to guarantee the hedger a level of storage income.

Several authors, including Brennan (1958), Heifner (1966), and Working (1948, 1949, and 1962), have proposed that securing a return for storage is the main reason for hedging. In 1962, Working described several other reasons why hedging would be undertaken. In this article, he defined hedging as the use of a futures contract as a temporary substitute for a cash contract that is to be made at a later time. The futures transaction was simply a paper purchase or sale of the cash commodity position which the trader expected to hold in the future. At the close of the hedge, the cash position would be taken and the futures position liquidated by an opposite and equal transaction in the futures markets. This definition differs from Johnson's in that a cash position is expected to be held as opposed to one already held by the trader when the hedge is initiated.

Working also made a distinction between different types of hedges in this article. Different classes of hedging were distinguished by the purpose of the hedge and hedger characteristics. Working's five types of hedging are summarized as follows:

1. Carrying Charge Hedging: A hedge undertaken in conjunction with the holding of stocks for direct profit from storage. Whereas the traditional definition of a hedger implies a hedge is undertaken to offset cash price losses with futures price gains, the carrying charge hedger is concerned that the basis will cover the cost of storing the cash commodity until the future date. Carrying charge hedging would be undertaken by a wheat trader engaged in providing storage as a service to others, or who wishes to guarantee a certain level of storage return on stocks he owns.

2. Operational Hedging: Hedging undertaken by merchants or processors of the cash commodity to facilitate the day to day operations of their business. Operational hedgers are concerned with the very short term changes in the cash and futures prices; even changes during a trading day. Conventional hedgers are more concerned with long term price relationships. For operational hedging to be

effective, there must exist a high correlation between the cash and futures price changes. Wheat millers and processors who are concerned with inventory levels and inventory control would be likely to engage in operational hedging.

3. Selective Hedging: The incomplete hedging of commodity stocks to limit the potential loss from cash price changes while retaining the chance of gaining from cash price increases. A selective hedger will only hedge a portion of his cash position as partial insurance against adverse price movement. A selective hedger would have possession of the cash commodity in storage and want protection from price loss, yet retain the ability to speculate on price gain.

4. Anticipatory Hedging: Hedging undertaken to offset an expected future position in the cash commodity. The purpose of anticipatory hedging is to guarantee or "lock in" a particular price the hedger wishes to receive when the cash position is filled. An illustration of an anticipatory hedger would be a producer hedging an unharvested crop of wheat by selling a futures contract. An effective anticipatory hedge would eliminate a producer's cash price risk while the crop is growing. Nosker (1981) used this definition of hedging in his publication.

5. Pure Risk Avoidance Hedging: This type of hedging is undertaken to perfectly insure the hedger against adverse price movements in the cash market. To perfectly insure against cash price loss, the futures transaction must perfectly offset the cash position of the hedger, and the futures and cash prices must move by exactly the same amount over the life of the hedge. For pure risk avoidance

hedging to be effective, the basis must remain constant while the hedge is in place, or the price changes will not offset each other perfectly. Working suggested that pure risk avoidance hedging is nonexistent.

Sandor (1973) states that the fundamental assumption of hedging is that futures prices and cash prices tend to move in the same direction over time, as both prices vary in response to the same set of economic conditions. However, the two prices seldom react to the same degree, resulting in a change in the basis. The movement of the basis is thought to be much more predictable than either the cash or futures prices.

Consequently, the underlying assumption of hedging is that the risk of basis change is less than the risk of cash price change. Nosker (1981) added a second principal of hedging. As futures contracts expire, the cash price at the delivery location and the expiring futures price tend to seek the same level. If the expiring futures were above (below) the cash price at the delivery location, traders could sell (buy) the futures and make (take) delivery of the cash commodity, thus profiting from the price relationship. Arbitrage, therefore, would cause downward (upward) pressure on the futures price, and an opposite pressure on the cash price, bringing them into line. Nosker implied that the delivery point basis would approach zero as the futures contract expired, and this relationship could be utilized by hedgers in making hedging decisions.

Graph, in a 1953 study of hedging effectiveness, concluded that hedging is most effective in periods of large cash price fluctuations, and often ineffective in times of relative cash price stability.

Effectiveness of a hedge was measured by the degree to which it neutralized the effects of a cash price change to a producer of corn, wheat, or oats. Based on Graph's conclusions, in times of volatile cash prices, when a producer is at the most risk of cash price loss, hedging is the most effective. Conversely, in times of relative cash price stability, when the risk of cash price to a producer is less, hedging often caused greater losses than if the producer had not hedged.

Determinants of Price

Most articles on hedging theory conclude that the basis is the most important determinant of hedging success. Because basis is a function of two prices, the fundamental precepts of cash and futures price behavior should hold a clue to basis behavior.

The cash price for a commodity, often called a "spot" price, is today's price for products delivered today. A futures price is today's price for a commodity to be delivered at a future time. Cash prices are determined by market supply and demand conditions on a particular day for trades consummated on that day. Futures prices are prices for contracts for the future delivery of a commodity. Due to the nature of futures trading, very few futures contracts actually end with delivery of the commodity. However, since a futures contract is legal and binding on futures traders until it is offset by an opposite trade, the futures price can be viewed as a reflection of the expected cash price at the delivery location on the delivery date. As expectations of the supply and demand situation for the time of delivery change, futures prices can be expected to change.

Tomek and Robinson (1981) present a good description of the process of price determination. In a perfectly competitive market, the equilibrium price for a commodity is found by the intersection of the market supply and demand curves. Perfect competition assumes a large number of buyers and sellers acting with perfect knowledge of the economic variables affecting price. Over one-half of the farm products in the United states are traded in markets that closely approximate perfect competition. Hard-Red Winter wheat is traded in a highly competitive market atmosphere.

Teweles, Harlow, and Stone (1974) discussed the factors affecting the price for wheat. They agreed that the basic determinant of a wheat price is the local supply and demand relationship. However, there are many factors which may alter this relationship. One of the most important factors is governmental action. Planting restrictions will affect supply, international trade policies will affect demand, and price support programs will affect prices even more directly.

In the local market, commercial storage availability will affect demand for wheat. The availability of rail, barge, or truck transportation is also an important short-run determinant of local demand. At harvest time, shortages in these two factors can cause further depression of the local cash prices offered to producers.

Farmers' actions will affect wheat supply. Tight farm holding of crops can force local merchants to bid up the cash price to draw stocks into the market. Farmers often hold wheat in expectation of higher prices, especially after periods of increasing price levels. Participation by farmers in government loan programs, acreage set-aside programs, or the Farmer Owned Reserve program further tightens the supply of wheat to the local market. These actions by growers make the analysis of the impact of program changes on wheat prices difficult.

In discussing price patterns, Tomek and Robinson (1981) found that agricultural prices do exhibit certain identifiable patterns. For Hard-Red Winter wheat, the most pronounced pattern has been a seasonal price pattern. Normally, as for most seasonally produced, storable commodities, wheat prices are lowest at harvest and rise after harvest until peaking prior to the new crop year and falling until after the new crop is harvested in May - July.

Prices for Hard-Red Winter wheat may deviate from seasonal patterns due to factors such as government program changes, weather conditions, or international political events. Working (1958) found that cash prices often respond to expected changes in factors influencing futures prices. Nevertheless, he concluded that wheat prices normally follow the previously mentioned seasonal pattern. He felt the increasing price levels following harvest would reflect the costs of storage, or the "carrying costs" of holding wheat into the future.

Labys and Granger (1970), in an analysis of wheat prices from 1950 to 1965, found that cash prices for wheat showed a strong seasonal pattern. They described the cash price behavior for wheat as a "12 month shifting seasonal superimposed on a basic random walk." Teweles, Harlow, and Stone (1974) discussed the effect of speculators and hedgers on the seasonal price pattern for wheat. They described the seasonal pattern as having low post harvest prices followed by increasing prices until a high is reached near December to January, when wheat supplies become more scarce. The futures market may not fully follow this seasonal pattern. At harvest time, a large volume of producer hedging would put downward pressure on the futures price but, according to the authors, the buying by speculators (who are net long, thus offsetting the net short position of hedgers) would tend to override the effects of the increased hedging on the futures price. Speculators would be the largest buyers of the futures contracts at harvest time and offer the highest prices. Later, as the cash price increased, speculators would liquidate their positions in the futures market, placing downward pressure on the futures price. Thus, their actions tend to eliminate, except for carrying charges, any seasonal pattern existing in futures price fluctuations for wheat.

The "random walk" hypothesis suggested by Working (1949) is widely accepted as an explanation of futures price movements. This hypothesis suggests that price changes in futures markets are independent, and thus, historical price information may not be useful in predicting what a price will be in the future. In 1962, Working stated that random walk in futures prices would result from the perfect functioning of a futures market. The perfect futures market was described as one in which the market price reflects the best estimate that could be made, based on available information, of the cash price at the delivery date.

The random walk hypothesis does not disallow for the existence of trends and patterns in price behavior. The hypothesis merely states that short-term changes in the futures price can not be accurately predicted in advance. Daily price variation due to changing market conditions, or in the case of the futures market, changing <u>expected</u>

market conditions, is not perfect. Rather, the effects of changing conditions are distributed over time. Thus, the immediate price change due to new information may be an exaggeration of the actual impact of the market conditions, and minor price readjustments will follow as the changes are better understood.

Basis Relationships

The relationship between two prices is called a "basis." A cash price minus futures price basis is normally associated with the costs of holding a commodity over time. These costs are composed of the storage and handling costs, or carrying charges. Thus, the basis is often referred to as a carrying charge.

Tomek and Robinson (1981), and Tomek and Gray (1970) state that the prices for different futures months tend to move up and down together, but by different amounts, due to changes in the costs associated with storage or in future inventory expectations. They did caution that this relationship may not exist across crop years. New-crop futures prices tend to move together differently from old-crop prices. This is because old-crop prices are influenced by current inventories, and new-crop prices are influenced by expected production levels.

Tomek and Gray (1970) found that the relationship between cash and futures prices would remain basically the same for the different crop year. In a perfectly functioning futures market, the cash and futures prices tend to converge as the contract matures. On the delivery date, however, the prices may differ by the costs of making or taking delivery.

Second, prior to contract maturity, the basis should reflect the costs of holding the cash commodity in storage until the contract matures. As the contract matures, the remaining total cost of storage decreases. Therefore, the cash price should rise relative to the futures price. At the delivery point, the Hard-Red Winter wheat futures price should initially be above the cash price by an amount approximately equal to the cost of carrying the wheat until the delivery date, resulting in a negative cash price minus futures price basis. As the delivery date approaches and the cash price rises relative to the futures price, the basis is said to "narrow."

It is important to note that at points other than the delivery point, the basis relationship may be different. For example, the Gulf cash price has been consistently above the Kansas City cash price at the beginning of a contract year. The difference between the Gulf and interior par delivery point cash prices is normally due to transportation and handling costs between the two points. The two cash prices do tend to move together, with the exception of short-term fluctuations caused by local market changes. Therefore, while the delivery point basis is narrowing (the cash price rising relative to the futures price), the Gulf cash price minus the Kansas City futures price basis would be widening.

