THE UNIVERSITY OF MANITOBA

AN ANALYSIS OF
CANADIAN FED CATTLE BASIS

by

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A THESIS

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ABSTRACT

This study analyzes cash, futures and basis for the live cattle futures and slaughter cattle prices for Manitoba, Omaha and Alberta. Futures and hedging efficiency and hedging ratios are analyzed. The results find similar mean basis series for the Omaha and Canadian markets, other than a slightly increased basis in the Canadian markets attributed to extra transportation and delivery costs. Mean cash prices have insignificant differences between markets, however, variances are different between markets. Hedging ratios are found to be slightly lower for the Canadian markets. When analyzing the basis standard deviations compared to the Canadian cash price deviations, efficient hedging opportunities are lower than using an R^2 measure of analyzing hedging efficiency. This is attributable to exchange rate effects, which increased the Canadian cash price variance.

Therefore, while studies may find the performance of the futures market similar in both the U.S. and Canadian markets, the exchange rate reduces efficiency of the Canadian hedge by increasing cash variance. Hedging in the Canadian market is most risk reducing during periods of lower slaughter of Canadian cattle, unfortunately, these periods also typically exhibit the highest cattle prices (such as 1987). Futures prices are found to exhibit more downward bias than cash prices.

To my family

CHAPTER I

INTRODUCTION AND BACKGROUND

1.1 Agricultural risk and uncertainty

Agricultural production is characterized by uncertainty and risks. There is uncertainty in estimating input prices, weather, death and disease loss. In addition, prices in agricultural markets are uncertain. Agricultural markets are worldwide and uncertainties relating to trade agreements such as the General Agreement on Tariffs and Trade (GATT), exchange rates, surpluses, subsidies and embargoes all affect the product price. Seasonality of production and prices as well as perishability also increase risk to the producer.

In the grains and oilseeds industries these risks are often managed differently than the livestock industries. Grains and oilseeds are storable and in some cases may be withheld from the market until the price improves. Livestock are subject to substantial reductions in quality (i.e. gain fat) over time while increasing costs due to a longer feeding period.

1.2 Feedlot industry risk

The fed beef industry faces risks from many sources. Variability in beef prices, input costs, weather, cost of

credit and herd health are rated highly by ranchers as sources of risk in production of beef cattle (Walker and Mapp, 1984). Part of the variability in beef prices is due to the cyclical nature of production. Another aspect affecting beef prices is the export price. If local supplies are exported to another market such as the U.S., then a decreased supply can increase the price of cattle locally. In addition, local production is typically greater than local demand, therefore the excess supply must be exported (not necessarily to the U.S). If cattle prices are low in the importing area, the export price will need to be low to clear the market. In 1989, Western Canada exported approximately $78,537,000 of beef, $5,524,000 worth of Purebred cattle and $247,288,000 of other cattle to the U.S. (Alberta Agriculture, 1989 Exports). These transactions involve the risk of exchange rates, transportation costs, grade differences and acceptance in the U.S. While the value of beef exported is currently a small percentage of total Western Canadian cattle sales, these transactions indicate the potential for and actual delivery of cattle into the U.S. This potential depends primarily on the price of slaughter cattle and the exchange rate.

Feedlot producers have variable costs including purchasing cattle, feed, veterinary supplies, fuel, and transportation in addition to interest expenses. These costs fluctuate and increase risk to the operator. Cattle are subject to variable weight gains due to breed and individual

differences. In addition, heat or cold stress may occur and reduce feed intake. Dampness also can aid the spread of diseases, weakening the cattle and reducing gain. Bauer, Mumey and Coles (1989) quantified these risks in a simulation model analyzing risk and return of beef feedlots in the context of investments. These authors found market price risk to be the major source of risk in cattle feeding. Most production associated risks have been minimized through extensive facilities and veterinary maintenance programs. However, marketing risks, including the uncertainty of the fed cattle final price, exchange and interest rates require different types of solutions. Producers have some options available which reduce the risk of the final price of their production. Hedging in a futures market is one of the options used to minimize price risk.

