IDENTIFICATION AND ANALYSIS OF VARIABLES INFLUENCING THE BASIS OF FEEDER AND SLAUGHTER CATTLE

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IDENTIFICATION AND ANALYSIS OF VARIABLES

INFLUENCING THE BASIS OF FEEDER

AND SLAUGHTER CATTLE

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PREFACE

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CHAPTER I

INTRODUCTION

Current Situation

Growing uncertainties in the United States economy are a major concern for every sector in the nation. The economy has experienced a period of rapid growth in the 1960's followed by accelerating inflation in the early 1970's, a severe recession in 1974 and an increase in the inflation rate again in recent months. These events have had serious implications in the production and marketing of agricultural products.

The inputs that producers must purchase have skyrocketed in recent years due to scarcity, inflation and the energy shortage. The biggest increases have occurred in land and equipment investments. Since most producers need financial assistance in acquiring the needed capital, they have been forced deeper into debt and their ability to make the necessary payments have been hampered. Guy Benjamin, an economist for the Federal Reserve Bank of Chicago, conducted a study in 1974 which revealed that a segment of our farm population is getting dangerously heavy in debt. Most of the farmers in this group are young and have high incomes; but with heavy debt loads, high interest rates and high operating expenses they could experience serious difficulties in the liquidation of these debt loans.

The marketing of agricultural commodities has been hampered as a result of the highly volatile prices that have occurred in recent

years. During the 1960's most price fluctuations were caused by weather, insects and normal production cycles. The producers are well acquainted with these events and know how to cope with them, however they are not as well equipped to deal with the violent price fluctuations of the 1970's resulting from inflation, unpredictable export markets, and unanticipated changes in government policies. Figure 1 is an example which shows how much more variable the prices for agricultural commodities have become in the last eight years.

Government officials at times have initiated programs with the purpose of stabilizing prices, however these programs have in reality often had a destabilizing effect. For example, in March of 1973 the government introduced price limits on food at the retail and wholesale level. Later that same year government officials announced that price limits on beef would be lifted in September. This announcement led many producers to believe that the price of beef would rise as soon as the price limit was removed. The price ceiling on pork had been lifted one month earlier and hog prices proceeded to rise. So cattle producers held back their stocks until that time. As a result of the large supply of cattle that was held back on the farm there was a tremendous amount of cattle that went to market as soon as the price limit was removed; consequently the price of beef cattle dropped dramatically. The impact of this event lasted several months and contributed to a 50% reduction in the inventory value of our cattle inventory in 1974. The government has also initiated elimination of import controls or increasing the quota, freezes on exports and placing ceiling prices on agricultural chemicals. Each of these actions has resulted in unexpected reactions in the prices of the affected commodity.

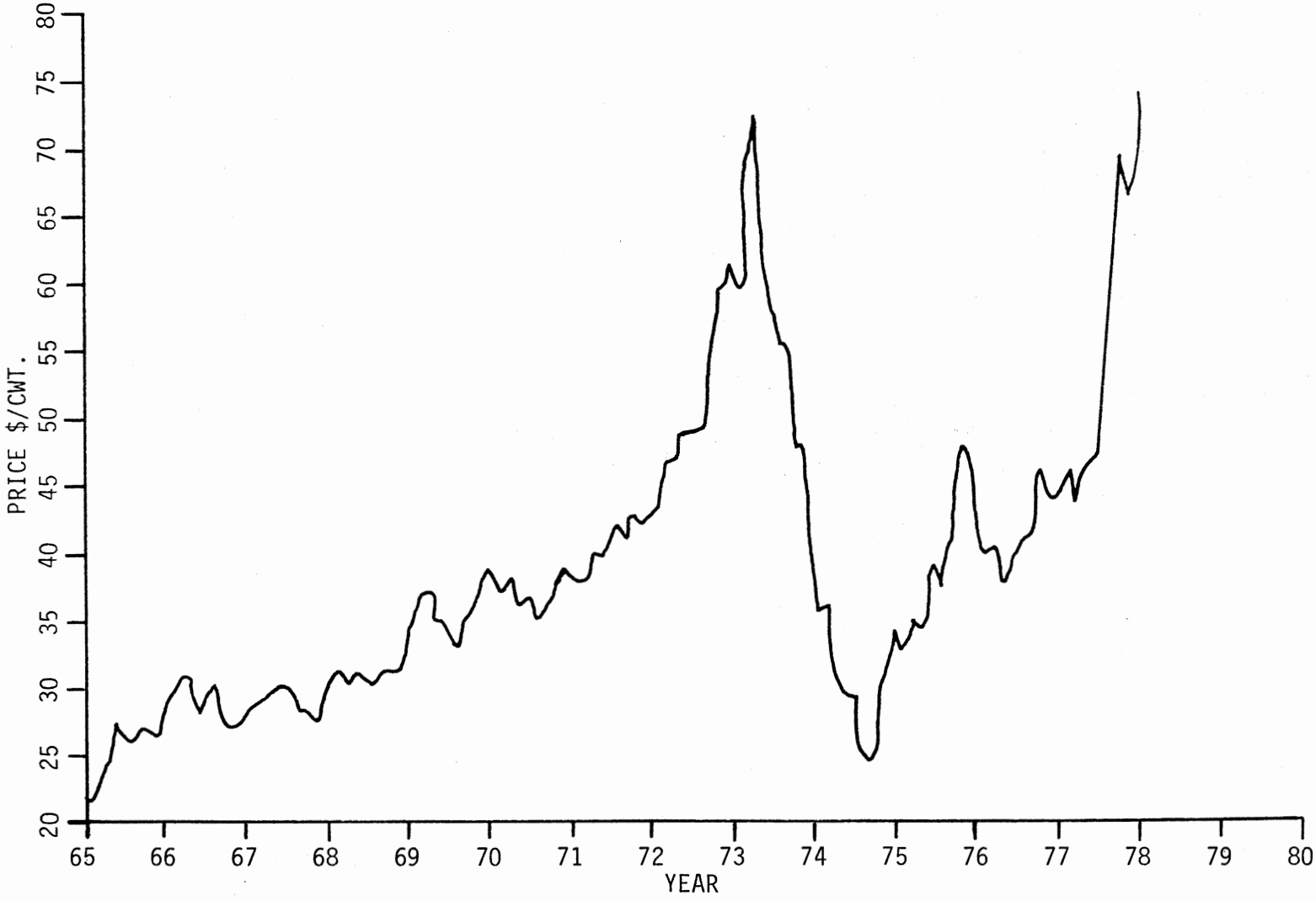

Figure 1. Choice 400-500 Pound Feeder Steer Price, Oklahoma City, 1965 - August, 1978

As a result of rapidly increasing production costs, increasing indebtedness and highly volatile prices, many producers are feeling the effects of highly variable, and often negative profit margins. These circumstances have already forced many producers into bankruptcy. Producers being oriented toward production have responded by attempting to reduce their risks in the production area. They have tried diversification, crop insurance, irrigation and new crop variations in an attempt to reduce the variability of production. They have accepted the newest technological and management practices to increase the efficiency of their operation and reduce their costs to a minimum. Even though these actions have been implemented, most producers were still not able to improve their financial situation. As a result, they have often asked the government for assistance through acreage controls, disaster payments, support prices and crop loans. However there is a limit to the effectiveness of continuing to try and reduce their production risks, and in many instances this point has already been reached, and government programs are an unexceptable market to many producers, particularly the livestock producers. Producers must now be better informed of the marketing aspect if they are going to be able to manage the large risks that they must face. Efficient marketing strategies must be adapted if the producer is going to survive the existing situation, without massive government aid.

Problem

One method of managing the risks associated with changing prices in the cattle industry is to use the futures market to hedge or forward price the cattle. The two major functions of the futures market is to

provide a means by which producers can shift price or market risk to the speculator and to provide a gathering place for information where it can be analyzed and distributed to everyone concerned. Through hedging, a cattleman can establish a price for his livestock well in advance of delivery.

Hedging commodities is not necessarily a risk minimizing strategy but rather it is a risk management process. A hedge can be used to maximize profits, protect profits, avoid losses or minimize losses. When a cattleman hedges his cattle he is protecting himself from the major adverse price moves.

There are two basic types of hedging strategies, multiple hedging strategy and forward pricing. A multiple hedging strategy implies that a set of cattle are hedged more than once during the production process. The cattle are hedged when the cattleman has reason to believe that the price will be falling and the hedge is lifted when he believes the price will be rising. The hedging cattleman never sells contracts in excess of the amount of cattle that he is actually producing and buys contracts only to offset previous sales.

The forward pricing strategy implies that a set of cattle are hedged only once during the production process. The hedge is placed and not lifted until the cattleman is ready to deliver the cattle in the cash market and buy back an offsetting contract. With either strategy, the amount of contracts sold should never exceed the amount of cattle the cattleman actually expects to have.

As a result of the highly volatile prices, the banking institutions have realized that hedging can be a very valuable marketing tool. When the borrowing cattleman's collateral is hedged in the futures market,

the additional security provided by the hedge enables the banker to increase the size of the loan and the cattleman can then expand his operation. Many banks have reacted favorably to the hedging of commodities and have increased the size of the loan for producers who are willing to place hedges. Other banks provide services to help the cattleman decide if he should hedge or not and if he does they provide part of the funds for margin calls.

Regardless of these promising situations many cattlemen are still not willing to use the futures market to reduce their price risk. It has been estimated that only about 10 percent of the total American cattle and hog numbers produced since these contracts began trading on the Chicago Mercantile Exchange have been hedged.

The reasons for cattlemen not using the futures markets are numerous and varied. Many are not aware that hedging in the futures market exists. Others are not well enough informed about the mechanics of the futures market to use it. While others have actually hedged their commodities and incurred losses or received a lower price than if they had not hedged. These latter cattlemen have convinced themselves that the futures market is just another form of gambling and that only the large speculator can ever win. Placing a hedge is something that shouldn't be rushed into blindly but should be given careful consideration. But, a true hedge is the opposite of gambling and reduces rather than increases risk.

One reason why cattlemen fail when they hedge their cattle is that their pricing objective is unclear or is nonexistent. If a cattlemen's pricing objective is to obtain the highest possible price he must be able to accurately anticipate the futures and cash price that will

exist at time of delivery. He should not hedge unless he feels the futures market is offering him a higher price than he would receive at his local cash market when he is ready to sell his cattle. He fails his objective if he hedges at a lower price than he could have gotten at the cash market or doesn't hedge and could have gotten a higher price if he had hedged. The chances of the cattleman achieving this objective are not good. If the cattleman wants to reduce his price risk he will consider the price that the futures market is offering him and place the hedge if it is a profit. If the cattleman cannot hedge at a profit he should consider waiting for a more favorable price or find another alternative method; such as forward contracts. This same cattleman can receive help from the futures market in making his production decisions. When he is able to hedge his inputs these costs can be estimated more accurately and by hedging his finished cattle he is better aware of the price he will receive. Therefore he can estimate more accurately the expected return from his investment and adjust his level of production.

There are many other factors that must be taken into consideration if a cattleman is contemplating a hedged position. The amount of cattle to be hedged is an important factor. The futures contract specifies a specific quantity and the cattleman usually does not have that exact amount. A cattleman must know his operating costs, for without this he is not aware if he is pricing his cattle at a profit or a loss.

Regardless of the cattleman's price and risk objectives if he is using the futures markets to forward price, one of the most important factors that must be considered is "basis". If he cannot anticipate his basis then he cannot know what price the futures market is actually offering him for his cattle. Therefore it is impossible for him to be

able to intelligently decide whether or not to hedge. It is the inaccurate estimation of the basis that causes many hedges to fail.

If a cattleman has different price and risk objectives he might consider using the multiple hedging strategy. Since he is not establishing a specific price for his cattle the basis is of little concern to this particular hedger.