The third relationship between cash and futures prices is that they tend to move together in response to the same market changes. Market conditions affecting the cash price usually affect the futures price. The prices may not react to the same degree because of differences in expectations and other random variations. Nevertheless, the tendency for prices to react nearly together often results in periods of constant basis levels even if cash and futures prices are changing. Graph (1953) pointed out that the protective feature of hedging is that movements and trends in cash and futures prices are sufficiently similar so that losses in one market due to a price change are offset by gains in the other market.

The carrying charge theory of basis may also explain seasonal price patterns for wheat. Hieronymus (1971) stated that there are three reasons why carrying charges can cause seasonal patterns. The first is that, as commodities such as Hard-Red Winter wheat are only harvested once a year in the United States, inventories must be carried forward from harvest as consumption occurs at fairly even rates throughout the year. Second, there are costs associated with storing and maintaining the quality of stored agricultural commodities. Third, the cost associated with holding a futures contract is minimal. Therefore, post harvest prices would have to increase to "pay" holders of cash wheat for storing, or to "carry" stocks it into the future. Based on this, futures prices at the delivery location should be above cash prices by, roughly, the amount of the carrying costs remaining until the delivery date. Likewise, distant futures prices should be above nearby futures prices for the same reason, with the exception of new crop versus old crop futures contracts, as pointed out in Tomek and Robinson.

Holbrook Working has conducted numerous studies of basis, or carrying charge relationships. In his 1948 article, Working studied the reasons why a market may show an inverse carrying charge. He defined "carrying charge" as the market difference between prices of a commodity for different dates of delivery. The prices would be for commodities of equal quality for different dates of delivery to the same location.

An inverse carrying charge at a futures delivery point would exist when the cash price is above the futures price. Working found that carrying charges between contracts in the futures market often approximate or even exceed the costs of holding wheat in public facilities at regular storage rates. When the price difference is less than the storage costs, the market is said to be showing less than full carrying charges in the price relationships. Such relationships usually occur when the commodity is in short supply, and buyers are required to raise their cash offer price to draw more supplies into the market.

Working concluded that, even when inverse carrying charges were present, the cash and futures prices still tended to respond to the same economic information. For as long as the market supply and demand imbalance existed, the cash price would remain above the futures price. When the market situation returned to an equilibrium, the carrying charge would return to a normal level. Working (1949, 1962) later would refer to the "carrying charge" as the "price of storage."

Nosker (1981) also pointed out that a "strong" basis reflects strong demand, and a "weak" basis reflects weak demand for a commodity. A strong basis is one where the cash price is increasing relative to the futures price. Strong demand could be synonymous with tight supply. Regardless of the terminology used, when demand exceeds supply in the Hard-Red Winter wheat market, the cash price will rise relative to the futures price for as long as the imbalance exists.

Thus, in such a market situation, the basis would be said to "strengthen."

The Gulf cash minus Kansas City Hard-Red Winter wheat futures basis has two major components. Bailey (1983) identified these as locational and carrying cost. A locational basis is the spot price difference between two delivery locations. The price difference is normally equal to the costs of transportation and handling between the two locations.

The second component of a basis is due to carrying costs. This is an intertemporal basis reflecting the difference between prices for a commodity delivered to a particular location at different times. The main determinants of the carrying charge basis are storage costs, insurance costs, interest rates, handling costs, and value losses due to commodity deterioration over time.

Updaw stated that the wheat basis at a local market could be expected to reach a level equal to transportation costs from the local market to the futures delivery point, or arbitrage would force its equalization. Therefore, he concluded, transportation and handling costs place an upward bound on the level that a basis can be expected to reach. He went on to propose that, if interest rates, transportation costs, and local supply and demand show little variation from year to year, the average historical basis would be a good estimator of the next year's basis. He pointed out that it is only in years when transportation costs or storage costs rise continually due to inflation, interest rate changes, energy costs, or freight tariff changes, that the basis would vary consistently from the expected basis level.

CHAPTER III

ANALYSIS OF BASIS VARIATIONS

Scope and Focus

In the wheat trade, the cash price is often quoted as a number of cents over or under a selected futures contract price. This cash price quote is equivalent to subtracting the futures price from the cash price. For this study, the basis for each Kansas City Hard-Red Winter wheat futures contract is calculated by subtracting the contract settlement price for a day from the same day's Gulf cash bid, f.o.b. delivered to the Gulf. By calculating the basis in this manner, the results of this study will be readily applicable to the needs of many wheat traders.

The identification of the expected relationships between a selected economic variable and the basis is difficult. Price theory will suggest that any variable affecting the cash price will have the same directional impact on the futures price. However, short term imbalances in a local market's supply and demand situation may cause cash price changes while not affecting a futures price. Thus, the basis may change from an expected level for short periods of time. When the local market returns to an equilibrium, the basis should return to the expected level.

Expectations about free stock levels, government program changes, or world supply and demand balances may have a greater immediate impact on the futures price than on the cash price. As expectations change and adjust to new information, it is possible for the cash price to remain constant while the futures price changes. When this occurs, the basis will change.

This chapter describes the estimation of an economic equation for the Gulf cash minus Kansas City futures basis. Quantitative and qualitative measures of selected price determining variables are used. Changes in any of these variables are expected to result in changes in the basis. The results of the estimation are reported in Chapter IV.

Time Period of Analysis

The time period for this analysis is from October, 1978 through July, 1984. The availability of data for free and government wheat stocks variables determines the starting time for this study. Government stocks are wheat stocks held in the Commodity Credit Corporation program and Farmer-owned Reserve program. Free stocks are stocks of wheat held outside of the government programs which are readily available to the cash market. Total wheat stocks have been reported since 1975, but the breakdown between free stocks and government stocks was not reported until October, 1978.

This analysis uses weekly information and Thursday's cash and futures prices. Thursday's prices are used for several reasons. Mondays and Fridays may fall on holidays, when prices are not available. Also, the liquidation of futures contracts on Friday by traders not willing to hold open positions over a weekend may cause the basis on Friday to change in an indeterminable direction. Monday's futures prices often exaggerate the impact of weekend news, and thus could cause inconsistent basis variation. By Thursday, much of the price adjustment of changing expectations will have occurred, and the Thursday's basis should be an accurate reflection of the current week's market situation.

The cash and futures price data used in this analysis are for Thursdays. The remaining data for the analysis is entered into the model so that their impact would be reflected on the Thursday immediately following their date of availability. The major problem associated with using one weekday to analyze basis reaction to those variables not reported on that day is that some of the short-term or daily basis variation may be lost.

The estimated equation is only intended to explain basis variations over the analyzed time period, not to provide the best prediction of these variations. Therefore, the primary importance of the estimated parameters will lie in their algebraic signs. The actual value of estimated parameters may not be useful in terms of predicting the magnitude of basis variations. However, the signs of the estimated parameters should provide wheat traders with insight into the expected direction of a basis change resulting from new market information.

Theoretical Basis Model

Model

The explanatory model of the Gulf minus Kansas City Hard-Red Winter wheat basis is shown in Equation (1). The model consists of eleven independent variables considered to be significant determinants of the basis.

$$BASIS = B_0 + B_1CY + B_2WEEK + B_3(CY*WEEK) + B_4PIR + B_5IEX + B_6(FS/EX) + B_7TR + B_8GP + B_9ST + B_{10}WS + B_{11}GEM \quad (1)$$

The variables are defined as follows:

BASIS = The Gulf cash price minus a given Kansas City futures settlement price. The basis is calculated in dollars per bushel.

B_0 = Estimated intercept.

B_1 through B_{11} = Estimated coefficients.

CY = Crop year price and storage seasonality. This variable enters the model as 1 for the periods when cash prices are expected to increase due to seasonality. This variable is entered to partially account for the change in the slope and intercept of the basis during the wheat storage season which begins after harvest.

WEEK = The number of weeks since trading began in the futures contract.

PIR = The prime interest rate charged by leading banks for loans granted on that day. It is entered into the model as a percentage.

IEX = The inspections of Hard-Red Winter wheat for export from Gulf ports within the next thirty days. Inspections are reported in units of thousand bushels, and converted to million bushel units for the model.

FS = The expected level of free stocks for the end of the current crop year. Estimated carryover stocks are reported in million metric ton units, and converted to million bushel units for the study.

EX = The expected level of wheat exports for the current crop year. Estimated exports are reported in million bushel units.

TR = Transportation situation dummy variable. This variable enters the model as 1 for periods when transportation from inland points to Gulf locations is reported to be a problem. Transportation problems include rail car shortages, rail strikes, or bad weather preventing the movement of grain from inland points to the Gulf.

GP = Gulf port situation dummy variable. This variable enters the model as 1 for periods when grain congestion is reported at Gulf ports. Grain congestion at Gulf ports occurs when the transfer of grain from rail cars onto ships is slowed for some reason.

ST = Storage situation dummy variable. This variable enters the model as 1 for periods when a shortage of storage facilities is reported at inland points.

WS = World wheat stocks dummy variable. This variable enters the model as 1 when future world wheat stocks are expected to be down, or when the current world wheat crop is expected to be smaller than previously estimated.

GEM = Government grain embargo dummy variable. This variable enters the model as 1 for the period when the Soviet grain embargo of late 1979 to early 1980 was in effect.

Variable Selection Criteria

Availability of Data. The variables included in the model are determined largely by traditional basis theory, moderated by the availability of time series data for the variables. Because one component of the Gulf minus Kansas City basis is the cost associated with the transportation and handling of grain between two locations, a measure of these costs would be useful for this analysis. However, following the Stagger's Act, transportation rates have not been publicly reported, but are privately negotiated between a carrier and the grain merchant. Therefore, necessary data pertaining to transportation costs are not available.

The theoretical relationship between transportation costs from the Gulf to Kansas City and the basis is positive. As transportation costs increase, the Gulf f.o.b. delivered price will have to rise relative to the Kansas City cash price (and, hence, the Kansas City futures price) to draw wheat to the Gulf location. When the Gulf price rises relative to the futures price, the basis increases.

Correlation Between Independent Variables. A second consideration when selecting variables for inclusion in the model is the presence of correlation between certain independent variables. When two or more independent variables in an economic model are correlated, the estimation of the impact of these variables on the dependent variable will be biased upward or downward, depending on the algebraic relationship between the variables. Correlation between two variables exists any time one of the variables is functionally related to the other. Perfect correlation exists if unit changes in one variable result in constant proportional changes in the other. When a model includes correlated variables, the effect of a change in one of the variables on the dependent variable may be exaggerated by the presence of the correlation.