1.3 Management of risk

An integral function of the feedlot operator is his or her management of risk. As Robison and Barry (1987) suggest, risk provides an additional cost to the firm. Assuming the operator is risk averse, in order to consider alternatives which involve risk, compensation is needed above the level of return which would be required by a risk less alternative. This difference in compensation between a risk-free and a risky alternative is called a risk premium. Once variance of returns is introduced into the manager's objective of maximizing revenue, the manager is actually maximizing a

certainty equivalent of the revenue which can be expected from an activity while taking into consideration the variability of returns and/or chance for a loss (Robison and Barry, 1987).

The operator may attempt to maximize returns through several means. The decision will involve choosing between the possibly higher returns of a risky alternative as opposed to the lower returns of a known-return alternative. The producer may try to set up a marketing-feeding regime where the cattle from lots are sold at differing times in the cash market in an attempt to average the slaughter cattle price over lots. However, this method will not insure the manager from the risk associated with a long-term downward trend or constantly low prices which do not cover costs. The producer may use only the cash market in order benefit from possible price increases, or he may lock in a lower return through a hedge or futures contract.

Non-agricultural industries will typically reduce production if the output price for their product is too low. However, once cattle are in the feedlot, it would rarely be economical to take them off the feed and/or sell them at lighter slaughter weights (Purcell, 1979). The manager may keep them on feed longer. However, due to the costs of keeping the cattle fed and the potential quality discount mentioned earlier, this option is also limited.

Some primary industries, using raw materials, such as agriculture also have an option of using futures markets to

"insure" the price they will receive on their production or will pay for their inputs. This method of managing risk is called hedging.

1.3.1 Hedging as a vehicle for risk management

One method of managing risk is to transfer the risk to others who are willing or able to bear it (Walter, 1984). Commodity futures markets provide a vehicle for producers to shift some of their price risk to speculators through hedging. Hedging is used extensively by U.S. feedlot operators in protecting their slaughter cattle prices. This risk reducing tool is not widely used by their Canadian counterparts. Carter and Loyns (1983) propose that this lack of involvement in the U.S. futures market by Canadian feedlot operators may be due to a lack of understanding in the use of hedging in managing feedlot cattle price risk. Ambiguous results of Canadian studies in this area may also contribute to the lack of interest in hedging (Carter and Loyns; Caldwell, Copeland and Hawkins; Gillis; Novak, Mumey and Unterschultz; Novak and Unterschultz). In addition, the theory behind hedging nonstorable commodities and those which change form over the hedging period is not well developed (Garcia, Leuthold and Sarhan, 1984). Although Naik and Leuthold (1988) have linked feeder and live cattle futures through corn prices, the theory for explaining price trends over live cattle futures still needs to be developed. Furthermore, basis risk may make hedging an inefficient means for Canadian feedlot managers to

reduce price risk. Basis risk has not been thoroughly studied in the Canadian context.

1.3.2 Futures market and hedging efficiency

In addition to the lack of basis analysis and inconsistent hedging results of studies, producers may be reluctant to hedge due to concerns of futures market and hedging efficiency. Price performance of livestock futures markets has been the emphasis of a great deal of research. However, results from these attempts on measuring efficiency and performance are conflicting. Ranges of response to the question of efficiency of these markets have been from extremely efficient (Kolb and Gay, 1983); to concern of them having the potential for misleading decision makers in production decisions; to either enhancing or adversely affecting the cash market (Helmuth, 1981). Some studies hold that futures markets are not only superior to cash markets in predicting futures spot prices, but are also more accurate than many econometric models used by consulting firms in the short run (Just and Rausser, 1981). Others believe live cattle futures markets to be only spuriously correlated to cash cattle prices particularly in long run forecasts where long run is defined as any period greater than six weeks (Bigman, Goldfarb and Schechtman, 1983).

Canadian producers need to know whether the use of the U.S. livestock futures markets will provide efficient hedging and cash price forecasting for their production.