Explanation of Basis

The usual definition of the term basis is simply the futures price minus the cash price. Basis can refer to any futures price minus any cash price. The basis is used to adjust the futures price to represent the quality, location and time applicable to delivery of the hedged cattle at the local market. The basis can be determined for any length of time before the delivery month matures, however the basis that determines the success or failure of the hedge is the one that exists between the cash price of cattle at the time that they are sold and the futures price of the contract that was used to hedge them.

The ability to anticipate the basis determines the accuracy with which the net outcome of the hedge can be estimated. The net price will remain the same regardless of whether futures prices rise or fall as long as the basis is accurately estimated. As accurate basis estimate implies that futures profits or losses are exactly offset by lower or higher price in the cash market. If the cattleman is able to get a higher cash price relative to his futures price (smaller than estimated basis) he will get a higher realized price regardless of whether overall price levels are higher or lower than expected. If the cattleman gets a lower cash price relative to his futures price (larger than estimated

basis) he will get a lower realized hedged price regardless of how the price levels have changed. In some cases it may pay the cattleman to complete his hedge early if he can get a more favorable basis than he had estimated. Basis is important because it allows the producer to know what price the futures market is offering him for his cattle at the local market so he can better decide whether or not to place the hedge; and the basis rather than the levels determine the end result of the hedge.

Factors Affecting Basis

The basis is influenced by many factors. Among these are location, time and quality. Because of their effect on the basis each will be examined in more detail.

Locational differences are caused mainly by local supply and demand conditions compared with the futures market supply and demand conditions which encompasses the world market. Local market supply and demand conditions are determined by local production and consumption. All areas can be classified as either partially deficit, partially surplus or self sufficient. In an area that has a deficit during a reduction in local supplies, it is forced to import more, thus resulting in a higher local price relative to other areas. Surplus areas export more as local supplies are increased and therefore their local cash price is lower relative to other areas. These relationships could change as the situation in that area changes, such as increasing supplies in a deficit area will increase its basis while reducing supplies in a surplus area will reduce its basis.

Time differentials are a result of the different delivery months

available. The futures market specifies the months that are delivery months and the time during which they are deliverable, which in most cases is between the first and 20th of the month. Many cattlemen are selling their cattle in the market continuously while others sell their cattle only a few times a year. The time problem arises when there is not a futures delivery contract available for the time a producer will be ready to sell. Producers should then use the contract that matures closest to the expected delivery date but one that does not mature before they are ready to sell their cattle. Cash and futures prices have some tendency to move in the same direction even prior to the delivery month. So when cattle are to be delivered prior to the delivery month, the basis relationship would depend on the trend in prices from the month of actual delivery in the cash market until the contract month that was used as the delivery month when the hedge was placed. If prices are trending upward you would expect the actual basis to be greater than the contract month basis and be smaller when prices are trending down. Therefore it is important to adjust the basis accordingly when you decide to hedge.

A quality difference must also be accounted for in determining the basis. Many cattlemen receive a premium or a discount in relation to the majority of the cattle sold at his local market, this must be added or subtracted respectively to his basis. If a cattleman wants to hedge steers of a weight that is different from the weight specified in the futures contract or if he wants to hedge heifers using the steer contract it is possible by making allowances in the basis estimate. The cattleman must realize in this situation that these cattle cannot be delivered and he must offset his position by either buying or selling

another futures contract.

The cash price for a commodity differs among market locations, market times and different qualities of cattle. Whereas the futures price is a price for a particular quality and quantity delivered at a specific location by a specific method at a specific time in the future. The quality of cattle that is delivered for futures contracts is the minimum quality allowable under the contract. If any of these factors in the cash market differ from the futures market then the basis will not equal zero.

There are specific cash markets selected by the futures exchanges that will take delivery of cattle in fulfillment of their contract obligations. One group is classified as par delivery, meaning that cattle delivered there will be accepted without any discounts. The closest par delivery market for cattle in the Oklahoma area is Omaha, Nebraska, however, Guymon is scheduled to be a par delivery for fed cattle in Janaury 1979. The other deliverable markets are non-par markets. Cattle can be delivered at these markets but are discounted a flat rate. Currently Guymon is a deliverable market with $0.50 discount for live cattle and Oklahoma City has a $0.50 discount on feeder cattle.

As the futures contract approaches maturity the futures price and cash price begin to converge. At this point in time the location, time and quality are the same in the futures market and the cash market at par delivery points. However this convergence does not continue until it equals zero. Cattle delivered in fulfillment of contract obligations must be graded, weighed, fed, watered, held in sealed pens and inspected by a federal inspector. All of these activities have costs associated

with them and so the basis theoretically will never be less than nor higher than these transaction costs. If the futures price was larger than the cash price by more than the delivery costs a profit could be made by buying cattle in the cash market, selling a futures contract then delivering the cattle in fulfillment of the futures contract. If the cash price is larger than the futures price by more than delivery costs a profit could be made by buying a futures contract, accepting delivery then selling the cattle in the cash market. This process, called arbitrage, would continue until it forced the basis to converge closer to the delivery costs. However the delivery costs are stable and predictable while the basis is variable which implies something else is influencing the basis. The other variable is the risk of delivery. When cattle are delivered in fulfillment of the contract obligations there is the risk that some will not make the specified quality of weight and therefore will be discounted according to the contract specifications, and because of the low volume of trades in a contract during maturity there is a risk that the order to buy or sell would not get filled before the contract expires. For those accepting delivery there are risks associated with exact time of delivery, exact quality and elapsed time between delivery and resale of cattle. These risks are part of the reason why the basis doesn't exactly equal the delivery costs.

Differences in cash prices among markets are determined by patterns of trade among different geographic locations and the associated costs of transportation. Since trade patterns and transportation costs are relatively stable and predictable from year to year the futures-cash basis tends to be less variable and more predictable than the cash or

futures price by itself. However the basis does vary.

The basis is used for other purposes besides just hedging. Some cattlemen forward contract their cattle and the price established is based upon the futures price minus the appropriate basis. They then cover themselves in the futures market. Others use the basis to establish prices for deferred purchases of various inputs they need. Knowing what the basis usually is can help in making marketing decisions. If the basis is smaller than usual this implies that the cash price at the local market is higher than usual relative to other areas, so this might be a good time to sell the cattle and complete the hedge. Conversely, if the basis is larger than usual this might be an indication that the cash price is relatively weak at the market and therefore you may want to hold cattle longer until the reasons for the larger basis is understood.

Methods of Basis Estimation

There are two ways to estimate your basis. The most popular and widely used is the historic price relationship method. This method consists of calculating your basis from daily data, then finding the monthly average for each month of the year. These monthly averages are then calculated for a number of years, usually five years or more. The corresponding months are then averaged to arrive at a monthly average. These averages are then used as estimates for the month your cattle will be ready for delivery.

The other procedure is called the actual cost method. To use this method you derive the actual cost of transporting the cattle from your local market to a par delivery market, use this as your basis estimate

and deliver the cattle when they are ready to sell. This method seems simple and straightforward but there are many hidden pitfalls. Whenever cattle are delivered the seller assumes certain costs; among these are feeding, bedding, weighing, insurance, delivery to buyer's holding pen, grading, documentation and the cost of the Livestock Delivery Certificate. The seller must also find replacements for those cattle not making the necessary grade, and if it is an oddlot he must buy additional cattle to meet the number of pounds of beef specified in the contract. Discounts are also imposed for cattle not in the specified allowable weight range. Tables I and II show the amount of deliveries that have occurred in the feeder and live cattle contracts respectively. The majority of these deliveries have been handled by large brokerage firms which have large cattle producers as clients. After considering all of these factors it is clear that this procedure is simply not practical nor applicable for most producers. So the following study is based on the historical method.

The basis is a very important part of any hedging decision. Time and careful consideration must be taken when arriving at your basis estimate, for it will determine your hedging failure or success.

Review of Literature

Cattle futures trading is a relatively new market. The live cattle contract has been trading for fourteen years whereas the feeder contract has been in existence only six years. Because of this newness research concerning these contracts is scarce. Most of the research that has been done involves hedging strategies in the live cattle market. The most current research that is relevant to the basis of feeder or live

TABLE I

MONTHLY DELIVERIES FOR FEEDER CATTLE, 1973-1977

Months	1973	1974	1975	1976	1977
March	73	1	83	40	35
April	20	15	36	6	51
May	49	59	16	27	21
August	28	32	14	5	72
September	4	29	0	26	28
October	134	44	20	75	8
November	4	67	7	39	32

Source: Chicago Mercantile Yearbook (1973-1977).

TABLE II

MONTHLY DELIVERIES FOR LIVE CATTLE, 1973-1977

Months	1973	1974	1975	1976	1977
February	610	504	106	81	12
April	96	327	150	37	353
June	214	423	205	58	443
August	838	458	79	505	114
October	170	219	149	217	89
December	1238	344	327	212	65

Source: Chicago Mercantile Yearbook (1973-1977).

cattle will be discussed in this paper.

Crow, Riley, and Purcell (1972) analyzed the effectiveness of the non-par delivery markets. They noted that delivery creates economic pressures which cause the basis to converge close to the cost of delivery, and the smoothness with which delivery can be completed determines the degree of convergence. They found that because of the discount associated with non-par delivery markets that delivery is impractical and therefore the non-par markets cannot be used as an effective delivery market for hedged cattle.

Vollink and Raikes (1977) studied the level and variability of the basis for live cattle during the delivery months for Omaha, Nebraska, a par delivery market. Their results showed that the basis varied considerably and was quite often different from zero by more than the estimated transaction costs associated with arbitrage. They found, through an empirical analysis, that about 40% of the variation was caused by the price expectations of speculators. They suspected that a large part of the remaining variation was caused by risks associated with delivery.

Guy and Wildermuth (1970) compared the basis for three different markets, one of which was a par delivery point. In this study they used the live cattle contract. Their results revealed that the level, seasonal pattern and variability of the basis does differ among areas and does affect the hedging results from areas too distant from a par delivery point.

Bobst (1973) conducted a study that was similar to the one Gum and Wildermuth (1970) had done. Bobst compared the basis of Omaha, Nebraska to markets in the Southern Plains, Georgia and Kentucky, the last three

being non-par markets, to test for location basis variability for live cattle. He discovered that the location of the market had a significant effect on the variability of the basis. He concluded that hedgers located long distances from par delivery markets could not hedge as effectively as those that were located close enough to use a par delivery point, and therefore they might be less likely to hedge.

O'Bryan, Davis, and Bobst (1977) used the same procedures as Bobst (1973) did to test for locational basis variability of the feeder contract. The only difference being the markets they compared. They compared the Omaha basis with Oklahoma City, and various Kentucky markets. In this instance they found that location had an insignificant effect on the basis variability of the non-par markets and the effectiveness of hedging is not reduced as a result of being too far from a par delivery to use it.

McLemore (1978) analyzed the basis patterns of some Tennessee markets and the Omaha market from 1972-1976. He found that the Tennessee markets exhibited a trend in the basis which was positive from 1972-1974 and negative from 1975-1976. These markets also exhibited a significant seasonal effect during the entire period. This effect was strongest in the winter months, resulting in a larger basis, and weakest in May and September, causing the smallest basis. The basis patterns for the Tennessee markets were quite similar to one another in respect to the trends and seasonal effects, however there was only a small similarity between them and the Omaha basis. The Omaha basis did not contain any trends but had a small seasonal effect. It too had a large basis during the winter months and lower basis during May and September but the Omaha basis remained at a low level between early

September and early November while the Tennessee basis increased. McLemore attributed some of these differences to the changes in feed prices which changed the relative value of the different weight categories of feeder cattle.

Elrich (1972) built a theoretical model based on the notion that the basis variability was a result of the changing supplies of fed cattle that were ready to be slaughtered. He concluded that the two-way inventories, cattle that could be slaughtered or held back, appear to play a key role in the determination of the basis during a period of two to three months prior to the futures delivery month.