If one of two highly correlated variables is omitted from a model, the explanatory ability of the model may decrease, but often only slightly. If both variables are included, the overall ability of the model to explain the dependent variable may increase, but the estimated impact of each of the variables on the dependent variable will be biased, and may be incorrect. Also, the statistical significance of the estimated parameters for both independent variables is decreased when both are included in the model.

Prices, supply, and disappearance variables are often correlated. Total supply for a crop year consists of beginning stocks, plus total production, plus imports for the crop year. Beginning stocks and production are both functions of the previous crop year's supply and price. Likewise, the components of Hard-Red Winter wheat disappearance; domestic feed, seed, and food use plus exports, are correlated with each other and price. Ending stocks, both free stocks and government stocks, are also functions of price, supply, and disappearance.

Even though some correlation exists between the independent variables in a model, they all may have some unique impact on the basis. The question is how much correlation is acceptable between independent variables for the model to be a good predictor of basis variation? A simple rule of less than 60 percent positive or negative correlation was adopted for the inclusion of a variable in the model. If two variables had more than 60 percent correlation, it was felt that one variable could be dropped with little impact on the prediction capability of the model as a whole, while improving the marginal prediction capability and statistical significance of the remaining variable.

Description of Data

Crop Year Price and Storage Seasonality

The basis for a contract which does not expire in the current crop year is effected by the seasonality of prices when crop years change. Prior to the new crop year harvest, the basis has historically followed no consistent pattern. The basis tends to increase following the harvest in a crop year, when the storage season begins. Therefore, the changing crop year will effect both the slope and intercept of the basis.

The crop year seasonality variable is included in the model as an adjustment to the intercept term when crop years change. Prior to the new crop year (for futures contracts expiring in the new crop year), the intercept of the estimated basis will be the intercept estimated in the regression analysis. After the beginning of the crop year in which a futures contract expires, the intercept for the basis will be the sum of the estimated intercept term and the estimated coefficient for the crop year indicator variable.

Weeks Into the Contract Year and Crop Year Seasonality Interaction

The weeks in the life of a futures contract is calculated by subtracting the date of the second week of the contract maturity month from the date of an observation. This date was chosen so that the weeks of contract trading will begin at zero and increase to 52 weeks, giving a consistent measure of time expired until contract maturity across different contract years.

The expected relationship of time expired with respect to the basis is positive. As a contract year advances, the basis is expected to increase. Total carrying costs decrease as the futures delivery date approaches, thus the storage component of the basis should decrease. However, prior to the beginning of the storage season for wheat (following harvest), the relationship of time to the basis is indeterminant. After harvest, the combined relationship of time and storage seasonality on the basis is expected to be positive.

The crop year and time interaction variable (CY*WEEK) is included as an adjustment to the slope of the estimated basis when a contract will expire during the current crop year. Prior to the beginning of the crop year, the slope of the basis line will be accounted for mostly by the coefficient for the time variable (WEEK). After the beginning of the crop year, the slope of the basis will be the sum of the coefficients for the CY*WEEK and WEEK variables. Prior to the new crop year, the expected relationship of WEEK to the basis is indeterminant. After the beginning of the crop year, the sum of the coefficients for CY*WEEK and WEEK is expected to be positive to reflect changes in the storage component of the basis. As the maturity date for a futures contract approaches, the total costs of storing wheat until the maturity date decreases. Therefore, as the storage component of the basis decreases, the Gulf minus Kansas City futures basis should increase.

Prime Interest Rate

The prime interest rate is reported in the Federal Reserve Bulletin. It reflects the interest rate charged by the majority of major banks on loans during the previous week. The expected relationship of the interest rate to the basis is negative. If the interest rate increases, the costs of holding wheat in storage is expected to increase, thus the cash price will fall relative to the futures price. In this instance, the basis will decrease.

Inspections for Export

The volume of Hard-Red Winter wheat inspected for export at Gulf ports is reported in the Grain Market News. The information is found in the table entitled "Wheat Inspected for Export by Class and Region" for the previous week. The volume of inspected wheat is reported in thousand bushel units, and converted to million bushel units for the model. Data for Hard-Red Winter wheat inspected at Gulf ports is used in this study.

The level of inspections for export is expected to be positively related to the basis. Inspections are reflective of the demand for wheat at the Gulf ports. When inspections increase, demand increases, therefore the Gulf price offered will increase relative to the Kansas City futures price. Thus, the basis will increase.

Ratio of Free Stocks to Exports

Estimated Free Stocks. Estimated free stocks for the current crop year are found in World Agriculture Supply and Demand Estimates in the table entitled "U.S. Grain Carryover Stocks, Farmer-owned Reserve, CCC Inventory, and Prices." The units are recorded in million metric tons and converted to million bushel units for the model.

Estimated free stocks are negatively related to the basis. When estimated free stocks increase, the expected future supply of wheat in the cash market increases. Traditional price theory suggests that when supply increases, other things constant, the price will decline. Cash wheat traders will have less incentive to pay higher prices for wheat not needed until a future time if they expect the future cash price to be lower. Therefore, the cash price should decline relative to the futures price when free stocks are expected to be up, and the basis should decrease.

Estimated Exports. Estimated exports of Hard-Red Winter wheat for the current crop year are reported in the World Agriculture Supply and Demand Estimates. The information is found in the table entitled "U.S. Wheat by Classes: Supply and Disappearance." Projected values for the current crop year are recorded in million bushel units.

Estimated exports will be negatively related to the basis. When exports are expected to increase, traders in the futures market will expect the future cash price to increase, and will push the futures price up through speculative action. As the futures price rises relative to the cash price, the basis will decrease.

Ratio of FS to EX. The ratio of free stocks to expected exports is used in the model, rather than each series separately, because of the high negative correlation between the two variables. When estimated exports change, the estimated free stocks for the current crop year tend to change in the opposite direction. An increase in the level of free stocks has a negative impact on the cash price for Hard-Red Winter wheat, as it reflects expected supply for the remainder of the current crop year. As the level of free stocks increases, the Gulf cash price is expected to decrease relative to the Kansas City futures price, thus decreasing the basis. The level of expected exports is a reflection of the future demand for wheat at Gulf ports. As expected future demand for wheat increases, the futures price is expected to increase relative to the cash price, thus having a negative impact on the basis. Decreasing levels of free stocks or exports will have opposite effects of those discussed above.

Both expected free stocks and expected exports, then, are important in determining basis variations. However, because of the high correlation between the two variables, the ratio of expected free stocks to expected exports is used. This ratio is expected to be inversely related to the basis. As the ratio increases, due to an increase in expected free stocks or a decrease in expected exports, the Gulf cash and Kansas City futures prices will converge, causing the basis to decrease.

Transportation Situation

The transportation dummy variable enters the model for periods when problems in transporting wheat from inland points to either the Gulf or a par delivery point are reported in the Grain Market News weekly summary of market conditions. The expected relationship of this variable to the basis is positive. When transportation is a problem, the cash price at the Gulf is expected to rise relative to the futures price. The cash price would have to rise to compensate wheat sellers for the higher costs of alternative transportation modes, as the cash price is quoted "free on board, delivered." This means the seller is required to pay transportation and handling costs to the delivery location.

Gulf Port Situation

The Gulf port dummy variable is included to reflect periods when there is a short term surplus of wheat at Gulf ports waiting to be loaded onto ships for export, as reported in the Grain Market News weekly summary of market conditions. Causes of loading problems include dock worker strikes, loading facility break downs, or any other factor causing a slowdown of ship loadings. This variable is expected to be inversely related to the basis. When there is a surplus of wheat due to a loading problem, the cash offer price will decrease relative to the futures price to slow the flow of wheat from inland points to the Gulf. Thus, the basis will decrease.

Storage Situation

The storage situation dummy variable is included to reflect periods when inland storage facilities for Hard-Red Winter wheat are in short supply, as reported in the Grain Market News weekly summary of market conditions. This variable is expected to be inversely related to the basis. When inland storage facilities begin to fill up, sellers are willing to accept lower prices to move wheat out of storage. Thus the cash price at the Gulf will decrease relative to the futures price, and the basis is expected to decrease.

World Wheat Stocks

The expected world wheat stocks variable is a reflection of the status of the current world wheat crop and expected world wheat carryover into the next crop year. When it is reported in the Grain Market News weekly summary of market conditions that weather or some other factor could cause a lower volume of world wheat production, the variable is entered into the model as a 1. This variable is expected to be inversely related to the basis. If world wheat production goes down, all other things constant, the demand for wheat from the United States is expected to increase. Therefore, the futures price will increase relative to the cash price, causing the basis to decline.

Government Grain Embargo

The grain embargo dummy variable enters the model as a shock variable to account for any basis variation caused by a grain embargo such as the one imposed in 1979. This variable is expected to be inversely related to the basis. While the embargo was in effect, wheat exports from Gulf ports declined, thus demand for wheat at the Gulf declined. Lower demand at the Gulf resulted in lower cash prices for wheat at the Gulf. The cash price at the Gulf decreased relative to the futures price and, thus, the basis weakened while the embargo was in effect.

CHAPTER IV

RESULTS OF REGRESSION ESTIMATION OF GULF MINUS KANSAS CITY BASIS VARIATIONS

Price and basis summary information for each of the five Kansas City futures contract months is presented in Table I. The first column reports the average basis, cash price, and futures price for each contract month. The next column reports the standard deviation of the basis, cash price, and futures price for each contract month over the time period analyzed. The final two columns report the minimum and maximum values observed for the basis, cash price, and futures price for each contract over the analyzed time period. Two-thirds of the observed basis and price values for a particular futures contract will be within a range of one standard deviation above or below the mean value for that contract.

The results of the ordinary least-square regression estimation of Equation (1) for the basis for each of the five Kansas City Hard-Red Winter wheat futures contracts are reported in Table II. Each column represents the estimation of the model for a particular contract. The variables included in the model are listed down the left side of the table, and the contract months are listed across the top of the columns. The body of the table reports the estimated parameters for the intercept term and for each of the variables included in the model.

TABLE I

MEAN, STANDARD DEVIATION, AND RANGE FOR THE BASIS, CASH PRICE, AND KANSAS CITY SETTLEMENT PRICE, OCTOBER, 1978 TO JULY, 1984

Contract Month	Mean*	Standard Deviation*	Minimum*	Maximum*
March				
Basis	0.2858	0.23	-0.40	0.65
Cash Price	4.30	0.49	3.10	5.41
Futures Price	4.01	0.57	2.76	5.30
May				
Basis	0.3428	0.24	-0.34	0.74
Cash Price	4.36	0.44	3.21	5.41
Futures Price	4.02	0.54	2.95	5.41
July				
Basis	0.4146	0.22	-0.36	0.88
Cash Price	4.37	0.42	3.37	5.41
Futures Price	3.95	0.54	2.88	5.37
September				
Basis	0.3608	0.25	-0.48	0.79
Cash Price	4.44	0.36	3.63	5.41
Futures Price	4.08	0.53	3.12	5.49
December				
Basis	0.2937	0.21	-0.33	0.79
Cash Price	4.31	0.51	2.80	5.41
Futures Price	4.02	0.58	2.71	5.15

*Figures are in dollars per bushel.