1.4 Basis risk

Traditionally, hedging trades off price risk for basis risk. The basis is the futures price minus the cash price. Basis can be identified by time and location (e.g. December 17, 1987 Winnipeg basis) (Gillis, 1986). Basis risk in this study refers to the level and variance of the basis. The level of the basis can become a risk due to a narrowing or widening of the basis which may be detrimental to the producer. A narrowing of the basis (i.e. the difference between the futures and cash price becomes smaller) is beneficial to the feedlot producer if short hedged (i.e. sold a futures contract). Conversely, a widening of the basis creates a loss of the short hedger (Carter and Loyns, 1983). If the reason for hedging is to reduce variability this movement reduces it's effectiveness.

The basis will be affected by any factor which alters cash and or futures prices with different magnitudes at a particular point in time. The basis level is especially important at the time of expiration of the futures contract. It is at this time when the producer must close out his positions and the level of the basis will determine how much of his cash price risk is covered by the futures position. Operators need to make hedging and forward contracting decisions based on the expected basis at the expiration of the futures contract as well as the hedge price. If feedlot managers intend to use futures markets, they should follow the

basis closely. This type of monitoring requires an understanding of the basis and information regarding the factors which affect it.

It is important for a producer to understand hedging, the basis, and basis risk for several reasons. Unpredictable movements in the basis can reduce the effectiveness of hedging. Basis information can also be used in sophisticated hedging strategies (as in speculative hedging) where "hedges" are placed and lifted in anticipation of basis change (Martin, 1983).

Previous research suggests that complex basis relationships reduce the price insurance function of hedging (Carter and Loyns, 1983; Thompson and Bond; Caldwell, Copeland and Hawkins; and Gillis). Canadian livestock hedging studies have hypothesized that Canadian cattle basis is more complex than in U.S. markets. Carter and Loyns (1985) found that feedlots are generally better off without using the Chicago futures market for hedging, if simple hedging strategies are used. Caldwell, Copeland and Hawkins (1982) believe basis behaviour is responsible for their own unsatisfactory hedging results. Martin (1983) and Gillis (1986) found specific forms of selective hedging strategies useful. However, Gillis noted, that there is difficulty in predicting the Calgary basis. In a further study, Gillis (1989) noted the high degree of managerial ability required to use the futures markets in hedging due to the complexity of the basis, the

exchange rate and the interest rate. He found that the Canadian dollar futures contract to be inefficient at covering exchange rate risks. Novak and Unterschultz (1990) found that exchange rate risks are a very small portion of the price risk for Canadian feedlot operators although Carter and Loyns (1983), Gillis (1989) and Caldwell, Copeland and Hawkins found it to be significant. Complexity of the basis implies greater risk in hedging Canadian cattle, making this alternative less attractive to producers.

The Canadian studies mention basis behaviour as affecting their hedging results, however, only Novak and Unterschultz examined basis risk. These authors found that basis risk is lower for 1985 to 1989 than the period 1976 to 1980. The authors identify basis risk as the variance measured through the mean square error. The basis level also affects the returns of a hedge therefore this aspect should also be examined. Most of the Canadian studies have focused on feedlot simulations and used historical basis levels to estimate basis. The emphasis of these studies is in analyzing what would have happened under various marketing scenarios including selected hedging strategies. In order to determine possible optimal hedging strategies for future use, it is first important to understand the basis and find hedging ratios which reflect the amount to be hedged as well as the efficiency of the hedge while taking into account exchange rate risks.

Producer knowledge of seasonal or cyclical patterns of basis changes will reduce risk in the use of live cattle futures contracts. Several days and sometimes weeks of flexibility exists in marketing so producers can use this information in timing their cash sales. Some trading months may have more variability in the basis or have a basis which tends to widen (narrow) in a manner which would be detrimental (beneficial) to the producer creating higher risk when compared to other months for lifting or placing a hedge. In this case a producer may hold the cattle slightly longer or shorter to use a less risky month. Naik and Leuthold (1988) mention this flexibility in marketing time when developing their theory of hedging nonstorable commodities.

If producers can use the futures market, hedging ratios are needed to help establish the level of production to be hedged and to check for hedging efficiency. This study intends to measure and analyze Canadian cattle basis risk for Manitoba and Alberta in comparison with Omaha, over the life of each live cattle futures contract. Structural differences between U.S. domestic and Western Canadian markets may exist which complicate the basis for Canadian feedlot operators. If this is not the case, Canadian feedlot operators may use the futures similarly to U.S. beef feeders. Then hedging effectiveness and ratios will be analyzed.