Leuthold (1978) based his study on the same idea that Elrich (1972) had about the basis variability being brought about as a result of the changing supplies of fed cattle. He used ordinary least squares to build a model to explain the basis for fed cattle. He used the model to explain the basis for different time periods. In his model he divided the number of cattle on feed into three weight classes. The lighter weight cattle are too small to be slaughtered and must be fed longer, the middle weight cattle can be slaughtered or fed longer, while the heavier cattle must be slaughtered. These variables emphasized the changing supply of cattle available for slaughter. The model used for the delivery month had a R^2 of .26 with most of the variables being significant, however one of the significant variables possessed the wrong sign. He also used this model to explain the basis of longer time spans.

Objectives

The objectives of this paper can be divided into two basic parts:

1. To identify the factors that have a significant influence on the basis and determine the direction and amount of that influence. Basis is the difference between the futures price and the cash price at any location and time. The basis that is of concern occurs between the cash price of the cattle at the time they are sold at the cash market and the futures price of the contract that was used to hedge the cattle. The Oklahoma City cash market was used to derive the basis for feeder cattle while the Guymon cash market was used to arrive at basis estimates for the slaughter cattle. The basis is influenced by many factors, among the most important are time, quality, and location. If relationships can be found that have an influence on the basis, then the behavior of future bases can be better understood.

2. To build a model that could be used to explain the basis during the delivery month and using the results of the explanatory model to develop a model for predicting this delivery basis at the time the hedge is placed. A model using the significant relationships and ordinary least squares regression can be built to explain the basis during the delivery month. From this model, the relationships could be lagged the amount of time that a hedge will be in place to predict the basis that will occur at the time the hedge is to be completed. During the delivery month the explanatory model can be used to determine the best estimate of the basis and allow the hedger to make a more intelligent decision of whether to complete the hedge now or wait for a better basis.

The basis of the two types of cattle were analyzed, feeder cattle and slaughter cattle. The feeder cattle were 400-500 pound steers, 600-700 pound steers and 500-600 pound heifers. The slaughter cattle were Good and Choice steers and Choice and Prime heifers.

CHAPTER II

FEEDER CATTLE BASIS ANALYSIS

Procedure

The definition of basis that was used in this part of the analysis was simply the futures price minus the cash price. A positive basis implies that futures prices exceed cash prices and a negative basis implies futures prices were less than cash prices. The basis that exists between the cash price of the cattle at the time they are sold at the cash market and the futures price of the contract that was used to hedge the cattle is the only one of concern. It was assumed that the hedger would use the futures contract that matured nearest to but not before the delivery of the cattle in the cash market.

Cash prices were recorded for two classes of feeder cattle. The first class consisted of feeder steers of two different weights; the 400-500 pound range and the 600-700 pound range. The other class consisted of feeder heifers weighing between 500-600 pounds. The cash price used was the midpoint of the price range at the Oklahoma City market. The price ranges are found in the Weekly Livestock Market Report that is published in Oklahoma City. Daily cash price data were used in all of the analyses. The two days of each week which had the most prices recorded for the different weights and classes of feeder cattle were the days selected for this study.

The futures price used was the midpoint of the high-low price range

of the futures delivery contract. The delivery month contract is the futures contract that matures closest to but not before the time of actual delivery of the cattle in the cash market. The contract expires approximately the 20th day of the month. The futures price data were collected for the days corresponding to the days for which cash prices were recorded. The futures prices were taken from the Chicago Mercantile Yearbook.

The basis was computed as the futures price minus its corresponding cash price. The daily bases were recorded for a period of five years, beginning in January 1973 and ending in December of 1977. When lighter steers were hedged using the futures contract which specified heavier steers, the basis was generally negative, however when heavier steers or heifers were hedged the basis was usually positive.

Previous studies have been undertaken in an effort to more accurately estimate the basis for various locations. John Ikerd (1978) used the historical price relationship procedure to estimate the basis for feeder and live cattle in the Guymon and Oklahoma City markets. While conducting this study he discovered that a significant difference in the basis occurred between the fall and spring months. As a result of the similarities of time and location, the data collected for this study were tested for the same phenomenon.

The means of the bases were used to test for significant differences occurring between the bases of two groups of data. The procedure selected as the best test for significant differences between means was the univariate procedure. The months of the year were divided into three groups; fall delivery, spring delivery and other non delivery months. The fall months included August, September, October and

November, the spring months consisted of March, April and May and the remaining months, December, Janauary, February, June and July were classified as other months.

The mean of the fall and spring months' basis was calculated for both classes of feeder cattle and using the univariate procedure were tested for significant differences. The results of these tests are tabulated in Table III. The significance level that gives the more important critical value is at the 5% level. These results show that a significant difference in the basis does occur between the fall and spring months for both classes of data at the 5% significance level. It also reveals that a significant difference occurs at the 1% level for the heavier steers and heifers while being very close to significant for the lighter steers. As a result of these tests the data were analyzed in three different parts, fall months, spring months and other months.

There are two types of variables that were considered in this analysis. The first type of variable, period variable, was applicable for only one of the three parts of the data. Therefore these variables were used only where appropriate. The second type of variable, total variable, was applicable for all three parts of the data and was used whenever significant.

As a result of the data being divided, a model for each part was built to explain the corresponding bases. However, a model explaining the basis for just the "other months" was not used. Since the data composing the "other months" combined summer and winter seasons a model using only total variables and consisting of all parts of the data was built to explain the basis for all the months, specifically the other months.

TABLE III

RESULTS OF MEAN TESTS

Class	Hypothesis	Calculated	Table	Conclusion
Feeder Steers	H_o: $\bar{x}_f = \bar{x}_s$	t = 2.34	t = 1.96*	reject H_o
400-500 lbs	H_a: $\bar{x}_f \neq \bar{x}_s$	df = 254	t = 2.57**	
Feeder Steers	H_o: $\bar{x}_f = \bar{x}_s$	t = 4.37	t = 1.96	reject H_o
600-700 lbs	H_a: $\bar{x}_f \neq \bar{x}_s$	df = 252	t = 2.57	
Feeder Heifers	H_o: $\bar{x}_f = \bar{x}_s$	t = 3.57	t = 1.96	reject H_o
500-600 lbs	H_a: $\bar{x}_f \neq \bar{x}_s$	df = 264	t = 2.57	

*5% Significance level.

**1% Significance level.

Explanation of Variables: 400-500 Pound Steers

The values of the forward slaughter price variable was derived from the midpoint of the high-low price range of the fed cattle futures contract four months hence from the time the hedge was placed. These values served as a proxy for expected price for finished cattle. This information was obtained from the Chicago Mercantile Yearbook.

The values for the cost of feed variables were derived from total feed cost estimates for Great Plains' feedlots. Total costs were divided by 500 pounds, the expected additional weight the cattle gained, to obtain an estimate of the cost per pound gain. The information is published every other month in the Livestock and Meat Situation.

The expected fed price and cost of feed are important factors to anyone considering the purchasing of feeder cattle and feeding them to slaughter weights. Most cattle feeders have an estimate of the price they expect to receive for their finished cattle. At least to some extent, these expectations are reflected in the live cattle futures contract price. These expectations would be reflected in contracts maturing after the cattle are placed in the feedlot by the amount of time that is required to have the cattle finished and ready for slaughter. As the expected fed price increases, with other factors held constant, the feeder price will also increase, with the lighter steers' price increasing proportionately more than the heavier steers. As a result, the basis that occurs between the lighter steers and the heavier steers specified in the futures contract will decrease. Therefore the expected fed price is expected to vary inversely with the basis of the lighter steers.

After the cattle feeders have derived their expected fed price,

their operating margin must be estimated in order to determine the maximum price they can pay for the input feeder cattle. The component that has the largest effect of determining their operating margin is cost of gain. This implies that as cost of gain increases, the operating margin also increases and therefore the amount that the cattle feeder can pay for input feeder cattle decreases. This price decrease will be greater for lighter relative to heavier cattle. As input feeder cattle prices decrease, the basis, particularly for lighter steers, will increase. Therefore the cost of feed variable is expected to vary directly with the basis. These interactions can be examined more closely with the use of the following break-even equation for feeder cattle.

$$\text{Break-even price} = \frac{\text{fed wt}}{\text{feeder wt}} (\text{expected fed price}) - \frac{\text{gained wt}}{\text{feeder wt}} (\text{cost gain})$$

The futures and cash prices can be obtained by substituting the appropriate weights into the equation as follows:

$$\text{Price 600 lb steers} = \frac{1000}{600} \text{FSP} - \frac{400}{600} \text{COF}$$

$$\text{Price 600 lb steers} = 1.6 \text{ FSP} - .6 \text{ COF}$$

$$\text{Price 450 lb steers} = \frac{1000}{450} \text{FSP} - \frac{550}{450} \text{COF}$$

$$\text{Price 450 lb steers} = 2.2 \text{ FSP} - 1.2 \text{ COF}$$

The futures contract represents 600 lb cattle so the derived price for 600 lb cattle may be substituted conceptually for the futures price.

Substituting the derived prices into the following basis equation indicates the expected sign of the cost of feed variable and forward slaughter price variable.

Basis = Price 600 lb steers - price 450 lb steers

Basis = 1.6 FSP - .6 COF - (2.2 FSP - 1.2 COF)

Basis = -.6 FSP + .6 COF

The level of prices has a large effect on the amount of price spread between lighter and heavier steers. As price levels increase the price spread between different weights of cattle also increases. The current cash price variable takes account of this relationship. The cash price used was the current cash price of the 400-500 pound feeder cattle at the Oklahoma City market when the hedge was being considered. The information was contained in the Weekly Livestock Market Report.

Using the break-even equations that were developed in the analysis of the previous variables, this relationship can be examined more closely. If costs of feed are assumed constant at $35.00 and the futures price is equivalent to the heavier cattle price while the cash price corresponds to the lighter cattle, the price spread relationship can then be examined at a $40.00 price level and a $60.00 price level.

Heavier cattle price = 1.2 ($40) - .6 ($35)

= $27

Lighter cattle price = 1.75 ($40) - 1.2 ($35)

= $28

Price spread = lighter cattle price - heavier cattle price

= $28 - $27

= $1

Heavier cattle price = 1.2 ($60) - .6 ($35)

= $51

Lighter cattle price = 1.75 ($60) - 1.2 ($35)

= $63

Price spread = lighter cattle price - heavier cattle price

= $63 - $51

= $12

Difference in spread = price spread at $60.00 - price spread at $40.00

= $11

As a result of the price level increasing twenty dollars the price spread increased eleven dollars. This implies that the price of lighter cattle will increase proportionately more than heavier cattle and cause the basis to decrease. Therefore the current cash price variable is expected to vary inversely with the basis.

The proportional cattle inventory variable is affected by changes in the supply of the input feeder cattle in the Oklahoma area. The values for this variable were derived by dividing the total number of steers, bulls and heifers under 500 pounds in the state of Oklahoma by the total in the United States. This information was gathered from the Quarterly Cattle on Feed Report. A graphical analysis of the interactions that occur are presented in Figure 2. This analysis assumes the transportation costs are initially zero.

The two regions selected for comparison were the Corn Belt and High Plains. Since Omaha is located in the Corn Belt it was designated as the futures price.