TABLE II

STATISTICAL COEFFICIENTS FOR REGRESSION OF SPECIFIED VARIABLES ON THE GULF - KANSAS CITY FUTURES BASIS, OCTOBER, 1978 TO JULY, 1984

Contract Month	MARCH	MAY	JULY	SEPTEMBER	DECEMBER
R^2	0.7081	0.7560	0.7449	0.7395	0.6785
F-Value	55.59	72.40	71.40	69.17	48.92
PARAMETER*	coeff (t)	coeff (t)	coeff (t)	coeff (t)	coeff (t)
Intercept	0.6583 (8.35)	0.3609 (6.31)	1.3536 (7.44)	0.7292 (12.52)	0.7318 (10.86)
Crop Year (CY)	-0.4107 (-6.66)	-0.1536 (-3.83)	-0.7995 (-4.67)	-0.1918 (-4.34)	-0.2371 (-4.24)
Contract Week (WEEK)	-0.0130 (-2.80)	0.0078 (10.55)	-0.0123 (-3.23)	0.0037 (4.63)	-0.0003 (-0.18)
Interaction (CY*WEEK)	0.0259 (5.43)	0.0054 (4.85)	0.0195 (4.99)	0.0034 (2.89)	0.0082 (4.01)
Prime Rate (PIR)	-0.0233 (-7.66)	-0.0163 (-5.36)	-0.0209 (-7.74)	-0.0269 (-9.97)	-0.0266 (-9.14)
Exports (IEX)	0.0052 (2.32)	0.0073 (3.53)	0.0100 (5.30)	0.0099 (5.23)	0.0086 (3.70)
Ratio FS to EX (FS/EX)	-0.1727 (-2.35)	-0.0999 (-1.45)	-0.1553 (-2.42)	-0.2591 (-3.83)	-0.3559 (-4.94)
Transportation (TS)	0.0569 (2.65)	0.0469 (2.34)	0.0565 (3.05)	0.0771 (3.97)	0.0591 (2.65)
Gulf Port (GP)	-0.0304 (-0.88)	-0.0466 (-1.39)	-0.0883 (-2.87)	-0.1319 (-4.28)	-0.0214 (-0.64)
Storage (ST)	-0.0632 (-2.10)	-0.0818 (-2.96)	-0.1097 (-4.18)	-0.0702 (-2.58)	-0.0669 (-2.32)
World Stocks (WS)	-0.0204 (-0.84)	-0.0217 (-0.96)	-0.0443 (-2.11)	-0.0435 (-2.03)	-0.0638 (-2.69)
Grain Embargo (GEM)	-0.1985 (-8.54)	-0.2279 (-10.96)	-0.2710 (-13.57)	-0.2583 (-13.12)	-0.2256 (-10.12)

*Dollars per bushel change in the basis due to a one unit change in the associated variable.

The first row of each column contains the coefficient of determination (R^2) for each contract month's basis model. The coefficient of determination is a measure of how much variation in the dependent variable can be explained by the model. The higher the R-Square value, the better the model is at explaining variation in the dependent variable (the basis). The second row contains the calculated F-values for the estimated model for each of the contract months. This value is used to test the significance of the overall model. The remainder of the table contains the estimated coefficients for each of the independent variables along with their associated t-values.

Model Significance Criteria

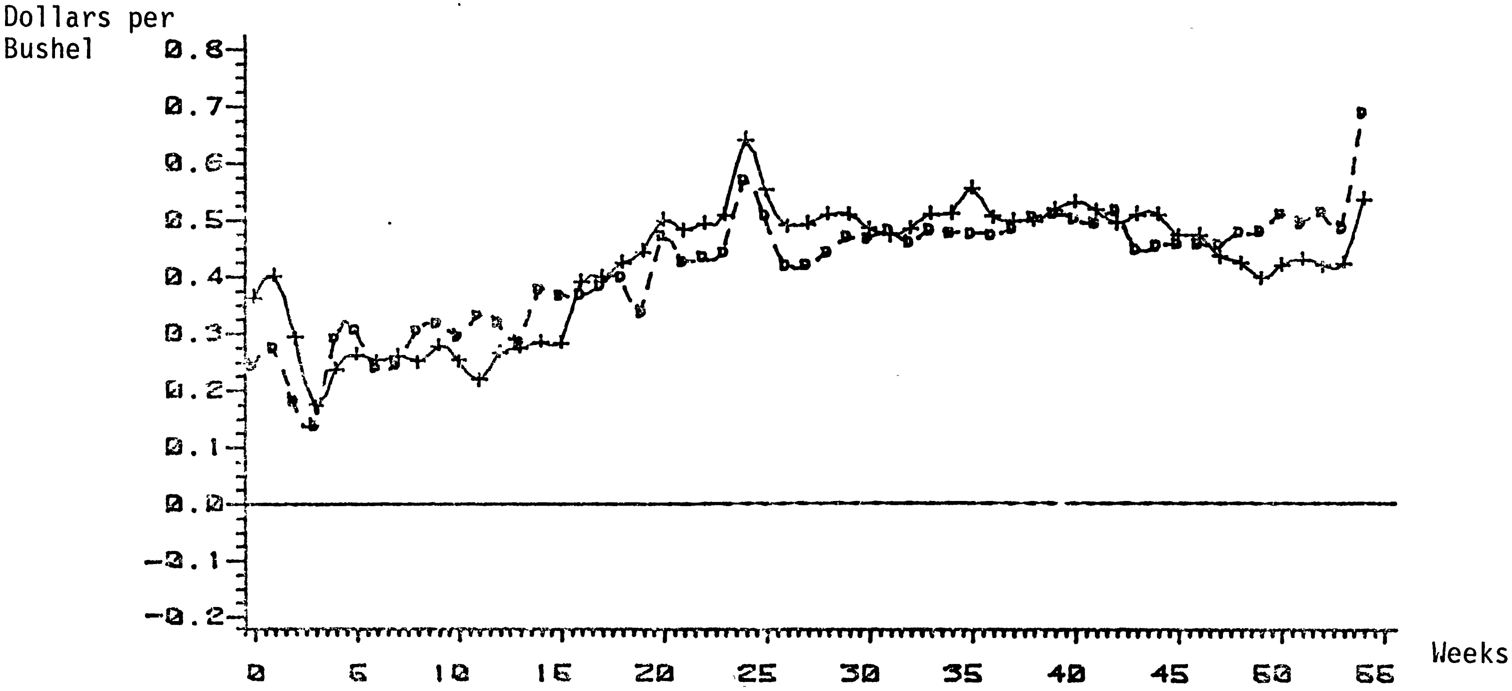
The model for each contract is based on the ordinary least squares estimate of Equation (1) for the data pertaining to the contract month. An explanatory model for any contract month should contain the same variables for the model to be the most useful to wheat traders. Although some of the estimated coefficients were not significant at the same level for all contract months, the overall model for each contract month is significant. Significance of the model was determined by a one sided F-test of whether the basis was equal to or not equal to the estimated Equation (1) for the particular contract month. The hypothesis that the basis was not equal to the estimated Equation (1) was rejected for each of the five contract months, and the conclusion was that the model was significant for each contract month.

Analysis of Individual Contract Months

The results of the estimation of Equation (1) for the Gulf minus Kansas City July futures contract basis will be discussed in depth. The results of the estimation of Equation (1) for the remaining four contract months will be reviewed relative to the July contract results. The first section of the analysis of each contract month's basis is an overview of the historical basis behavior for that particular contract month. The second section discusses the significance of the model estimated for the basis. The third section is an analysis of the significance of the individual independent variables included in the model. The final section is a graphical comparison of the average actual basis and the average estimated basis for the time period analyzed.

July Futures Contract Basis

Analysis of Historical Basis Pattern. Analysis of the actual basis for the July futures contract (Figure 2) shows an increasing trend from the first week of the contract year until the expiration date of the contract. A notable exception occurred in the 1980 contract year. At the beginning of the grain embargo, the July basis fell from nearly 50 cents per bushel to near zero. The basis was positive for the entire contract year for all years except 1980 and 1981. The basis for the 1981 contract varied near zero until January, 1981, and then began to trend upwards until the contract expired in July. Because the July futures contract extends over a complete crop year, the pre-harvest basis inconsistency seen in the basis for other contracts is not as evident in the July contract basis.



Legend: + = actual
0 = predicted

Figure 2. Plot of Actual and Predicted Basis for the July Contract

The July contract basis ranged from -36 cents per bushel to 88 cents per bushel. The basis mean for the period analyzed was 41.46 cents per bushel and the standard deviation was 22 cents per bushel. The Gulf cash price ranged from \$3.37 to \$5.41 per bushel. The cash price mean was \$4.37 with a standard deviation of \$0.42 per bushel. The July Kansas City futures contract settlement price ranged from \$2.88 to \$5.37 per bushel. The mean settlement price was \$3.95 with a standard deviation of \$0.54 per bushel.

Full-Model Results. The results reported in the third column of Table II pertain to the July futures contract basis. The coefficient of determination (R^2) value for the estimation of Equation (1) is 0.7449. This indicates that the estimated model accounts for 74.49 percent of the July contract basis variation over the analyzed time period.

The F-value used to test the significance of the model is 71.40. Using an overall F-test of significance, the conclusion was made that there is a significant regression relationship between the July contract basis and the independent variables in Equation (1). The relationship of the individual independent variables to the basis is analyzed in the next section.

Analysis of Independent Variables. Each independent variable is discussed separately in the following sections. The analysis of the estimated coefficients begins with the significance of the estimate and the interpretation of the results. Finally, the results will be compared with the initial expectations for the variables as described in Chapter III.

B_0 - Intercept and B_1 - Crop Year Price and Storage Seasonality: The estimated coefficient of the intercept term for the July contract basis prior to a new crop year is 1.3536. The coefficient has a t-value of 7.44. Using the Student's t-test for significance, it was concluded that this coefficient is significant for the model at the 99 percent level of significance. The interpretation of the intercept term is made by referring to the coefficient as being in units of dollars per bushel. If all other independent variables are equal to zero, the predicted basis would be \$1.3536 per bushel.

When the effect of the crop year seasonality is considered, the intercept for the post harvest period of the July contract changes. The estimated coefficient for CY is -0.7995 with a t-value of -4.67. Summing this value with the estimated coefficient for the pre-harvest intercept results in an actual basis intercept of 0.5541 per bushel for the post harvest period.

B_2 - Weeks Into the Contract Year and B_3 - Crop Year Seasonality Interaction: The estimated coefficient for the number of weeks the futures contract has been traded on the July contract basis is -0.0123 with a t-value of -3.23. The coefficient is significant at the 99 percent level of significance. The estimated coefficient for the interaction of crop year seasonality with time (CY * WEEK) is 0.0195 with a t-value of 4.99. These coefficients indicate that in the two months prior to a new crop year, the July basis decreases by 1.23 cents per bushel per week. After the beginning of a new crop year, the July basis increases by an average of 0.72 of a cent per bushel per week.