1.5 The problem

Hedging in the U.S. futures markets may be beneficial in reducing price risk for Western Canadian feedlot operators. These operators have received conflicting messages regarding the benefits of hedging their product on the U.S. futures live cattle market. Knowledge of futures efficiency, hedging effectiveness, basis behaviour and basis risk will provide the producer with improved information to select marketing options.

1.6 The objectives

This study has two objectives. The first objective of this study is to provide feedlot operators with information on live cattle futures prices, cash prices, and hedging basis among differing markets and over time. This information may be used to help determine whether to use hedging, through determining the complexity of the basis compared with U.S. markets and if hedging is to be used, which futures contract months have favourable basis relationships. The second objective is to provide producers with a hedging ratio and measurement of hedging efficiency using the Chicago Mercantile Exchange Live Cattle futures contracts.

CHAPTER II

THE RELATED STUDIES

2.1 General livestock futures research

Leuthold and Tomek (1979) provide a summary of the developments in livestock futures literature from 1965 to 1979. Included in the summary is Leuthold's analysis of U.S. cattle basis. Leuthold identified several important supply variables in explaining cattle basis. Included are slaughter, number of cattle on feed, prices of corn, feeder steers, fat cattle and seasonal shift variables. The model did not provide a good fit for the nearby basis, that is, a large component of unexplained variation remained in the basis closest to contract maturity.

Carter and Loyns (1983) promoted Canadian education in the use of futures markets as a farm management tool in Canada. The authors felt that the futures markets are not well understood as a risk managing alternative. Carter and Loyns (1985) tested traditional and selective hedging techniques and hypothesized that basis risk may have decreased the effectiveness of some of their hedging strategies. Gillis (1986), also studied hedging strategies for Canadian feedlot producers. He found some hedging techniques to be beneficial in increasing returns. Caldwell, Copeland and Hawkins,

however, in studying the same market as Gillis had little success in finding profitable hedging strategies.

Novak, Mumey and Unterschultz (1991) studied risk in the cattle feeding industry in Alberta and Omaha using deviations in net returns and found a one hundred per cent hedge as an effective risk management tool. They found the hedging ratio to be approximately sixty per cent of the cattle placed on feed to obtain a 100% hedge, that is, the futures market would hedge all the cattle on feed if contracts are taken out for sixty per cent of the cattle on the lot. However, this study only analyzed the nearby futures contracts in real rather than current dollars and did not incorporate exchange rate effects on the hedging ratio. These authors compared the Alberta and Omaha basis and found that the Alberta basis did not have significantly more variance for a three month period. The authors note that the test used is weak and should be used with caution. In addition, monthly prices and exchange rates are estimated using one day of the month, which may not have been representative of the entire month.

Most of the Canadian studies have focused on simulation models of feedlot enterprises and analyzed risks in a portfolio investment model (Gillis; Carter and Loyns, Novak and Unterschultz; Bauer, Mumey and Coles). This study does not attempt to simulate an average feedlot but measures the risk of hedging compared to cash price risk.

2.2 Futures market efficiency

As mentioned in Chapter one, futures market efficiency has been extensively studied (Hudson, 1987). These studies focus on the efficiency of the futures market in providing a price discovery role or in forecasting cash prices. While these roles are not identical they are closely related. Hudson indicates the degree of diversity of results of these studies and states that such diverse findings are due to the results being dependent on the commodities, time periods, and data being studied as well as the research method used.

Leuthold (1974) in a study using a mean square error (MSE) measure of evaluating price forecasting performance found a substantial decrease in the performance of live cattle futures markets for periods of 15 months or longer before delivery. Leuthold suggested that cattle feeders and producers should use the cash market rather than the futures market to make appropriate production decisions. He also states there is little evidence to believe that feedlot operators used the futures markets when making decisions to buy feeder stock. However, Leuthold and Taylor (1977), analyzed the potential influence of live cattle futures trading on spot cattle market price variations. They hypothesized that producers in the cattle feeding market may enhance their decision-making by understanding the futures-cash price spreads (i.e. basis).