Assuming the given supply and demand conditions for both regions, a difference in equilibrium prices occur. Therefore an excess supply and demand curve can be drawn. By calculating the price differential for each quantity that occurs between the excess supply and demand curves, a demand for transportation can be drawn. The supply curve of

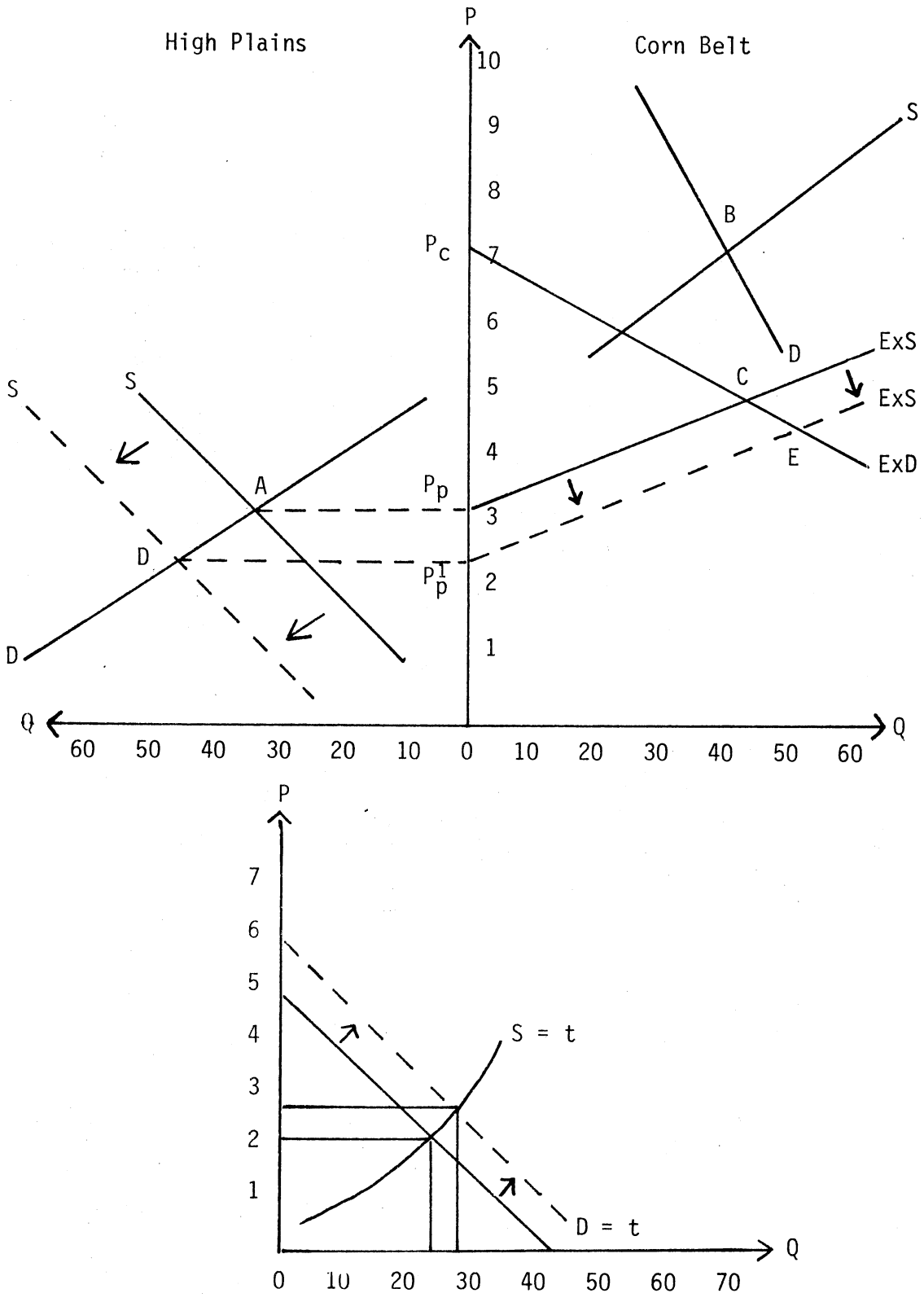

Figure 2. Illustration of Increasing Transportation Costs

transportation is then included to determine the cost of transportation and the amount of cattle that will be shipped given these costs.

If the proportional cattle inventory increases, this implies that the supply of these input feeder cattle has increased; causing the supply curve in the High Plains region to shift downward and to the left. This shifting supply curve results in a new excess supply curve and demand for transportation curve. As the demand curve for transportation increases it intersects the supply curve at a higher transportation cost, resulting in more cattle being exported but at a higher price. The transportation costs increase as a result of the increase in transportation demand caused by more cattle being shipped further distances and not necessarily by increasing transportation rates. As the transportation costs between regions increase so must the price differential, this results in a bigger price spread between Omaha and Oklahoma City.

As a result of the basis between the lighter feeder cattle and the futures contract feeder being negative, an increase in the price spread causes the basis to decrease. Therefore the basis and PCI are expected to vary inversely with one another when considering the lighter weight feeder steers.

The wheat pasture demand variable is one factor that influences the demand of feeder cattle in Oklahoma. Its deviation consisted of two steps. The first step was to determine the acreage that would be planted to wheat. This information is published semiannually in the Oklahoma Prospective Plantings report. The second part was to calculate the acres that had sufficient growth to allow grazing and the number of those acres actually being grazed. The Oklahoma Wheat Pasture Report publishes the percent of seeded wheat with sufficient growth to pasture,

percent of seeded wheat being pastured and the acres of wheat pasture required to carry a 400 pound calf. The percentage figures were multiplied by the acres to be planted, then subtracted from one another to determine the number of acres with sufficient growth to pasture but were not being pastured. This acreage not being grazed was then divided by the acres required to carry a 400 pound calf; the resulting figure revealed the number of additional feeder calves that could be pastured on wheat in the Oklahoma area.

Wheat acreage in Oklahoma provides the opportunity to harvest two crops during the span of one year. It has the capabilities of providing cheap pastureland during the fall and winter months for feeder cattle, then producing the wheat crop in the summer. The amount of wheat pasture available influences the feeder cattle price more significantly in the fall months. During the fall months, as more wheat pasture becomes available, the demand for feeder cattle to place on the additional acres increases, causing prices to increase. As prices rise, a point will be reached where any further increases in price will result in the importation of additional cattle from outlying regions. This increased supply has a stabilizing effect on the price of the feeder cattle and causes a resistance to further price increases. It is the initial price rise that is of interest, hence the wheat pasture demand variable is a period variable used in the fall months only.

As the price for input feeder cattle increases, the basis that exists between the lighter cattle in Oklahoma and the heavier feeder cattle at Omaha increases implying a smaller negative basis. Therefore the wheat pasture demand variable is expected to vary directly with the basis.

The July wheat futures price is another variable that has an effect on the supply of cattle in Oklahoma. The values for this variable were obtained by calculating the midpoint of the high-low price range for the July wheat futures contract. This information is published in the Chicago Board of Trade Yearbook.

Cattle producers who are grazing their wheat land must decide in the late winter months whether to keep the cattle and graze out the wheat or remove them and harvest the crop in the summer. The futures price for wheat could be used as a cheap and daily estimate of the value of the wheat crop. As the futures price for wheat increases the value of the wheat crop also increases, resulting in increasingly more cattle being removed from the wheat land. As more cattle are removed and sold in the market, the price for cattle is depressed, usually enough that exportation of the excess amounts of cattle occurs. This trend continues until all cattle on wheat are removed and large numbers are shipped to outlying areas. However, in mid-spring, cattle ranchers begin to demand cattle to graze for the summer months. As a result of the large influx of cattle to the local markets in earlier months and substantial exporting, the available supply is not adequate to meet the increased demand, causing cattle prices to rise. It is this period of price increases that is of concern and therefore the July wheat futures price is a period variable used only in the spring months.

The final result of the increase in July wheat futures price is an increase in the price of feeder cattle during the spring months in Oklahoma. As the price for lighter feeder steers in Oklahoma increases, the basis, that exists between them and the heavier cattle that meet the futures contract specifications in Omaha, also increases-implying a

smaller negative basis. Therefore the July wheat futures price variable is expected to vary directly with the basis.

Results of Models: 400-500 Pound Steers

The models that were built to explain the basis were derived by using ordinary least squares and were assumed to be linear.

Fall Explanatory Model

The model that explained the basis during the fall months is as follows:

$$\underset{}{FSB4F} = \underset{(-.85)}{-4.16} + \underset{(4.89)*}{27.73\ COF} + \underset{(3.27)*}{.01\ WPD} - \underset{(-5.20)*}{.16\ CFS433} - \underset{(-1.18)}{61.51\ PCI}$$

where:

FSB4F = fall basis for 400-500 pound feeder steer

COF = cost per pound of gain

WPD = wheat pasture demand

CFS433 = current cash price of 400-500 pound feeder steers when the hedge is being considered

PCI = proportional cattle inventory

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. All relationships excluding the PCI are significant at the 1% level. The corresponding sign of each variable is consistent with the analysis developed earlier. The F value was 83.52 which was also highly significant at the 1% level. This highly significant F value and a R^2 value of 71% implies that the model is explaining a highly significant part of the variation. The Durbin d statistic, which was .51, implies that

positive autocorrelation is prevalent during this time period. This causes the variance estimates to be underestimated and the t and f values to be overestimated. The shortness in the time period between observations is probably the main cause of this autocorrelation.

Fall Prediction Model

Using ordinary least squares, a model was developed to predict the basis for the fall months. The data were lagged four months so that all the necessary information would be available when the hedge was being considered. The wheat pasture demand variable was not used in the model since data were not available at that time. The current cash price was also deleted as a result of the correlation between the FSP variable and cash price. The model is as follows:

$$FSB4F_1 = \underset{}{22.54} - \underset{(4.22)*}{.16\ FSP} + \underset{(10.87)*}{31.34\ COF} - \underset{(-5.24)*}{569.29\ PCI}$$
$$\qquad\qquad\quad (-3.02)*$$

where:

$FSB4F_1$ = predicted fall basis for 400-500 pound feeder steers

FSP = forward slaughter price

COF = cost per pound of gain

PCI = proportional cattle inventory

The t values of the coefficients are in parenthesis and the asterisk reveals which relationships were significant at the 1% level. All of the relationships were highly significant at the 1% level and had the expected sign. The R^2 dropped from 71% to 57% and the F value also dropped from 83.52 to 59.80, however these figures reveal that a highly significant part of the variation is still being explained by the model. The standard deviation increased from 2.045 to 2.493 while the Durbin d

statistic dropped from .51 to .38 indicating an increased influence of positive autocorrelation.

Spring Explanatory Model

The model that was built to explain the basis for the spring months is as follows:

$$\underset{}{FSB4S} = \underset{}{26.75} - \underset{(6.23)*}{10.51\ COF} - \underset{(-4.91)*}{357.70\ PCI} + \underset{(5.91)*}{1.61\ JWF} - \underset{(-13.80)*}{.27\ CFS433}$$

where:

FSB4S = spring basis for 400-500 pound feeder steers

COF = cost per pound of gain

PCI = proportional cattle inventory

JWF = July wheat futures

CFS433 = current cash price of 400-500 pound feeder steers when the hedge is being considered

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. The difference between this model and the previous explanatory model was the selection of a different period variable. The JWF variable was used instead of the WPD variable.

In this model all of the relationships were highly significant at the 1% level. The COF variable was the only variable that did not have the expected sign. This inconsistency can be attributed to the large increase in demand for these cattle for summer grazing. This model decreased the standard deviation of the previous explanatory model from 2.045 to 1.591 while maintaining the same R^2 value. The F value decreased from 83.52 to 69.51, however this value is still highly

significant. The effect of the positive autocorrelation diminished somewhat from the Durbin d statistic of .51 to a value of .90.

Spring Prediction Model

Using ordinary least squares, a model was developed to predict the basis for the spring months. These data were also lagged four months and the current cash price was deleted. The model is as follows:

$$FSB4S_1 = \underset{(.29)}{2.25} - \underset{(-6.42)*}{.42\ FSP} + \underset{(1.07)}{3.89\ COF} + \underset{(.25)}{23.33\ PCI} + \underset{(8.86)*}{2.88\ JWF}$$

where:

$FSB4S_1$ = predicted spring basis for 400-500 pound feeder steers

FSP = forward slaughter price

COF = cost per pound of gain

PCI = proportional cattle inventory

JWF = July wheat futures

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. The FSP and JWF variables were the only relationships significant at the 1% level however the PCI variable was the only one that did not possess the expected sign. Since the expected sign was wrong and the t value was very low, there was probably some multicollinearity that existed in the model. This model, compared to the explanatory spring model, resulted in an increase in the standard deviation from 1.591 to 1.687. The F value decreased from 69.51 to 58.66 but the R^2 dropped a small amount from 71% to 67% implying that almost the same amount of variation was being explained. The Durbin d statistic dropped only a small amount from .90 to .81 meaning that the influence of the positive autocorrela-

tion was almost the same.