The positive value of the sum of these coefficients is as expected, and indicates that time is positively related to the basis when the futures contract will expire in the current crop year. As the contract approaches maturity, the costs of storing wheat until the futures delivery date decrease, therefore the cash price at the delivery point will gain on the futures price. The Gulf price is usually above the futures delivery point cash price. Therefore, as the delivery point cash price gains on the futures price, the Gulf cash price will increase relative to the futures price, and the basis will increase.

The estimated value of these coefficients indicate that for every week the July futures contract is traded after the harvest in a crop year, ceteris paribus, the basis will increase by .72 of a cent per bushel. This coefficient can also be interpreted as reflecting an average return of .72 of a cent per bushel per week offered by the holders of short positions in the futures market to the holders of long cash wheat positions to store the wheat until the futures contract expires.

B_4 - Prime Interest Rate: The coefficient estimated for the impact of a one percentage point change in the prime interest rate on the July contract basis is -0.0209 with a t-value of -7.74. The estimated coefficient is significant at the 99 percent level of significance. The prime interest rate ranged from 8.5 percent per year to 21 percent per year over the time period analyzed. The prime rate mean was 13.68 percent per year over the time period of the analysis with a standard deviation of 3.35 percent.

The negative sign of the estimated coefficient indicates the interest rate and basis are inversely related. The interpretation of the coefficient is that, other factors constant, a one percentage point change in the prime interest rate will result in an inverse 2.09 cent per bushel change in the July basis. This relationship was expected, as the interest rate is an implicit component of storage cost. As the interest rate increases, the opportunity cost of storing wheat increases. The futures price would have to increase relative to the cash price to compensate the holders of the cash commodity to store wheat until a later date as opposed to selling at the present time.

B_5 - Inspections for Export: The estimated coefficient for the effect of a change in the volume of wheat inspected for export the previous week on the July basis is 0.0100. The t-value for this coefficient is 5.30, and the coefficient is significant at the 99 percent level. The mean weekly volume of Hard-Red Winter wheat inspected for export from Gulf ports was 9.65 million metric tons with a standard deviation of 3.98 million metric tons. The volume of weekly inspections ranged from .98 million metric tons to 21.28 million metric tons.

The positive value of the coefficient is as expected. The level of inspections for export at Gulf ports reflects the demand for wheat at Gulf locations. As inspections increase, the Gulf cash price will increase relative to the futures price. Therefore, the basis will increase. The value of the coefficient indicates that for each one million metric ton increase in inspections for export, the July contract basis will increase by one cent.

B_6 - Ratio of Free Stocks to Exports: The estimated coefficient for the effect of a change in the ratio of estimate free stocks to estimated exports for a crop year on the July basis is -0.1553 with a t-value of -2.42. The coefficient is significant at the 99 percent level of significance. The mean value of the ratio for the time period analyzed was 0.3429 with a standard deviation of 0.131. The value of the ratio ranged from a minimum of 0.1238 to a maximum of 0.6141.

The negative value of the coefficient was as expected. If the ratio changes due to a change in the numerator, the inverse impact on the basis will be the result of the changing cash price offered relative to the futures price. The cash price would have to change to encourage holders of the cash wheat to either store or not store the wheat, as discussed in Chapter III. If the ratio changes due to a change in the denominator, an inverse change in the basis would be the result of the futures price changing relative to the cash price, as expected future demand for wheat exports increases or decreases.

The coefficient is interpreted as indicating that for every one percentage point change in the ratio, the July contract basis will change in the opposite direction by .1553 of a cent per bushel, ceteris paribus. The exact change in either the numerator or denominator which would result in an exact .1553 of a cent per bushel change in the basis is not immediately apparent from the results of this analysis. Estimated free stocks and estimated exports are functionally related to each other. The analysis of the impact of a change in only one of the variables on the basis is beyond the scope of this study. Data for each of the variables are readily available to wheat merchants, and the ratio of free stocks to exports can be easily calculated by wheat traders when analyzing basis variations.

B_7 - Transportation Situation: The estimated coefficient for the impact of transportation problems from inland points to the Gulf is 0.0565 with a t-value of 3.05. The coefficient is significant at the 99 percent level.

The positive sign of the coefficient is as expected. When there are problems with the transportation of wheat to Gulf locations, temporary shortages of wheat could occur at these locations. When shortages occur, the cash price is expected to rise relative to the futures price to encourage sellers of wheat to transport wheat from inland points to the Gulf location by alternate, more expensive means. The coefficient indicates that the July basis will increase by 5.65 cents per bushel when the transportation of wheat to the Gulf is disrupted, ceteris paribus.

B_8 - Gulf Port Situation: The estimated coefficient for the impact of problems loading grain at Gulf ports on the July contract basis is -0.0833 with a t-value of -2.87. This coefficient is significant at the 99 percent level of significance. The negative sign is as expected.

This coefficient indicates that the July basis will decrease by 8.33 cents per bushel whenever there is a slow down in the flow of grain through Gulf ports. When there are problems loading grain, or any disruption of the normal flow of grain, a short-term surplus of wheat can accumulate at Gulf elevators. A surplus would cause the cash price to decrease relative to the futures price, thus the basis will decrease. When the loading situation returns to normal, the basis will return to a normal level.

B_9 - Storage Situation: The coefficient for the estimated impact of full inland grain storage facilities on the July contract basis is -0.1097 with a t-value of -4.18. The coefficient is significant at the 99 percent level of significance.

The negative value of this coefficient is as expected. When inland storage facilities begin to fill up, inland elevators are willing to accept lower prices to sell wheat out of storage and free storage space for either new crop wheat or other grain being delivered to the elevator. Therefore, the cash price will decrease relative to the futures price, and the basis will decline. The coefficient indicates the July basis will decline by 10.97 cents per bushel when inland storage facilities begin to fill up, ceteris paribus.

B_{10} - World Wheat Stocks: The estimated coefficient for the impact of lower estimates of current world wheat stocks on the July contract basis is -0.0443 with a t-value of -2.11. This coefficient is significant at the 98 percent level.

The negative sign of the coefficient is as expected. When world stocks are reported to be lower than previously estimated, the future export demand for wheat produced in the United States will increase. This will, in turn, result in an increase in the futures price relative to the current cash price at the Gulf, and the basis will decrease. The value of the coefficient indicates that whenever estimated world wheat stocks decrease, the July basis will decline by 4.43 cents per bushel, ceteris paribus.

B_{11} - Government Grain Embargo: The coefficient for the estimated impact of the grain embargo which began in 1979 on the July contract basis is -0.2710 with a t-value of -13.57. The coefficient is significant at the 99 percent level of significance.

The negative value of the coefficient is as expected. When a grain embargo that includes wheat is imposed, the level of wheat exports will decrease. This, in turn, results in a decrease in the demand for wheat at Gulf locations, and the cash price will decline. The value of this coefficient indicates that the 1979 embargo of wheat shipments to the Soviet Union had a negative 27.10 cent per bushel effect on the July contract basis while the grain embargo was in effect, ceteris paribus. The numerical value of this coefficient should be interpreted with care. The exact impact of any future embargo on the Hard-Red Winter wheat basis will depend on the volume of wheat involved and other related factors. This particular coefficient is only an estimate of the impact of one particular embargo on the basis.

Comparison of the Predicted Basis to the Actual Basis. The average actual basis for the July futures contract is plotted with the average predicted basis for the analyzed time period in Figure 2. The increasing trend of the basis over the life of the futures contract is readily apparent. The predicted basis appears to fit the actual basis for the contract year with the exception of the period just prior to a new contract year. It is during this period that the new crop harvest begins, and the cash price usually decreases to its lowest levels of the crop year.

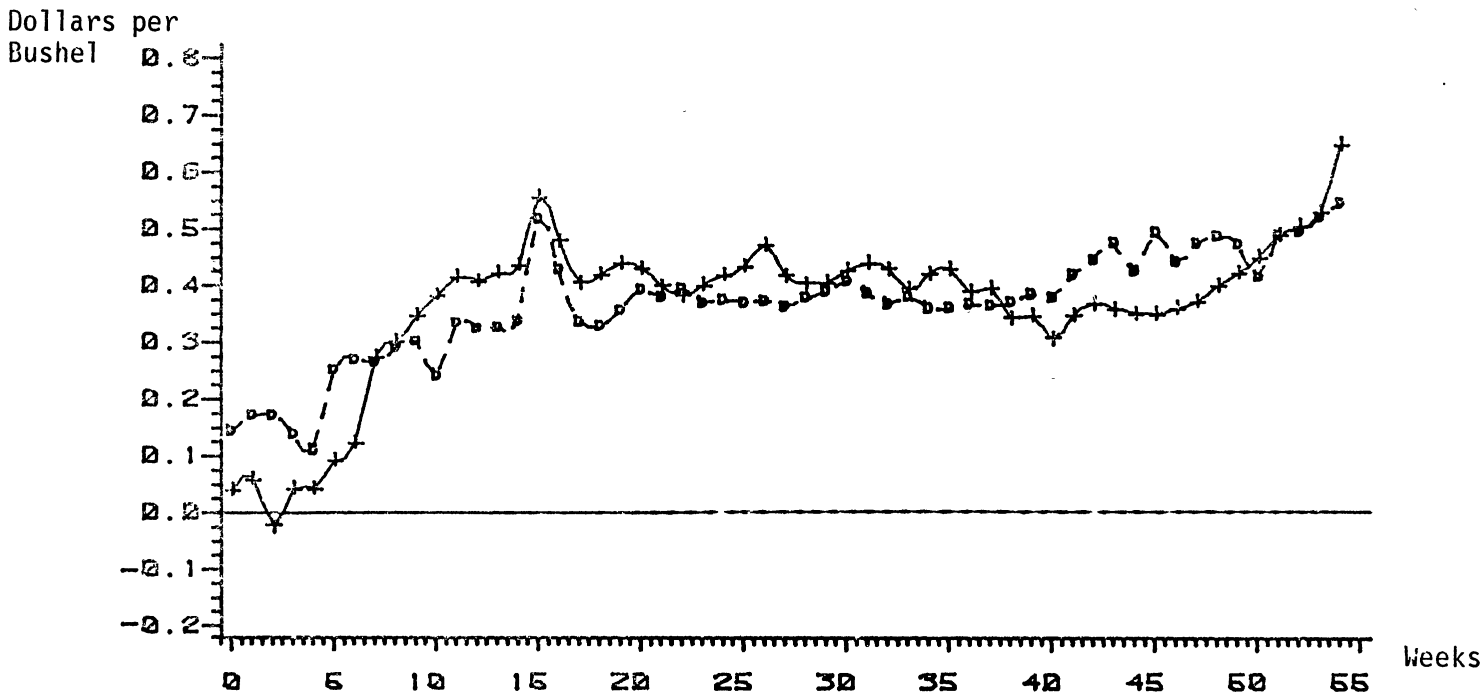
Analysis of the September, December, March, and May Contract Basis

<u>September Futures Contract Basis</u>. Analysis of the actual basis for the September futures contract (Figure 3) indicates the presence of the same general increasing trend as the March, May, and July contract basis. The period of the grain embargo affected the September contract basis in much the same way it affected the July contract basis. The September contract basis has generally decreased near the beginning of the new crop year, probably due to the influx of new-crop wheat in the cash market at harvest time.