Price, et. al. (1979) also studied the effect of futures markets on cash markets and found that the variance of the cash market declined after introduction of the futures market on a weekly and monthly basis. Tomek (1979), however, found that the existence of futures trading did not have a measurable effect on the variation of cattle prices.

Martin and Garcia (1981) tested the price performance of the live cattle beef futures market and found that while futures provided unbiased forecasts of eventual cash prices in the periods studied, they did not explain the movements in the cash price series well. The authors conclude that the live cattle market did not perform the price forecasting function well, but argue that the livestock futures markets act as agencies for rational price formation because they can enhance income stability through hedging strategies.

The question of biased pricing mechanisms has been addressed in live cattle futures markets with varied results. Garcia, Leuthold, and Sarhan (1984), in a study employing the variate difference method concluded that cattle basis in several Midwest markets exhibited unsystematic, or random, fluctuations. The authors propose that the results suggest that producers and market participants who hedge should discern where current prices are relative to their long-term pattern. In addition, they propose that such information could permit identification of periods of high basis risk by futures contract and lead to appropriate marketing strategies.

Helmuth (1981) found a systematic downward bias in live cattle futures. He asserts that such a bias means that the live cattle futures market is not fulfilling its economic hedging purpose. Kolb and Gay (1983) differ with Helmuth's methodology and propose an aggregated method of analysis which did not discover any bias. Koppenhaver (1983) states that if a bias is found in forward prices, market efficiency may still occur. If a bias is known, constant, or varies systematically, it can be used to create accurate price expectations. Further, the bias is suggested as providing a risk premium to attract speculators into the market.

Just and Rausser (1981) compared various futures market's price forecasting accuracy with the accuracy of large-scale econometric models of commercial forecasting firms. The live cattle futures contract price forecasts are ranked second after Chase Co. forecasts in the one month time horizon. Performance of the futures contract dropped drastically after the first forecast horizon (one month) and most of the econometric models are better predictors of futures spot price in the medium to long run.

Oellerman and Farris (1985) focused on whether the futures market is the centre of price discovery and found that the most obvious causality flowed from the futures to the cash market when compared to casual flows from the cash to the futures market, and that information incorporated into the futures market is integrated into the cash market within one

day.

Purcell, Flood, and Plaxico (1980) found a bidirectional feedback relationship between daily cash and future prices. These studies imply that the futures market is the centre of price discovery according to Hudson (1987). Hudson asserts that futures markets are important in the price discovery process however, a complex interrelationship exists between cash, futures, carcass and boxed beef prices. Further he states that information flows quickly and is assimilated rapidly between these markets. He believes that the focus for research should be shifted from futures market efficiency and how futures reflect information to concentrating on the adequacy of the information available.

Kolb (1985) states that futures markets are at least weak-form efficient, meaning that futures adequately reflect all historic price and market information. Since it is difficult to make super normal profits in the futures markets he also believes that futures may be semi-strongly efficient, reflecting publicly available information. Super normal profits are assumed to be very difficult to achieve using publicly available information.

2.3 Hedging efficiency and hedging ratios

Hedging efficiency is measured as the decrease in cash price variation due to hedging. This is typically measured through the use of the correlation coefficient of a standard bivariate regression model. The hedging ratio will be

explained in Chapter III. Several recent studies have focused on the measurement of hedging effectiveness.

Lindahl (1989), defines hedging effectiveness as the ability of a futures position to reduce the variance of the cash position. The R^2 statistic measures the percent reduction in the unhedged portion or cash market variance. She states that R^2 statistics may only be compared in the case where different futures market correlations are measured against the same cash market, unless price level models are used.

Witt, Schroeder and Hayenga (1987) compared different models of the hedging ratio. Models using price levels, price differences and percentage change are tested. They found that one should use a price difference model if high autocorrelation is found in the price level model. They also categorized hedges into storage and anticipatory hedges. The storage hedge is one where the commodity is held in its futures contract form at the time the hedge is placed. The storage hedger has a position in both markets simultaneously while hedging. The anticipatory hedge is one where the hedger "anticipates" having the commodity available at a later date. An example would be the case of a feedlot operator anticipating his feeder cattle to become slaughter cattle over the life of the contract. These hedges are to perform different functions. The hedger with an anticipatory hedge is concerned with the variance of the hedge because there is no

cash position. This is the type of hedge a feedlot operator would be making using a live cattle futures contract to cover their feeder cattle. A price level methodology is appropriate for this type of a hedge and the hedge ratio is the regression coefficient of cash price levels regressed on futures levels during the period when the hedger would be transferring his futures position to a cash position.