All Explanatory Model

The model built to explain the basis for all the months or more specifically the other months is as follows:

$$\begin{array}{l} FSB4A = 12.42 - 1.52\ FB - 1.18\ SB + 6.22\ COF - .18\ CFS433 \\ \qquad\quad (4.74)^* \ (-5.71)^* \ (-4.28)^* \ (2.83)^* \ (-14.00)^* \\ \qquad\quad - 158.13\ PCI \\ \qquad\quad (-3.95)^* \end{array}$$

where:

FSB4A = all months basis for 400-500 pound feeder steers

SB = spring intercept dummy

FB = fall intercept dummy

COF = cost per pound of gain

CFS433 = current cash price of 400-500 pound feeder steers when the hedge is being considered

PCI = proportional cattle inventory

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. This model used the spring and fall intercept dummies to account for the differences in the means of the basis that occurred between these months. It used only total variables since period variables can be used in only certain time periods and this model encompassed all of the time periods.

The relationships were all highly significant at the 1% level and all variables possessed the expected sign. The standard deviation is 2.286 which is the highest of the three explanatory models. This model had a R^2 value of 54% which was the lowest but yielded the highest F

value of 102.37, which means the model is explaining a large portion of the variation. The Durbin d statistic of .35 was the lowest indicating the highest level of autocorrelation.

All Prediction Model

Using ordinary least squares, a model was developed to predict the basis for the spring months. These data were also lagged four months and the current cash was deleted. The model is as follows:

$$FSB4A_1 = \underset{(4.61)^*}{16.77} - \underset{(-6.23)^*}{1.83\ FB} - \underset{(-3.79)^*}{1.17\ SB} - \underset{(-7.56)^*}{.22\ FSP} + \underset{(9.65)^*}{16.05\ COF} - \underset{(-5.52)^*}{275.19\ PCI}$$

where:

$FSB4A_1$ = predicted all months basis for 400-500 pound feeder steers

SB = spring dummy intercept

FB = fall dummy intercept

FSP = forward slaughter price

COF = cost per pound of gain

PCI = proportional cattle inventory

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. All relationships were highly significant at the 1% level and possessed the desired sign. Compared to the explanatory model for all months the standard deviation increased from 2.286 to 2.591 and the R^2 decreased from 54% to 41%. The F value also decreased from 102.37 to 60.75 but simply a significantly large part of the variation is being explained. The Durbin d statistic also decreased from .35 to .28.

Explanation of Variables: 600-700 Pound Steers

Many of the variables used in this section have been discussed and analyzed previously. Unlike the previous weight class of feeder steers, these steers are the approximate weight that is specified in the futures contracts and are assumed deliverable against those contracts. Consequently the sign of those variables would be expected to change.

The forward slaughter price variable causes the feeder steer price to vary. As the expected fed price increases the futures feeder price and cash feeder price will increase. However the futures price will increase more than the cash price which results in a larger basis. Therefore the forward slaughter variable is expected to vary directly with the basis.

The cost of feed variable is another factor that affects the basis for feeder steers. This variable is the largest component of the operating margin for cattle feeders. As the cost of feed variable increases, the operating margin increases and consequently the amount that the cattle feeder can pay for feeder steers decreases. As a result the price for lighter steers decreases proportionately more than the heavier steers, resulting in a smaller basis. Therefore the cost of feed variable is expected to vary inversely with the basis.

A variable used in this section that was not discussed previously is the proportional cattle on feed. Since most of the cattle in this weight range go directly to the feedlot, the availability of space should have an effect on the price the feedlot operator will pay for additional steers.

The values of this variable were derived from the Seven State Cattle on Feed Report. The number of cattle on feed in Colorado, Kansas and

Texas were added together then divided by the total number of cattle on feed in the seven state region. This figure was then lagged one month. Since the number of cattle on feed in Oklahoma is not reported in this publication, these surrounding states were used to arrive at an estimate of the supply of cattle on feed in Oklahoma and thus the available space of the feedlots in the Oklahoma Panhandle area.

If the proportional cattle on feed variable increases, this implies that the supply of cattle in the area has also increased. As the supply of cattle increases, the feedlots become full and therefore the operators do not need additional cattle to place in their feedlot so the quantity demanded decreases. As a result, the price for these cattle begin to fall and the basis becomes larger. Therefore the feedlot capacity variable is expected to vary directly with the basis.

The data in this section were divided following the same procedure as the previous section. After developing the models for the three data parts, very little difference existed among the spring and fall months' models compared to the other months' models. Consequently only one model will be presented in this section. That model will be the all months' model which encompasses all three data parts.

Results of Models: 600-700 Pound Steers

All Explanatory Model

The model that was developed to explain the basis for the other months is as follows:

$$\underset{}{FSB6A} = \underset{}{-8.27} \underset{(-3.08)*}{- 1.13\ FB} \underset{(-6.14)*}{- .14\ SB} \underset{(-.81)}{+ .11\ FSP} \underset{(6.36)*}{- 12.01\ COF} \underset{(-9.54)*}{+ 20.94\ CKTF8} \underset{(3.92)*}{}$$

where:

FSB6A = all months basis for 600-700 pound feeder steers

SB = spring intercept dummy

FB = fall intercept dummy

FSP = forward slaughter price

COF = cost per pound of gain

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. The intercept dummies were used to account for the differences in the basis that existed between the fall and spring months. All relationships except the spring intercept were highly significant at the 1% level, and all variables possessed the expected sign. The standard deviation was 1.467 and the Durbin d statistic was .62, indicating that positive autocorrelation existed in this model. The R^2 was 32% and the F value was 40.16 implying that a significant part of the variation was being explained.

All Prediction Model

Using ordinary least squares, a model was developed to predict the basis for the other months. All of the data were lagged four months so that the data would be available when the hedge was being considered. The model is as follows:

$$FSB6A_1 = \underset{}{-6.28} \underset{(-2.14)**}{- .89\ FB} \underset{(-4.99)*}{- .33\ SB} \underset{(-1.64)}{+ .07\ FSP} \underset{(4.50)*}{- 9.39\ COF} \underset{(-8.37)*}{+ 17.44\ CKTF8} \underset{(2.81)*}{}$$

where:

$FSB6A_1$ = predicted all months basis for 600-700 pound feeder steers

SB = spring intercept dummy

FB = fall intercept dummy

FSP = forward slaughter price

COF = cost per pound of gain

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the single and double asterisk reveals which relationships were significant at the 1% and 5% level respectively. All of the relationships used in the model were highly significant at the 1% level except the spring intercept dummy. However all variables possessed the expected sign. Compared to the previous explanatory model, this model had a slightly larger standard deviation, it increased from 1.467 to 1.55. The Durbin d statistic was relatively constant, only increasing from .62 to .60. The R^2 decreased from 32% to 24% and the F value also decreased, from 40.16 to 26.83, however the figures reveal that a significant amount of the variation is still being explained.

Explanation of Variables: 500-600 Pound Heifers

Several variables used in this section were used in the preceding sections. Since the heifer price is typically discounted relative to the steer price and the futures contract specifying steers is used for hedging purposes, the resulting basis is usually positive. Consequently the variables may affect the heifer basis differently than the steer basis.

The forward slaughter price variable is used as an estimate of the price of fed steers four months hence from the time of the hedge. This variable is expected to vary directly with the heifer basis, because an increase in the expected value of fed cattle will typically increase the

value of feeder steers more than feeder heifers.

The cost of feed variable gives an estimate of the cost per pound of gain. Since the feed efficiency of heifers is lower than steers, the cost of gain for heifers is greater than steers. As the cost of gain increases, the price that cattle feeders can pay for feeder cattle must decrease with heifer prices decreasing proportionately more, resulting in a larger basis. Therefore the cost of feed variable is expected to vary directly with the basis.

The wheat pasture demand variable measures the demand for additional feeder cattle to be placed on wheat pasture. As this variable increases, the price for feeder cattle will also increase. However, as a result of the discount of heifers and their lighter weight than steers, it was impossible to conclusively state whether the heifer prices would rise proportionately more or less than steer prices.

The proportional cattle inventory variable measures the proportion of steers, bulls and heifers less than 500 pounds in the state of Oklahoma compared to the United States total. When this variable increases it implies that more of these types of cattle are in the Oklahoma area. As the supply of these cattle increases the price will decrease, resulting in a larger basis. Therefore the basis is expected to vary directly with the proportional cattle inventory variable.

The July wheat futures variable is used as an estimate of the potential value of the wheat crop. As the July wheat futures variable increases the value of the wheat crop also increases which causes more cattle to be taken off wheat pasture at an earlier date than if they were allowed to graze out the wheat. The result is less cattle available when ranchers wish to purchase cattle to place on summer pasture.

As a result of these actions the price for feeder cattle will increase, however the exact nature of the change in the heifer prices compared to steer prices is uncertain.

The previous month's proportional cattle on feed measures the availability of space that additional feeder cattle could be placed. This variable can measure either the supply or demand of feeder cattle.

If the number of cattle on feed increases, resulting in a higher cash price for feeder heifers, the variable is measuring the supply of effect. This occurs when there is a strong demand for feeder cattle to place on feed but the available supply of steers is not sufficient to meet all of the requirements. Results of the analysis indicated that this event occurred during the fall months when farmers in the Corn Belt Region are typically placing a large proportion of cattle on feed which reduces the supply of feeders available to commercial feeders in the High Plains.

If the number of cattle on feed increases, resulting in less space for additional feeder cattle and the cash price for feeder heifers fall, the variable is measuring the demand effect. This occurs when the feedlots are approaching their desired capacity levels thus reducing the demand for additional feeder cattle. Results of the analysis showed that this is more typical of the spring months when there is less competition for feeder cattle in the High Plains

Results of Models: 500-600 Pound Heifers

The models that were built to explain the basis for heifers were derived by using ordinary least squares and were assumed to be linear.

Fall Explanatory Model

The model that was built to explain the model in the fall months is as follows:

$$\underset{}{FHB5F} = \underset{(-5.68)*}{-35.61} + \underset{(6.03)*}{.23\ FSP} + \underset{(.98)}{2.92\ COF} + \underset{(3.09)*}{.01\ WPD} + \underset{(6.43)*}{59.92\ CKTF8}$$

where:

FHB5F = fall basis for 500-600 pound heifers

FSP = forward slaughter price

COF = cost per pound of gain

WPD = wheat pasture demand

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. All of the relationships, excluding the cost of feed, were significant at the 1% level. The forward slaughter price, cost of feed and proportional cattle on feed variables all possessed the expected signs. The expected sign of the wheat pasture demand variable was uncertain, however in the model it possessed a positive sign and was highly significant. This implies that a strong wheat pasture demand affects the price of steers more than heifers and thus increases the price of steers relative to heifers and widens the basis. The R^2 value was 30% and the F value was 14.55, indicating that the model was explaining a significant part of the variation. The standard deviation of the model was 1.592 and the Durbin d statistic was .86, implying that positive autocorrelation existed.

Fall Prediction Model

Using ordinary least squares a model was derived to predict the basis for the fall months. These data were lagged four months so that all of the necessary data would be available at the time the hedge was being considered.

Since the information for the wheat pasture demand variable is not available that far in advance, it was deleted from the prediction model. The forward slaughter price was also deleted. Most ranchers observe the current price trend, develop their expectations and then decide whether to retain the heifers for herd expansion or for feeding purposes. Therefore the cash price for heifers at the time of the hedge was used instead of the forward slaughter price. This variable is expected to possess a positive sign which is consistent with the forward slaughter price variable.