The September contract basis ranged from -48 to 79 cents per bushel. The mean basis was 36.08 cents per bushel with a standard deviation of 25 cents. The mean Gulf cash price was $4.44 with a standard deviation of $0.36 per bushel. The mean September futures contract settlement price was $4.08 with a standard deviation of $0.53 per bushel.

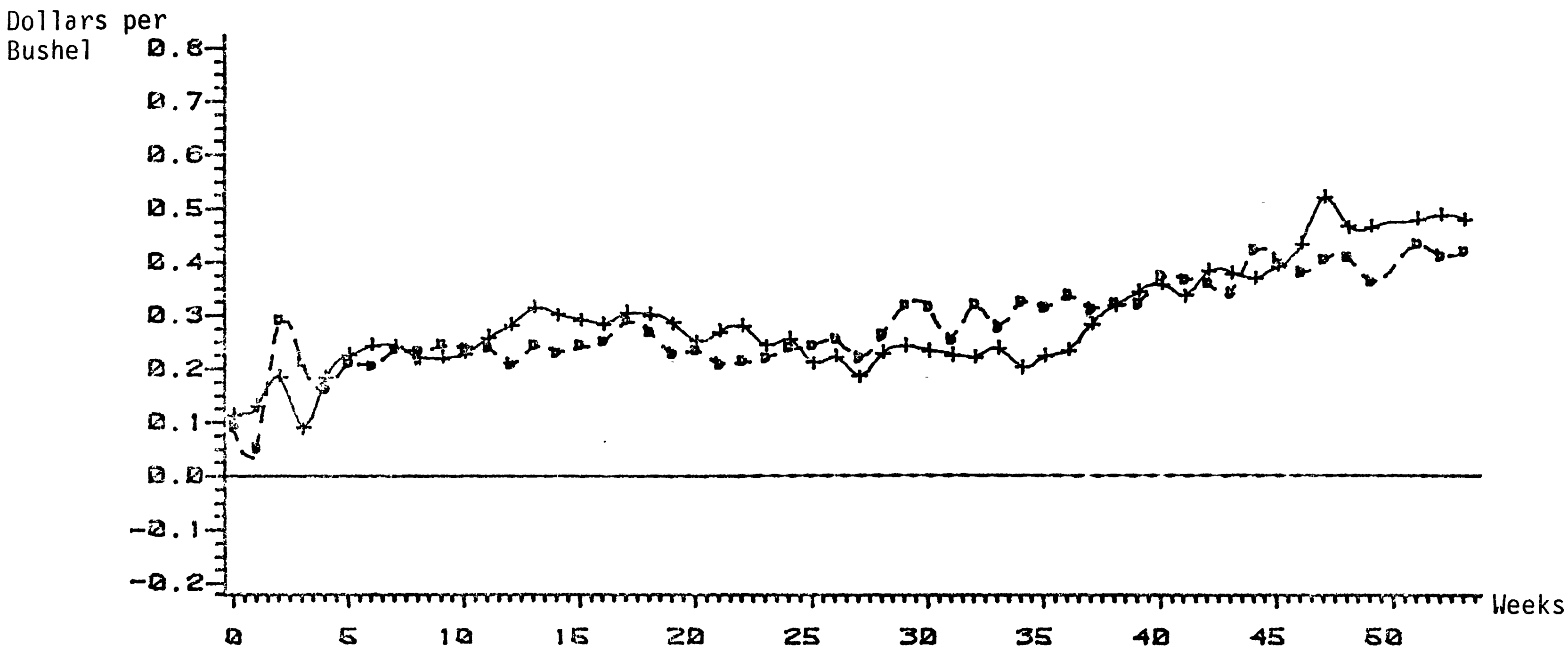
<u>December Futures Contract Basis</u>. Analysis of the actual basis for the December futures contract (Figure 4) shows the pre-harvest inconsistency which also appeared in the basis patterns for the March and September contracts. The December basis shows a general increasing trend following the beginning of the crop year until the futures contract expires. The grain embargo of late 1979 to early 1980 appeared to only cause slight variation in the December contract basis, as it occurred early in the 1980 contract year. The December contract basis was positive except in the early months of the 1980 and 1981 contract years.

The December contract basis ranged from -33 to 79 cents per bushel with a mean value of 29.37 cents and standard deviation of 21



Legend: + = actual
0 = predicted

Figure 3. Plot of Actual and Predicted Basis for the September Contract



Legend: + = actual
0 = predicted

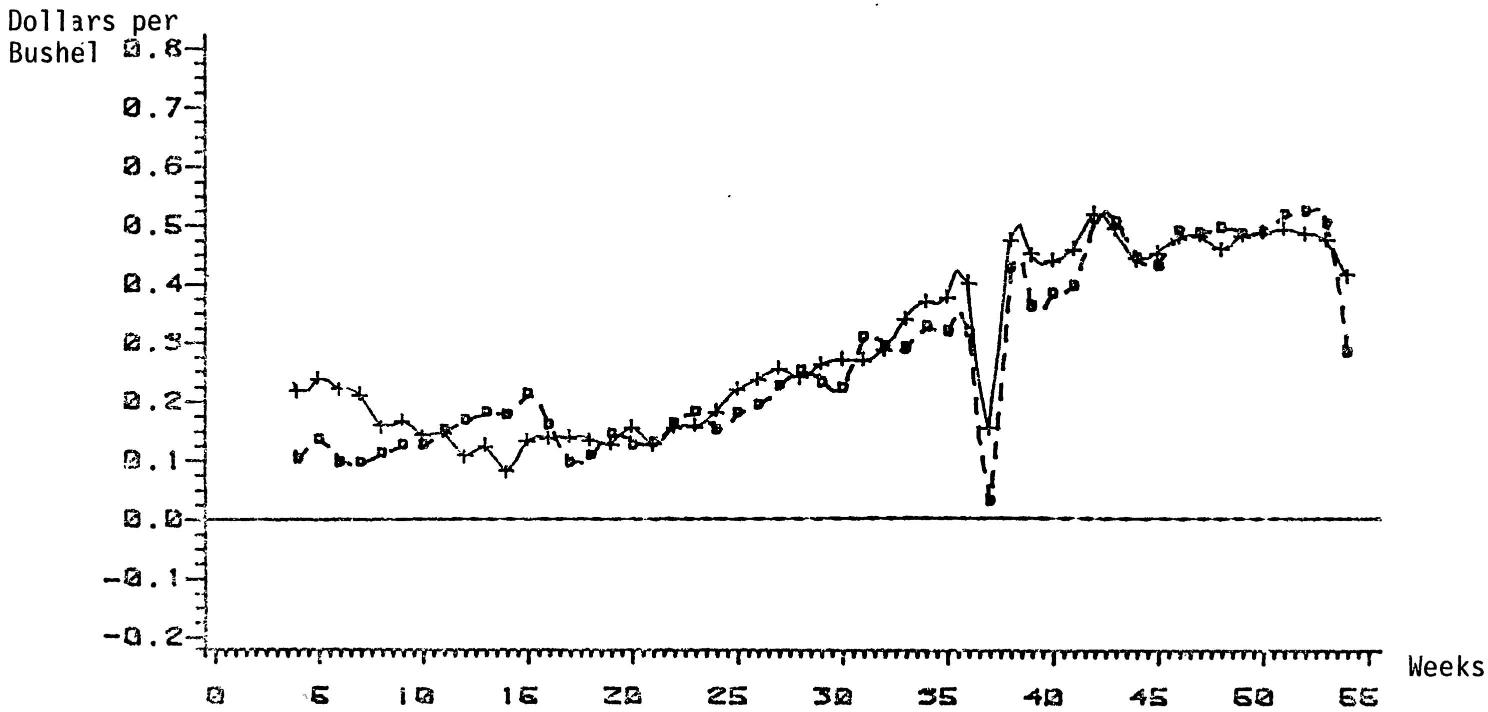
Figure 4. Plot of Actual and Predicted Basis for the December Contract

cents per bushel. The mean Gulf cash price was $4.31 with a standard deviation of $0.51 per bushel. The mean settlement price for the December futures contract was $4.02 with a standard deviation of $0.58 per bushel.

March Futures Contract Basis. The March contract basis (Figure 5) has shown a tendency to increase from a low at the beginning of the contract until a high near the expiration date for the contract. This upward trend in the basis has been most noticeable after the beginning of the new crop year in June. Prior to the new crop year, the March basis shows no consistent pattern. The basis was positive for the entire contract year except during the early months of the 1981 and 1982 contract years, and in one week of the 1984 contract year.

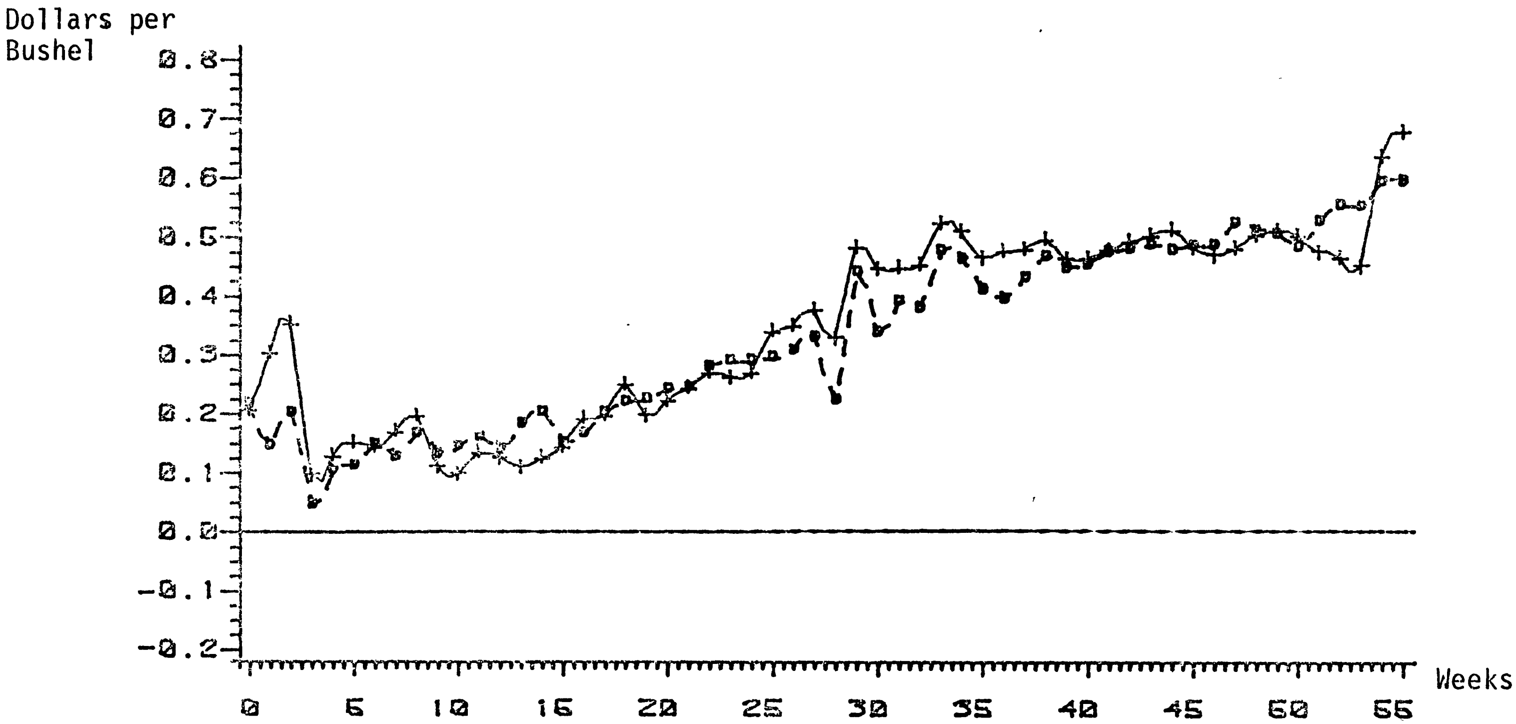
The March contract basis ranged from -40 cents per bushel to 65 cents per bushel during the time period analyzed. The mean basis was 28.58 cents per bushel with a standard deviation of 23 cents per bushel. The mean Gulf cash price was $4.30 per bushel with a standard deviation of $0.49 per bushel. The March contract settlement price mean was $4.01 per bushel with a standard deviation of $0.57 per bushel.

May Futures Contract Basis. Graphical presentation of the May contract basis (Figure 6) shows an increasing basis trend for all the crop years in the analysis. The May contract basis was positive during all the crop years except during the early months of the 1981 contract year. The May contract covers a time period which is very near the time period of a crop year. Therefore, the pre-harvest basis



Legend: + = actual
0 = predicted

Figure 5. Plot of Actual and Predicted Basis for the March Contract



Legend: + = actual
0 = predicted

Figure 6. Plot of Actual and Predicted Basis for the May Contract

pattern inconsistency which appears in the early months of the March contract basis is not as noticeable in the May contract basis.

The May contract basis ranged from -34 cents per bushel to 74 cents per bushel. The mean was 34.28 cents per bushel with a standard deviation of 24 cents per bushel. The Gulf cash price mean was $4.36 per bushel with a standard deviation of 44 cents per bushel. The settlement price mean was $4.02 per bushel with a standard deviation of 54 cents per bushel.

Full Model Results

The results of the regression estimation of Equation (1) for the September, December, March, and May futures contract basis are reported in the first, second, fourth, and fifth columns of Table II. The coefficient of determination for the estimated model for the March contract is .7081 with an F-value of 55.59. The coefficient of determination for the May contract basis estimation is .7560 with an F-value of 72.40. The coefficient of determination for the September contract basis is .7395 with an F-value of 69.17. The coefficient of determination for the December contract basis is .6785 with an F-value of 48.92. The R^2 values and F-values indicate the existence of a significant linear relationship between the basis and the independent variables in Equation (1).

Independent Variable Results

B_0 - Intercept and B_1 - Crop Year and Price Seasonality: The estimated intercept for the period a contract is traded prior to the beginning of a new crop year for the March, May, September, and December basis ranged from 36 cents for the May contract to 73 cents for the December contract. The intercept values are significant for all the contract months. The relatively higher intercept values for the September and December contracts are partially offset by larger negative values for the impact of the free stocks to exports ratio on the basis. Estimates of ending free stocks and total exports for a crop year are more uncertain earlier in the crop year, and this uncertainty is reflected in the coefficient values for these variables.

Summing the intercept and the estimated coefficients for the impact of crop year seasonality results in new intercept values ranging from 21 cents per bushel for the May contract to 53 cents per bushel for the September contract. The coefficients for the crop year seasonality are all significant at the 99 percent level. The combined post harvest intercept terms show a trend with the highest value for the July contract, which is the first contract trading in a crop year, to a low for the May contract, the last contract trading in a crop year. This indicates that the basis for futures contracts expiring later in a crop year is generally lower or "weaker" than the basis for the earlier contracts of a crop year, other things constant.

B_2 - Weeks Into the Contract Year and B_3 - Crop Year Seasonality Interaction: The estimated coefficients for the impact of the passage of time on the basis range from -1.3 cents per bushel per week for the March contract to 0.78 cents per bushel per week for the May contract. These values indicate that prior to the beginning of a new crop year, the basis for the March and December contracts tend to decrease, while the basis for the May and September contracts tend to increase. The estimated coefficients for the March, May, and September contracts are significant at the 99 percent level, but the coefficient for the December contract is not significantly different from zero. This indicates that the December basis, on the average, has been nearly constant until after a crop year begins, which is when the storage season for wheat begins.

The estimated coefficients for the interaction of time and crop year seasonality range from .34 of a cent per bushel for the September contract to 2.59 cents per bushel for the March contract. The coefficients are all significant at the 99 percent level. When the interaction of seasonality and time is considered, the basis changes per bushel per week range from .71 of a cent for the September contract to 1.32 cents per week for the May contract. This indicates that the basis offers less return for storage for the contracts expiring early in a crop year than for those contacts expiring later in a crop year, ceteris paribus. Based on these parameters, owners of wheat stocks intending to store wheat could "lock in" a larger storage return through hedging with a contract month expiring later in the crop year than with a contract expiring earlier in the crop year.

B_4 - Prime Interest Rate: The estimated coefficients for the impact of a one percentage point change in the prime interest rate on the basis for the March, May, September, and December futures contracts are nearly equal to the coefficient estimated for the July contract. The signs are all consistent with the expectations developed in Chapter III, and the coefficients are all significant at the 99 percent level of significance. Interpretation of the coefficients indicate a one percentage point change in the prime interest rate will result in an inverse 2 to 3 cent per bushel basis adjustment.

B_5 - Inspections for Export: The estimated coefficients for the impact of a change in the level of inspections of Hard-Red Winter wheat for export on the basis for the March, May, September, and December contracts are not significantly different from the coefficient value estimated for the July contract. These coefficients are significant at the 99 percent level, and the signs are consistent with the expectations described in Chapter III. The coefficient values indicate that a one million metric ton change in export inspections will result in a change in the basis of one-half to one cent per bushel in the same direction.

B_6 - Ratio of Free Stocks to Exports: The estimated coefficient for the impact of a one percent change in this ratio ranged from -.0995 for the May contract to -.3559 for the December contract. The reason for the wide range of the estimated coefficient values could be that the degree of uncertainty of free stock and exports estimates is greater while the September and December contracts are being traded the heaviest as nearby contracts.

The reason for the uncertainty of the export estimates is also related to the timing of the crop year for Hard-Red Winter wheat in other areas of the world. Argentina and Australia, major competitors in the world market for United States wheat exports, begin to harvest their crops in November and December. As harvest progresses in these countries, estimates of the future export demand for United States wheat are uncertain, and the uncertainty remains until after these countries complete their harvests. Therefore, a change in this ratio may result in greater basis variations for the contracts which expire during the beginning and middle of the United States crop year. As the crop year progresses, the estimates of stock levels and exports become more accurate, therefore, the contracts which expire later in the crop year are affected less by a change in the estimates.

B_7 - Transportation Situation: The coefficients estimated for the impact of transportation problems on the basis for the March, May, September, and December contracts are consistent with the estimated coefficient for the July contract. The estimated impacts range from 5 cents to 8 cents per bushel. The impact of transportation problems will be closely tied to the level of demand for a commodity at the delivery location. When wheat supplies are needed for immediate loading onto ships at Gulf ports, transportation problems from inland points could cause larger variations in the basis.

B_8 - Gulf Port Situation: The estimated coefficients for the March, May, and September, and December contracts are consistent with the estimated coefficient for the July contract basis. The higher coefficient value for the September contract basis can be associated with the flow of wheat to the Gulf early in the crop year. Immediately after harvest, there is usually an abundance of wheat flowing from inland points to the Gulf export locations. Surplus situations at Gulf terminals can be expected to have greater impacts on the basis for the nearby contract months after harvest than on the more distant contract months. Later in the crop year, the flow of wheat from inland points to the Gulf should be more orderly, therefore conditions at Gulf ports will have lower impacts on the basis for the contracts expiring later in the crop year.

Although the algebraic signs of the estimated coefficients are negative for all contracts, the coefficients differ in their levels of significance. The September coefficient is significant at the 99 percent level, the May coefficient is significant at the 90 percent level, and the March coefficient is significant at the 80 percent level. The coefficient for the December contract is only significant at the 70 percent level, and there is a greater than 50 percent chance that loading problems at Gulf ports have no impact on the December contract basis.

B_9 - Storage Situation: The estimated impact of full inland storage facilities on the basis for the March, May, September, and December futures contracts range from -6.3 cents per bushel to -8.2 cents per bushel. The estimated impacts are largest for the July and May futures contracts. This is probably due to the harvest time congestion at inland storage facilities at the beginning of a crop year. Harvest begins in late May in the southern regions of the United States where Hard-Red Winter wheat is grown, and cash prices may decrease relative to the futures price as storage facility owners begin to clear their facilities for incoming stocks of new crop wheat. As the crop year advances, the congested conditions will be relieved, and the impact of full local storage facilities on the basis for the distant contracts will be less than for the nearby contracts. These coefficients are consistent with the estimated coefficient for the July contract, and with the expectations presented in Chapter III.

B_{10} - World Wheat Stocks: The signs of the estimated coefficients for the impact of changing world wheat stock information on the basis for the March, May, September, and December contracts are consistent with the July contract coefficient and expectations.

The estimated coefficients for the December contract is significant at the 99 percent level. The estimated coefficient for the September contract is significant at the 97 percent level. The coefficients for the March and May contracts are significant at the 80 percent level. The lower coefficient values and significance levels for the March and May contracts indicate that world wheat stock estimates have lower impacts, or no impact, on these contracts. These contracts, which expire just prior to the beginning of the United States new crop harvest, may be effected more by domestic production estimates than by world estimates.