The model built to predict the fall basis is as follows:

$$FHB5F_1 = \underset{}{56.00} + \underset{(4.80)*}{.11\ CFH5} + \underset{(3.70)*}{25.15\ COF} - \underset{(4.56)*}{134.15\ CKTF8} \quad \underset{(-4.54)*}{}$$

where:

$FHB5F_1$ = predicted fall basis for 500-600 pound heifers

CFH5 = cash price for Choice 500-600 pound heifers when the hedge is being considered

COF = cost per pound of gain

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. All of the relationships were significant at the 1% level. The proportional

cattle on feed variable was the only variable which possessed a sign inconsistent with the explanatory model. This inconsistency may be attributed to the fact that a large number of cattle on feed in the current month, the month the hedge is placed, may indicate a relatively small number of cattle on feed four months in the future, when the hedge is completed. This is due to cyclical or period levels of large placements and marketings. The standard deviation increased slightly from 1.592 to 1.756. The R^2 value decreased from 30% to 14% and the F value decreased from 14.55 to 7.56. Even though these values decreased, the model was explaining a significant part of the variation. The influence of positive autocorrelation increased as shown by the Durbin d statistic decreasing from .91 to a value of .86.

Spring Explanatory Model

The model that was built to explain the basis for the spring months is as follows:

$$\begin{array}{lcccc} FHB5S = & -3.93 & + .05\ FSP & - 1.16\ JWF & + 223.97\ PCI \\ & (-1.32) & (1.45) & (-7.10)* & (4.28)* \end{array}$$

where:

FHB5S = spring basis for 500-600 pound heifers

FSP = forward slaughter price

JWF = July wheat futures

PCI = proportional cattle inventory

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. All of the relationships except the forward slaughter price is significant at the 1% level. The forward slaughter price and proportional cattle

inventory variables possessed the expected sign. The expected sign of the July wheat futures variable was uncertain, however in this model the variable was significant and possessed a negative sign. The R^2 value was 44% and the F value was 29.62, these values imply that a highly significant of the variation is being explained. The standard deviation was 1.158, while the effect of positive autocorrelation was diminished as shown by a Durbin d statistic of 1.40.

Spring Prediction Model

Using ordinary least squares a model was derived to predict the basis for the spring months. The current cash price for heifers was used instead of the forward slaughter price. The model is as follows:

$$FHB5S_1 = \underset{(-.10)}{-.32} - \underset{(-4.51)*}{.07\ CFH5} - \underset{(-1.70)}{.34\ JWF} + \underset{(3.89)*}{193.85\ PCI}$$

where:

$FHB5S_1$ = predicted spring basis for 500-600 pound heifers

CFH5 = cash price of Choice 500-600 pound heifers when the hedge is being considered

JWF = July wheat futures

PCI = proportional cattle inventory

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. The heifer cash price and proportional cattle inventory relationships were both significant at the 1% level. Even though heifer cash price was significant, it did not possess the expected sign. This inconsistency could occur as a result of the cash price reflecting long term price trend instead of the short term price movements reflected by the forward

slaughter price in the explanatory model. The R^2 value and F value both decreased but only by a small amount. The R^2 value decreased from 44% to 38% while the F value decreased from 29.62 to 23.07, indicating a large part of the variation was being explained. The standard deviation increased slightly from 1.158 to 1.219. The influence of positive autocorrelation increased as was shown by the Durbin d statistic decreasing from 1.40 to 1.33.

All Explanatory Model

The model that was built to explain the basis for the other months is as follows:

$$\begin{matrix} FHB5A = -19.89 - .22\ SB - 1.95\ FB + .14\ FSP - 7.29\ COF + 48.96\ CKTF8 \\ \quad\quad (-6.21)^* \quad (-1.07) \quad (-8.87)^* \quad (7.16)^* \quad (-4.86)^* \quad (7.69)^* \end{matrix}$$

where:

FHB5A = all months basis for 500-600 pound heifers

FB = fall intercept dummy

SB = spring intercept dummy

FSP = forward slaughter price

COF = cost per pound of gain

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the asterisk reveals which relationships were significant at the 1% level. This model used the spring and fall intercept dummies to account for the differences in the means of the basis that occurred between these months. All of the relationships were highly significant at the 1% level. The cost of feed variable was the only variable which did not possess the expected sign. The indication is that a higher cost of gain would favor

heifers relative to steers in the winter and summer months but would favor steers in the spring and fall. The R^2 value was 24% and the F value was 27.48. The F value was highly significant at the 1% level which indicates a small probability of the model relationships resulting from random occurrence. The standard deviation was 1.747 and the Durbin d statistic was .55.

All Prediction Model

Using ordinary least squares a model was developed to predict the basis for the other months. As done in the previous prediction models, the cash heifer price was used instead of the forward slaughter price. The models is as follows:

$$FHB5A_1 = \underset{(-.89)}{-2.97} - \underset{(-3.35)*}{.83\ SB} - \underset{(-4.83)*}{1.07\ FB} - \underset{(-.91)}{.01\ CFH5} - \underset{(-3.41)*}{5.96\ COF} + \underset{(3.44)*}{26.42\ CKTF8}$$

where:

$FHB5A_1$ = predicted all basis for 500-600 pound heifers

FB = fall intercept dummy

SB = spring intercept dummy

CFH5 = cash price for Choice 500-600 pound heifers when the hedge is being considered

COF = cost per pound of gain

CKTF8 = proportional cattle on feed for previous month

The t values of the coefficients are in parentheses and the asterisk reveals which relationships are significant at the 1% level. All of the relationships were significant at the 1% level except the cash

price of heifers variable. The sign of the cost of feed variable consistent with the explanatory model and the cash heifer price variable sign was the same as the spring prediction model. The proportional cattle on feed variable possessed the expected sign. The R^2 value decreased from 24% to 10% while the F value also decreased, from 27.48 to 9.87. Even though the R^2 and F values were low, the F value was significant at the 1% level indicating a significant part of the variation is being explained by the model. The standard deviation increased from 1.747 to 1.900 while the Durbin d statistic decreased from .55 to .50, indicating an increase in the influence of positive autocorrelation. Overall, the model was simply not as good as models for delivery months which implies a large proportion of unexplained or random error.

The statistical data for the feeder cattle models are given in Tables V through IX in the Appendix.

CHAPTER III

SLAUGHTER CATTLE BASIS ANALYSIS

Procedure

Basis as used in this analysis is the futures price minus the cash price. The basis of concern occurs between the cash price of the cattle at the time they are sold at the cash market and the futures price of the contract that was used to hedge the cattle.

Cash prices were recorded for two classes of slaughter cattle. The first class consisted of Good and Choice slaughter steers. The second class was composed of Choice slaughter heifers. The slaughter steers are usually not deliverable in fulfillment of the futures contract obligations. To be deliverable they must be composed of some Prime steers. As a result, the Omaha futures contract price is typically higher than the cash price of Good and Choice steers at Guymon. The heifers cannot be delivered in fulfillment of futures contract obligations.

The cash price used was the midpoint of the price range recorded at the Guymon market. These prices are published weekly in the Oklahoma Market Report. Daily prices for the two days of each week which had the most prices recorded for the different weights and classes of slaughter cattle were selected for this study.

The futures price used was the midpoint of the closing range for the live cattle delivery contract. The delivery contract was the

futures contract that matured closest to but not before the time of delivery. Daily futures prices were selected to correspond with the recorded cash prices. The futures prices are published in the Chicago Mercantile Yearbook.

The calculated basis was therefore the futures price minus the corresponding cash price. Bases were recorded for a period of five years, beginning in January 1973 and ending in December 1977.

Explanation of Variables: Steers

The values of the forward slaughter price variable were derived from the midpoint of the high-low price range of the fed cattle futures contract four months hence from the time the hedge was placed. These values served as a proxy for expected fed price for finished cattle. This information was obtained from the Chicago Mercantile Yearbook.

The futures price for fed cattle is an inexpensive and easily obtainable estimate of the expected fed price for slaughter cattle. Consequently many feedlot operators use these prices as an estimate of the price they can expect to receive when the cattle are finished. When the futures price rises this implies that finished cattle are worth more and the cattle that are in the feedlots are also worth more. The forward slaughter price variable is expected to vary directly with the basis. This variable was used in the explanatory model to measure future expectations.

The supply of fed cattle in a region has a large influence on the price that can be expected for those cattle. Two variables were used to estimate the supply of fed cattle in the Oklahoma region. The first variable was the capacity of feedlots in the surrounding states. The

values for this variable were derived by adding the marketings in Colorado, Kansas and Texas then dividing this value by the total placements in these states. These values were then lagged one month to obtain an estimate of cattle on feed relative to feedlot capacity for the previous month. These values were obtained from the Seven State Cattle on Feed Report.

As the unused capacity variable increases, it means that more marketings are occurring than placements, resulting in a larger than usual supply of fed cattle in the market. This would tend to decrease the price for fed cattle in this region and cause the basis to become larger. Therefore the feedlot capacity variable is expected to vary directly with the basis.

The proportional marketings variable was also used to estimate the supply of fed cattle. These values were found by dividing the total marketings in Colorado, Kansas and Texas by the total marketings in the seven state region. These values were also lagged one month to obtain the previous month's estimate. The information was obtained from the Seven State Cattle on Feed Report.

This variable also measures the amount of fed cattle that are being marketed in the Oklahoma region. As this variable increases it implies that proportionately more cattle are in the region, resulting in lower prices. As prices decrease the basis increases; therefore the proportional marketings variable is expected to vary directly with the basis.

Results of Models: Steers

The model that was built to explain the basis was derived by using ordinary least squares and it was assumed to be linear.

Explanatory Model

The model that explained the basis for the slaughter steers is as follows:

$$\underset{}{CSSB} = \underset{}{-10.31} + \underset{(-6.85)*}{.14\ FSP} + \underset{(7.81)*}{1.77\ D7MP9} + \underset{(6.62)*}{8.05\ MMST9} \quad \underset{(3.57)*}{}$$

where:

CSSB = choice slaughter steer basis

FSP = forward slaughter price

D7MP9 = previous month's feedlot capacity

MMST9 = previous month's proportional marketings

The t values of the coefficients are in parentheses and the asterisk reveals which relationships are significant at the 1% level. All relationships possessed the expected sign and were highly significant at the 1% level. The F value was 34.68 which was also highly significant at the 1% level. The R^2 value was 20%, however the F value implies that the model is explaining a highly significant part of the variation. The standard deviation was 1.485 and the Durbin d statistic was .73. The Durbin d statistic implies that positive autocorrelation is prevalent during this time period.

Using ordinary least squares a model was developed to predict the basis for slaughter steers. The data were lagged four months so that all the necessary information would be available when the hedge was being considered.

The sign of the feedlot capacity variable would be expected to change as a result of the time lag that is involved. If the feedlot capacity variable increases the month before you are considering placing

a hedge, this implies that more marketings have occurred than placements. As a result of the low number of placements, the number of cattle that will be marketed four months in the future will be less than the usual number. Consequently the price for fed cattle should rise resulting in a smaller basis. Therefore the feedlot capacity variable is expected to vary inversely with the basis in the predicting model. The proportional marketings variable was deleted in the prediction model because of its lack of significance resulting from the lagged procedure. The forward slaughter variable is expected to possess the same sign.

Prediction Model

The model that predicted the basis for the slaughter steers is as follows:

$$CSSB_1 = \underset{(-.50)}{-.42} + \underset{(3.92)*}{.07\ FSP} - \underset{(-4.32)*}{1.24\ D7MP9}$$

where:

$CSSB_1$ = predicted choice slaughter steer basis

FSP = forward slaughter price

D7MP9 = previous month's feedlot capacity

The t values of the coefficients are in parentheses and the asterisk reveals which relationships are significant at the 1% level. Both of the relationships possessed the expected and were highly significant at the 1% level. The F value decreased from 34.68 to 16.61 and the R^2 value also decreased from 20% to 7%, however the model is explaining a significant part of the variation. The standard deviation increased slightly from 1.485 to 1.595. The Durbin d statistic decreased from .73 to .62 indicating the effect of positive autocorrelation has

increased slightly.

Explanation of Variables: Heifers

The variables used in this section are composed of the same variables in the steer section plus additional variables that are relevant only for heifers.

The forward slaughter price, feedlot capacity and proportional marketings variables were used in the steer section and the heifer section. The signs of each are expected to be positive, the same as they were in the steer section.

The cost of feed variable is a new variable that was included for the heifer analysis. The values for this variable were derived by dividing the total feed cost that occurred at the Great Plains feedlots by 500 pounds, the expected additional weight the cattle gained, to obtain an estimate of the cost per pound gain. The information is published every other month in the Livestock and Meat Situation.

The feed conversion rate of heifers in the feedlot is less efficient than steers; consequently, they are sold at a discount compared to steers. As the cost of feed increases, the cost of feeding heifers compared to feeding steers also increases, resulting in the heifers being discounted more relative to steers. As the discount increases the basis will also increase. Therefore the cost of feed variable is expected to vary directly with the basis.

The proportional heifer on feed variable is the other new variable used only for the heifer analysis. The values for this variable were derived by dividing the number of heifers on feed by the total number on feed. The information was obtained from the Quarterly Cattle on Feed

Reports. Heifers are used for breeding or feeding purposes, and the ranchers and feedlot operators must bid against each other for these animals. If the prospects for profits in cow-calf operations are high, the rancher will bid the heifers away from the feedlot operator and start expanding his herd. If profit prospects are low, the rancher has no incentive to expand the size of his herd and therefore the feedlot operator will receive the heifers. This implies that if the proportional heifer on feed variable increases profit prospects are low and consequently the price for the heifers relative to steers has decreased. As heifer prices decrease the heifer basis will increase. Therefore the proportional heifers on feed is expected to vary directly with the basis.

Results of Models: Heifers

Explanatory Model

The model that was built to explain the slaughter heifer basis was derived using ordinary least squares and was assumed to be linear. The model is as follows:

$$\underset{}{\text{CSHB}} = \underset{(-9.52)*}{-17.99} + \underset{(6.45)*}{.13\ \text{FSP}} + \underset{(4.28)*}{7.40\ \text{COF}} + \underset{(2.48)**}{9.89\ \text{HOF}} + \underset{(6.02)*}{1.97\ \text{D7MP9}} + \underset{(3.75)*}{13.57\ \text{MMST9}}$$

where:

CSHB = choice slaughter heifer basis

FSP = forward slaughter price

COF = cost per pound of gain

HOF = proportional heifer on feed

D7MP9 = previous month's feedlot capacity

MMST9 = previous month's proportional marketings

The t values of the coefficients are in parentheses and the single and double asterisk reveals which relationships are significant at the 1% and 5% level respectively. All of the relationships in the equation possessed the expected sign. The proportional heifer on feed variable was significant at the 5% level whereas the remaining variables were significant at the 1% level. The R^2 was 23% and the F value was 23.77, which is significant at the 1% level. These values indicate that a significant part of the variation is being explained by the model. Positive autocorrelation is prevalent as indicated by the Durbin d statistic of .93. The standard deviation was 1.542.

Prediction Model

Using ordinary least squares a model was derived to predict the basis for slaughter heifers. All of the data were lagged four months so that the necessary data would be available when the hedge was being considered.

The sign associated with the feedlot capacity variable is expected to change as a result of the analysis that was presented in the steer section. The proportional marketings variable was deleted from the prediction model for the same reasons given in the steer analysis. The remaining variables are expected to possess the same sign as they had in the explanatory model. The prediction model is as follows:

$$\underset{}{CSHB_1} = \underset{(-.87)}{-1.39} + \underset{(1.30)}{.03\ FSP} + \underset{(1.96)^{**}}{2.74\ COF} + \underset{(2.55)^{**}}{8.32\ HOF} - \underset{(-3.69)^{*}}{1.23\ D7MP9}$$

where:

$CSHB_1$ = predicted choice slaughter heifer basis

FSP = forward slaughter price

COF = cost per pound of gain

HOF = proportional heifer on feed

D7MP9 = previous month's feedlot capacity

The t values of the coefficients are in parentheses and the single and double asterisk reveals which relationships are significant at the 1% and 5% level respectively. All of the relationships possessed the expected signs. The feedlot capacity and proportional heifer on feed variables were significant at the 1% level whereas the cost of gain variable was significant at the 5% level. The forward slaughter price was not significant, this could be the result of some multicollinearity occurring in the model. The R^2 for this model was 12% which was lower than the explanatory model's R^2 value of 23%. The F value decreased from 23.77 to 13.01, however this value is still significant at the 1% level. The standard deviation increased slightly from 1.542 to 1.653. The effect of positive autocorrelation increased resulting in the Durbin d statistic decreasing from .93 to .75.

The statistical data for the slaughter models are given in Tables X and XI in the Appendix.

CHAPTER IV

SUMMARY AND CONCLUSIONS

During the last eight years the volatility of agricultural product prices have increased dramatically. These highly variable prices coupled with increasing production costs have resulted in small or often negative profit margins for producers. When prices are volatile, an untimely marketing decision can have devastating effects on a producer's operation. These circumstances have emphasized the need for sound marketing strategies for agricultural producers in order for them to survive the current situation.

In the cattle industry producers can reduce their marketing risks by using the futures market to hedge their cattle. The forward pricing hedger is establishing a price for his cattle in advance of the time he will actually deliver them. This hedger is concerned with the estimate of his basis, for it is the basis that determines the result of the hedge. The more accurate the estimate, the more certain he is of the price he will receive, and thus the less market risk he must assume.

The most common method of estimating one's basis is the historical price relationship procedure. This procedure gives the producer an estimate of the basis based on an average of previous year's price relationships. This study was conducted in an effort to devise a method to obtain more accurate basis estimates, thus further reducing the producer's marketing risks.

The method used in this study was ordinary least squares regression. This method has a distinct advantage over the historical average price relationship procedure. In the typical estimation procedure the basis estimates are based on averages of past bases, and if the variables that have influenced the basis in the past are not exerting their average influence currently, greater basis error will result. Using the regression technique allows a producer to know the relevant variables that are influencing the basis and to be able to use current and relevant data to adjust the basis so that it is relevant to the period in which the hedge will be placed. By knowing the significant variables and their influence, more accurate estimate of the basis will be available.

The objectives of this study were to identify the variables that had a significant influence on the basis and build models that would be able to explain and predict that basis. The variables that were used in the models were almost all highly significant at the 1% level and possessed the expected sign. The models that were built had F values that were also highly significant at the 1% level. These figures indicate that a significant part of the variation is being explained.

There were two models that were developed in this analysis; a prediction model and an explanatory model. The explanatory model was used to determine which variables had a significant influence on the basis during the delivery months. After these relationships were found they were lagged four months, the length of time that a hedge would be placed, and a model to predict the basis was built. This model gives the hedger a better estimate of what the basis will be during the

delivery month and helps the hedger to make a more intelligent decision about placing a hedge. When the delivery month has been reached the explanatory model can be used to estimate what the the basis most likely will be during that month. The hedger can compare the actual basis with the estimated basis and decide whether to hold the cattle longer or to complete the hedge.

As a result of previous studies, the data for feeder cattle were divided into three parts; fall delivery months, spring delivery months and other nondelivery months. A model was built to explain the basis during the delivery month and also to predict the basis for the delivery month. The group of feeder cattle consisted of feeder steers, 400-500 pounds and 600-700 pounds, and feeder heifers which weighed between 500-600 pounds.

Variables: Feeder Cattle

Variables: 400-500 Lb Steers

The lighter feeder steers, 400-500 pounds, had several variables that were highly significant. The lagged cash price was significant in all three parts of the data for the explanatory model. The prediction model used the forward slaughter price variable instead of the cash price, and it was significant in all three parts of the data. Both of these variables had an inverse relationship with the basis. This resulted from the fact that increases in expected slaughter prices increase prices for light feeders more than for heavier cattle.

The cost of feed variable was significant in the explanatory and prediction models. The relationship between this variable and the basis was positive in every instance except the spring months for the

explanatory model. As the cost of feed increases, the amount that a cattle feeder can pay for input feeder cattle decreases; this decrease is proportionately more for lighter cattle. The inconsistency during the spring may have resulted from the large increase in demand for feeder cattle for summer grazing.

There were other variables that were significant in the explanatory and prediction models. The proportional cattle inventory variable had an inverse relationship with the basis. This variable estimates the supply of feeder cattle in Oklahoma and as supplies increase the price will typically decrease which increases the basis. The July wheat futures and wheat pasture demand variables were directly related to the basis. As July wheat futures increases, cattle are removed from wheat pasture in the late winter, this action results in decreased supplies available for summer grazing and prices tend to increase during the spring months. The wheat pasture demand variable estimates the demand for feeder cattle as additional wheat pasture is available for grazing; as wheat pasture increases the demand for feeder cattle increases, resulting in higher prices.

Variables: 600-700 Lb Steers

These data for the heavier steers, 600-700 pounds, were not divided into three parts and a prediction and explanatory model was built for the entire data set. The forward slaughter price variable was significant and positively related to the basis in the explanatory and prediction models. When the expected fed price increases, it results in the feeder futures and cash price to increase; however, the futures price will increase proportionately more than the cash price, causing the

basis to increase. The cost of feed variable was significant and inversely related to the basis in the explanatory and prediction models. As the cost of feed increases the price for lighter steers decrease proportionately more than the heavier steers resulting in a smaller basis. The proportional cattle on feed variable was significant and positively related to the basis in both models. This variable estimates the available supply in Oklahoma and as supplies increase the price will decrease, resulting in a larger basis.

Variables: 500-600 Lb Heifers

These data for the heifers, 500-600 pounds, were analyzed by using the same procedure as was used for the lighter steers. The forward slaughter price variable was significant and positively related to the basis in the explanatory model. This resulted from the fact that heifers are discounted relative to steers and when the expected fed price increases the steer price increases proportionately more than the heifer price. The prediction model used the current heifer cash price which was significant but the relationship varied between months. This inconsistency could occur as a result of the cash price reflecting a long term price trend of a short term price movement.

There were numerous other variables that were significant in the models. The cost of feed variable was positively related to the basis. Since the feed efficiency of heifers is lower than steers, if cost of feed increases the cost of gain for heifers is greater than steers, resulting in the price for heifers decreasing more relative to steers. The wheat pasture demand variable had a positive relationship with the basis, indicating that as wheat pasture becomes available, steers are

preferred to heifers. The July wheat futures variable was inversely related to the basis, indicating that when supplies of feeder cattle are low, ranchers are willing to place heifers on summer pasture. The proportional cattle inventory variable had a positive influence on the basis. This was a result of increasing supplies forcing the price to decrease. The proportional cattle on feed variable can measure the supply or demand of feeder cattle and will possess either a negative or positive relationship respectively. The supply effect results when the supply of cattle in feedlots, resulting in high prices. The demand effect results when the supply is sufficient or more than sufficient to meet the demand for placing cattle in feedlots, thus reducing the demand for additional cattle.

Many of the variables that were used in the models were common to all three of the different types of cattle. In almost every instance the variables were highly significant and possessed the expected sign. It was observed that during different times of the year, some of the variables would have a different influence on the basis. The lagging procedure also caused some variables to reverse their influence on the basis. The models that were built for the spring months had a smaller deviation than the fall and other months. This implies that the basis varies less during this time period.

Variables: Slaughter Cattle

Variables: Choice Steers

The slaughter cattle that were analyzed consisted of two types of cattle; choice steers and choice heifers. A prediction and explanatory model was derived for each type.

The steer models consisted of three variables. The forward slaughter price variable was used in both models. It was significant and was positively related to the basis. This relationship was a result of the futures price changes influencing the cash price for those steers. The feedlot capacity variable was also used in both models. This variable was significant and was positively related to the basis in the explanatory model and negatively related in the prediction model. In the explanatory model, it estimates the supply of fed cattle in the market and if supplies increase the price decreases. In the prediction model the large supplies of the previous months indicate a smaller supply will be available when the hedge is completed. The proportional marketings was significant and positively related to the basis. This variable also measures the supply of fed cattle in the market and as supplies increase the price will typically decrease.