B_{11} - Government Grain Embargo: The coefficients estimated for the shock of the grain embargo to the basis for the March, May, September, and December contract months are consistent with the July contract estimate and with expectations. The estimated impacts range from -20 cents to -26 cents per bushel, compared with -27 cents per bushel for the July contract. There is a decreasing relationship of the grain embargo on the different contract months. The largest impact is on the July contract with the estimated impact decreasing through the September and December contracts until the lowest impact in the March contract. The May contract was effected by less than the July contract, but more than the March contract.

This relationship is possibly due to the effect of the grain embargo on the estimated disappearance of wheat for the upcoming year.

When the grain embargo was initiated, estimations of the level of exports for the current crop year decreased, and expected carryover stocks increased. This caused expectations of a higher level of wheat classified as free stocks for the next crop year. Therefore, the new-crop year futures contracts would be effected most, with the nearby contracts effected more than the distant contracts.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Hard-Red Winter wheat traders have many marketing alternatives available to them. They must understand price behavior and price relationships to choose the best marketing strategy. Of these price relationships, the cash minus futures basis is one of the most important relationships for a wheat trader to understand.

Knowing what a normal basis pattern is, when to expect the basis to change, and in what direction the basis may change, helps wheat traders to make more profitable marketing decisions. By analyzing the current basis relationship, a wheat trader is better prepared to decide whether to sell a quantity of wheat in the cash market, forward contract the sale for a future date, store the wheat, hedge, or not to hedge. Once a hedge has been initiated, being able to predict basis variations can help prepare the hedger to profit from a basis change.

The basis for this study was calculated by subtracting a closing futures contract price from the Gulf cash price. The widest range for the basis of the five Kansas City Hard-Red Winter wheat contracts was from -48 cents per bushel to 79 cents per bushel over the time period analyzed. The average cash price for the time period analyzed ranged from $2.80 to $5.41 per bushel. The cash price range then was $2.61 per bushel, while the basis range was only $1.27 per bushel.

Comparison of the variances for the cash price and basis over the time period analyzed shows that the basis has been less variable than the cash price. The largest variance for the basis was only 6.3 cents per bushel, while the largest cash price variance was 26 cents per bushel. This implies the risk of a basis loss was less than the risk of cash price loss over the time period of this study. Although this does not immediately lead to the conclusion that hedging results in fewer losses, it does imply that a hedge can protect a hedger from cash price risk. The lower variances for the basis indicates the basis is subject to less change than is the cash price for Hard-Red Winter wheat.

The objectives of this study were first, to identify any seasonal basis pattern and second, to identify economic variables which could cause the basis to vary from a seasonal pattern. The hypothesis for this study was that basis variations could be associated with changes in the selected variables. A model of the basis as a function of eleven selected independent variables was developed. By using an ordinary least squares linear regression technique, the impacts of these variables on the Gulf minus Kansas City futures contract basis were estimated.

The data for most variables were found in several government publications. Five of the variables were quantitative measures, and the remaining six variables were qualitative dummy variables. The qualitative variables were entered into the model as "1" when the variable was expected to cause a variation in the basis, and were "0" otherwise.

The estimated model was able to explain an average of 73 percent of the basis variation over the time period analyzed. The best results were for the May futures contract basis, where the model explained 75.6 percent of the basis variation. The model was least effective in explaining the basis variation for the December futures contract with 67.85 percent of the basis variation explained by the model.

Conclusions

Graphical analysis of the historical basis indicates a tendency for the basis to increase following the beginning of a crop year, until a high is reached prior to the next crop year, and decreasing just prior to the new crop year. The selected model was able to predict a large amount of the variation in the basis for the time period analyzed. Overall, the individual independent variables included in the model were significant in explaining basis variations.

The average effect of time on the basis prior to the beginning of the crop year in which the futures contract expires was -.28 of a cent per bushel per week. After the beginning of the crop year in which the futures contract expires, the average effect of time on the basis was 0.97 of a cent per bushel per week. This is the equivalent of approximately 4.16 cents per bushel per month. Currently, Oklahoma storage facilities charge approximately 2.7 cents per bushel for each month wheat is stored.

The opportunity cost of storing wheat over the analyzed time period averaged 4.9 cents per bushel per month. This value is computed by multiplying the average monthly adjusted prime interest rate for the analyzed time period by the average cash price for the same period. Summing the opportunity and storage costs results in a net cost of approximately 7.6 cents per bushel per month to store wheat after harvest. Not even the increase in the May contract basis of nearly 5.7 cents per bushel per month would cover the combined storage and opportunity costs of holding wheat. Therefore, over the time period analyzed, it can be concluded that the basis did not guarantee a storage return sufficient to cover the total net costs associated with storing wheat beyond the harvest period.

The impact on the basis of a one percent change in the prime interest rate averaged an inverse 2.3 cents per bushel. This variable was significant for all contract months. This implies the basis will change an inverse one cent for every 0.4 percentage point change in the prime interest rate.

The average effect of a change in the volume of Hard-Red Winter wheat inspected for export from Gulf ports on the basis is 0.82 of a cent per bushel for each one million metric ton change in inspections. This variable was significant for all contract months. The basis will change by approximately one cent for every 1.2 million metric ton change in inspections of Hard-Red Winter wheat for export from Gulf ports.

The average estimated effect of a change in the ratio of free stocks to estimated exports on the basis is an inverse .21 of a cent per bushel for each one percentage point change in the ratio. This variable was significant for all contract months. For every 4.75 percentage point change in the ratio of estimated free stocks to estimated exports, the basis will change by one cent per bushel in the opposite direction.

The average estimated impact of transportation problems from inland points to the Gulf on the basis is 5.9 cents per bushel. The coefficients are significant for all contract months. The actual impact of transportation problems on the basis will depend on the demand situation at the Gulf and on the severity and type of the transportation problem. If demand for wheat at the Gulf is high, a transportation problem would cause a larger change in the basis. If demand is light, a smaller basis change, or no change in the basis will occur. However, if there is demand for wheat for immediate delivery at the Gulf, transportation problems will result in an increase in the basis.

The estimated coefficients for the effect of loading problems at the Gulf on the basis was consistent with expectations for all contract months. The average impact of loading problems on the basis for all contracts is -6.4 cents per bushel. Again, the exact impact of loading problems on the basis will depend on the severity of the problem. However, loading problems at Gulf ports will result in a decline in the basis.

The average impact of inland storage approaching capacity limits on the basis is -7.8 cents per bushel. The estimated coefficients are significant for all contract months. The conclusion is that when inland storage facilities begin to fill, the basis will decrease by roughly 7.8 cents per bushel until the storage situation is eased. However, the exact impact of filling storage facilities on the basis will be related to the urgency of the need for more storage space. The more urgent the need to open storage space for incoming grain, the greater the possible impact on the basis.

The estimated coefficients for the effect of declining estimated world wheat stocks on the basis were consistent with expectations for all contract months. The average impact of declining world stocks on the basis for the five contracts is -3.9 cents per bushel. However, the exact impact of declining estimates of world wheat stocks on the basis will depend on the exact decrease in the estimates. Larger increases will result in larger basis changes and smaller decreases will result in smaller basis changes.

The average estimated impact of the grain embargo of 1979 and 1980 on the basis was -24 cents per bushel. The estimated coefficients were significant for all contract months. The interpretation of this variable is the one time shock effect of the grain embargo of 1979 and 1980 on the basis. The exact impact of an embargo of wheat shipments on the Hard-Red Winter wheat basis will depend on the volume of Hard-Red Winter wheat involved in the embargo. Nevertheless, an embargo of Hard-Red Winter wheat shipments to an export buyer will have a negative impact on the basis.

Implications

Wheat traders can use the model developed in this study to analyze and predict basis variations. When economic conditions change, and one or more of the independent variables included in this model is affected, a wheat trader should be able to expect a change in the basis. By being more certain of what the basis will be in the future, the wheat trader can make better marketing plans.

Some general guidelines for the use of the results of this study in predicting basis variations are presented in this section. Because the expressed purpose of this study was to explain basis variations over the time period analyzed, the estimated model may not be appropriate for predicting the magnitude of basis variations. However, the relationships between the independent variables and the basis developed in Chapter IV can be used to predict the direction of basis change.

To use this model to predict the direction of basis variations, a wheat trader will first need to possess a good understanding of the normal basis relationship for his location. Second, he will need to be aware of the current market situation at the Gulf and at major inland points. Finally, a wheat trader will need to be aware of current estimates for stock levels and market conditions in the future. If the trader has access to current USDA publications such as the Grain Market News, Wheat Situation and Outlook, and World Agriculture Supply and Demand Estimates, as well as local market information, he will be able to locate data for the variables included in this model.

When market conditions change, the wheat trader could refer to the relationships developed in the estimation of the basis model in this study to predict when the basis may change in either a positive or negative direction. Using this prediction, he would be better prepared to make profitable marketing decisions.

Limitations

Whenever a model contains qualitative variables which are subject to judgement error, the predictive capability of the model is reduced. The variables included in the model for this study for the transportation situation, Gulf port situation, storage situation, and estimated world stocks, are all subject to judgement error. Therefore, the interpretation of the coefficient values estimated for the impact of these variables on the basis should be made with care. The algebraic relationship of these variables to the basis is expected to hold. Therefore, the coefficient signs for these variables can be used to predict directional changes in the basis.

A second limitation of this study is the shortness of the time period analyzed. This study covers a time period from October, 1978 to July, 1984. The availability of data for estimated wheat stocks established the beginning date of the analysis. A longer period of analysis, with more data for the variables in the model, could result in more accurate results.

The third limitation of this study is the absence of transportation costs from the model. Transportation costs are a major component of a basis. Transportation rates vary from location to location, and an accurate estimate of a single transportation rate for use in this model has not been available. Further compounding the lack of a good single measure of transportation rates is the effect of the Stagger's Act, after which transportation rates are not reported publicly.

These limitations detract from the appropriateness of this model to predicting the level of the basis for a future time. Suggestions for correcting these limitations are made in the following section.

Suggestions for Further Research

The results of this study will help wheat traders to predict the direction of a basis change, but the exact magnitude of a basis change cannot accurately be predicted by the model estimated in this study. Further research is needed to modify this model, or to develop a new model which can better predict the magnitude of a basis change. Data for variables included in this model need to be updated to lengthen the time period analyzed. Quantitative measures for the qualitative variables included in this model need to be determined and collected. A measure of transportation rates needs to be developed and entered into the model. If the qualitative, opinion based variables can be replaced with quantitative measures, the model developed in this study should be improved for predicting and explaining changes in the basis.

This project has not addressed the possibility of autocorrelation of the error terms. Any further research should address this area, and if autocorrelation is present, it should be corrected in the model.

A final suggestion for further research would involve the simultaneous determination of the basis and storage costs in a dynamic model. The basis is related to storage costs, and they both are functions of many of the same independent variables. One example is interest charges. The results of this study imply that, as interest rates fall, at some point the basis would begin to cover both the actual and the implicit (opportunity) costs of holding wheat. Whether this is true, and at what rate of interest would the basis cover storage costs, is an interesting question which should be addressed.

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