Variables: Choice Heifers

The heifers models were composed of the variables in the steer analysis plus additional variables that were relevant only to heifers. The forward slaughter price variable was significant and positively related to the basis. Since heifers are discounted to steers, an increase in the expected fed price will increase the price for steers proportionately more than for heifers. The cost of feed variable was significant and positively related to the basis. Since the feed efficiency of heifers relative to steers is less a change in cost of feed will influence the heifers more compared to the steers. The feedlot capacity and proportional marketing variables were significant in the models. These variables estimate the supply of fed cattle in the market

and as supplies increase it typically forces the price to decrease. The proportional heifer on feed variable was positively related to the basis. This variable estimates the profit prospects of cow-calf operators. As heifers on feed increase, it implies that the profit prospects for cow-calf operators are low, thus the price for heifers will be low.

Many of the variables were used in both the steer and heifer models. In almost every model they were highly significant at the 1% level and possessed the expected sign.

Conclusions

There are two types of participants in the futures market; hedgers and speculators. Most hedgers are only concerned with their basis estimates while the speculator has only one concern; the direction and magnitude of price movements. In an effort to determine price movements they employ both fundamental and technical analysis. The variables that affect the demand and supply conditions of commodities can be measured and incorporated into models. However, the factors affecting the technical analysis aspect are unmeasurable and therefore precluded from being included in model building. The psychology of the market and economy also affect the price movements in the futures market, as a result, the futures market possess a random effect.

The prices that are derived in the futures market are expected to prevail at a specific time in the future based on current information. This implies that the futures price is a function of cash price plus additional variables that explain the existing demand and supply conditions. In this analysis the dependent variable of each model was the basis, futures price minus cash price, which in reality is a residual

of the futures price relationship.

These two concepts imply that there may be a limit to the effectiveness of using models to explain or predict the basis. The variables used in this analysis measured the changing supply conditions. Since the hedge being considered was for a short period of time, the demand for the commodity was assumed constant. The models that were derived had highly significant F values, however the R^2 values were not exceedingly high. This implies that the variables were explaining a large part of the variation due to the changing supply conditions, but that the variation due to the random effect was quite large and was not being explained. The models that were developed in this analysis have lowered the variation of the non-deliverable cattle to the level of deliverable cattle.

In an effort to determine if basis error could be reduced by using basis models instead of basis averages, the standard deviations of both procedures were compared. The standard deviations are given in Table IV. The average procedure provided basis estimates for slaughter cattle and the heavier feeder steers during delivery and nondelivery months while the model procedure provided estimate for the combined months. In order to compare the two procedures, the average standard deviation of the delivery and nondelivery months was calculated and compared to the model procedure. The standard deviations for the average procedure are for delivery months and are therefore compared to the explanatory standard deviations of the model procedure. In every instance the model procedure provided standard deviations that were lower than those obtained by the average procedure. The standard deviations for the slaughter and heavier steers were lowered the least since the amount of

TABLE IV

COMPARISONS OF STANDARD DEVIATIONS OF
BASIS ESTIMATES

Average Std. Dev.	Exp.	Ave.	Model Std. Dev.	Exp.	Pred.
Slaughter Cattle			Slaughter Cattle		
Good and Choice Steers			Good and Choice Steers		
Delivery Months	1.16	1.61	All Months	1.48	1.59
Off Months	2.07				
Choice and Prime Heifers			Choice and Prime Heifers		
Delivery Months	1.36	2.49	All Months	1.54	1.65
Off Months	3.61				
Feeder Cattle			Feeder Cattle		
400-500 lb Steers			400-500 lb Steers		
Fall and Spring Months	3.40		Fall Months	2.04	2.49
Off Months	3.30		Spring Months	1.59	1.68
			Other Months	2.28	2.59
600-700 lb Steers			600-700 lb Steers		
Fall and Spring Months	1.32	1.71	All Months	1.47	1.55
Off Months	2.09				
500-600 lb Heifers			500-600 lb Heifers		
Fall and Spring Months	1.66		Fall Months	1.59	1.75
Off Months	2.70		Spring Months	1.15	1.21
			Other Months	1.74	1.90

Source: Ikerd, 1978.

explainable variation was smaller due to the fact that these cattle more nearly meet the specifications of deliverable cattle as stated in the futures contracts.

As a result of reducing the standard deviations, the standard deviation of the basis estimate will be smaller and the estimate will be more accurate. As an example, the two procedures may be compared at a 90% probability level, i.e., a 90% probability level means that there is a 90% chance that the cash price the producer will receive if the hedge is placed will be that estimated price or better, for the slaughter steers assuming a futures price of $50.00 per cwt. Using the average procedure the price that the futures is offering a producer is $46.46 (50 - 1.45 - 1.3 x 1.61 = 46.46), while with the model procedure the price is $46.63 (50 - 1.45 - 1.3 x 1.48 = $46.63). The procedure can also be compared for the light feeder steers assuming a price of $60.00. The cash price that is derived using the average procedure is $52.03, while the model procedure provides as estimate of $53.79. Since producers must calculate their costs of production in order to determine whether the futures market is offering them a profitable price, these price differences could result in a profitable hedge not being placed or a producer deciding not to produce. Consequently, producers can more accurately estimate the cash price that the futures market is offering them and therefore reduce the risks of making the wrong decision.

Suggestions for Further Research

There are related areas that additional research could prove to be beneficial. Hedging strategies need to be developed which incorporate the prediction and explanatory models. This analysis could also be

extended to different meat commodities.

The flow of cattle into the state of Oklahoma has a large influence on the basis in this area. Research needs to be done on where the cattle are shipped from and what conditions influence this rate of flow. The destination of cattle that are exported and the factors influencing these actions should also be studied.

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APPENDIX

STATISTICAL INFORMATION CONCERNING THE FEEDER AND SLAUGHTER CATTLE MODELS

TABLE V

RESULTS OF EXPLANATORY MODELS[a] FOR 400-500 LB. FEEDER STEERS[a]

Independent Variables	Fall Months	Spring Months	Other Months
FB			-1.52 (-5.71)*
SB			-1.18 (-4.28)*
B_o	-4.16 (-.85)	26.75 (6.23)*	12.42 (4.74)*
COF	27.73 (4.89)*	-10.51 (-3.32)*	6.22 (2.83)*
CFS433	-.16 (-5.20)*	-.27 (-13.80)*	-.18 (-14.00)*
PCI	-61.51 (-1.18)	-357.70 (-4.91)*	-158.13 (-3.95)*
WPD	.01 (3.27)*		
JWF		1.61 (5.91)*	
STD. DEV.	2.045	1.591	2.286
R^2	.71	.71	.54
F Value	83.52*	69.51*	102.37*
Durbin Watson d	.51	.90	.35

[a] t values in parenthesis.

*Significant at 1% level.

TABLE VI

RESULTS OF PREDICTION MODELS[a] FOR 400-500 LB. FEEDER STEERS

Independent Variables	Fall Months	Spring Months	Other Months
FB			-1.83 (-6.23)*
SB			-1.17 (-3.79)*
B_o	22.54 (4.22)*	2.25 (.29)	16.77 (4.61)*
FSP	-.16 (-3.02)*	-.42 (-6.42)*	-.22 (-7.56)*
COF	31.34 (10.87)*	3.89 (1.07)	16.05 (9.65)*
PCI	-569.29 (-5.24)*	23.33 (.25)	-275.19 (-5.52)*
JWF		2.88 (8.86)*	
STD. DEV.	2.493	1.687	2.591
R^2	.57	.67	.41
F Value	59.80*	58.66*	60.75*
Durbin Watson d	.38	.81	.28

[a] t values in parenthesis.

*Significant at 1% level.

TABLE VII

RESULTS OF EXPLANATORY AND PREDICTION MODELS FOR 600-700 LB. FEEDER STEERS[a]

Independent Variables	Explanatory Model	Predicting Model
SB	-.14 (-.81)	-.33 (-1.64)
FB	-1.13 (-6.14)*	-.89 (-4.99)*
B_o	-8.27 (-3.08)*	-6.28 (-2.14)**
FSP	.11 (6.36)*	.07 (4.50)*
COF	-12.01 (-9.54)*	-9.39 (-8.37)*
CKTF8	20.94 (3.92)*	17.44 (2.81)*
STD. DEV.	1.467	1.55
R^2	.32	.24
F Value	40.16*	26.83*
Durbin Watson d	.62	.60

[a] t values in parenthesis.

*Significant at 1% level.

**Significant at 5% level.

TABLE VIII

RESULTS OF EXPLANATORY MODELS[a] FOR 500-600 LB. FEEDER HEIFERS

Independent Variables	Fall Months	Spring Months	Other Months
FB			-1.95 (-8.87)*
SB			-.22 (-1.07)
B_o	-35.61 (-5.68)*	-3.93 (-1.32)	-19.89 (-6.21)*
FSP	.23 (6.03)*	.05 (1.45)	.14 (7.16)*
COF	2.92 (.98)		-7.29 (-4.86)*
CKTF8	59.92 (6.43)*		48.96 (7.69)*
WPD	.01 (3.09)*		
JWF		-1.16 (-7.10)*	
PCI		223.97 (4.28)*	
STD. DEV.	1.592	1.158	1.747
R^2	.30	.44	.24
F Value	14.55*	29.62*	27.48*
Durbin Watson d	.86	1.40	.55

[a] t values in parenthesis.

*Significant at 1% level.

TABLE IX

RESULTS OF PREDICTION MODELS FOR 500-600 LB. FEEDER HEIFERS[a]

Independent Variables	Fall Months	Spring Months	Other Months
FB			-1.07 (-4.83)*
SB			-.83 (-3.35)*
B_o	56.00 (4.80)*	-.32 (-.10)	-2.97 (-.89)
CFH5	.11 (3.70)*	-.07 (-4.51)*	-.01 (-.91)
COF	25.15 (4.56)*		-5.96 (-3.41)*
CKTF8	-134.15 (-4.54)*		26.42 (3.44)*
PCI		193.85 (3.89)*	
JWF		-.34 (-1.70)	
STD. DEV.	1.756	1.219	1.900
R^2	.14	.38	.10
F Value	7.56	23.07	9.87
Durbin Watson d	.91	1.33	.50

[a] t values in parenthesis.

*Significant at 1% level.

TABLE X

RESULTS OF EXPLANATORY AND PREDICTION MODELS FOR CHOICE SLAUGHTER STEERS[a]

Independent Variables	Explanatory Model	Predicting Model
B_o	-10.31 (-6.85)*	-.42 (-.50)
FSP	.14 (7.81)*	.07 (3.92)*
D7MP9	1.77 (6.62)*	-1.24 (-4.32)*
MMST9	8.05 (3.57)*	
STD. DEV.	1.485	1.595
R^2	.20	.07
F Value	34.68*	16.61*
Durbin Watson d	.73	.62

[a] t values in parenthesis.

*Significant at 1% level.

TABLE XI

RESULTS OF EXPLANATORY AND PREDICTION MODELS FOR CHOICE SLAUGHTER HEIFERS

Independent Variables	Explanatory Model	Predicting Model
B_o	-17.99 (-9.52)*	-1.39 (-.87)
FSP	.13 (6.45)*	.03 (1.30)
COF	7.40 (4.28)*	2.74 (1.96)**
HOF	9.89 (2.48)**	8.32 (2.55)**
D7MP9	1.97 (6.02)*	-1.23 (-3.69)*
MMST9	13.57 (3.75)*	
STD. DEV.	1.542	1.653
R^2	.23	.12
F Value	23.77*	13.01*
Durbin Watson d	.93	.75

[a]t values in parenthesis.

*Significant at 1% level.

**Significant at 5% level.

VITA - 2

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