Herbst, Kare and Caples (1989) discuss the difficulties of autocorrelated errors in determining the hedging effectiveness in the financial futures market. They compared the hedging ratios generated through the use of OLS regression techniques with a Box-Jenkins autoregressive integrated moving average model (ARIMA). The hedging ratios decreased significantly in the ARIMA model. This is proposed to be due to high levels of autocorrelation which are evident in the Durbin Watson statistics of the original OLS price level model.

Myers and Thompson (1989) developed a generalized optimal hedge ratio using price changes instead of price levels. These authors test price change models using storable commodity hedges where the hedger holds the cash commodity at the time the hedge is placed. They state that the decision of the hedger as to how much of his commodity to hedge is conditional upon the information available at the time the hedge is placed. Since the OLS method estimates the hedging ratio without using previous information, unlike the price

differences method, it is said to be unconditional. They prefer the price change model which incorporates conditional information between the lagged prices and the current prices of cash and futures markets.

CHAPTER III

THEORETICAL BACKGROUND

3.1 Firm behaviour under risk

Robison and Barry (1987), production theory under conditions of risk assumes that the firm competes in a market with imperfect information. The firm is assumed to be a price-taker and operates as a risk averse utility (profit) maximizer. The firm's intent is to maximize their expected utility of income with respect to the firm's operation costs. The simplest model which depicts this behaviour is as follows:

$$Max\ \mathrm{E}\ U(y) \qquad (1)$$

subject to:

$$y=pq-\sum_{i=1}^{n} p_i x_i - B - C(q) \qquad (2)$$

where

y = income

p = output price

p_i = input cost for x_i

x_i = input i

B = fixed costs

C = variable costs

q = $f(x_i,\ldots,x_n)$ = output

and where $x_i,\ldots x_n$ includes production and marketing costs. In the case where risk is not considered, taking the first derivative yields the optimum solution below:

$$U'(y)\,[p-C'(q)\,]=0 \qquad (3)$$

U'(y) is a positive constant (can be cancelled) leaving the typical solution of marginal cost equals marginal revenue as shown below:

$$p=C'(q) \qquad (4)$$

The second order condition is for C''(q) > 0. However, when risk is introduced into the model the first order condition is changed to the following expectation:

$$E\,\{U'(y)\,[p-C'(q)\,]\}=0 \qquad (5)$$

As explained by Robison and Barry, the expectation operator now evaluates the expression over the range of probability

density functions for continuous or discrete random variables. The random variables may represent output price and output quantity, as well as other shocks to the utility function.

Producers have some alternatives which may help control risks or help recover the costs of risks. Some of these tools are insurance policies, diversification of production, public or government support, and futures market hedging. These tools of risk management have different levels of efficiency and availability to managers. The futures market efficiency and hedging theory and efficiency are described below.

3.2 Futures market efficiency

Kolb (1988) defines market efficiency as the ability to fully reflect all information available. The degree of market efficiency is typically classified into three types; weak, semi-strong and strong form efficiency, following Fama (1970). Weak form efficient markets have the ability to reflect all historic information. Semi-strong efficient markets reflect all historic information as well as all publicly available information. Strongly efficient markets reflect all information of the weakly and semi-strong efficient markets, but also include reflection of private sources of information. Private sources would include company records, for example, which are not publicized. The futures market can be evaluated by its efficiency in reflecting information and expectations of future cash prices of commodities.

According to Kolb (1988) futures markets are at least weak form efficient because futures prices reflect historical prices and market information well. He asserts that futures may also be semi-strongly efficient because it is difficult to make super normal profits on public information, and it is difficult to make super normal profits on the futures market.

Futures markets are believed to perform a crucial role in the price discovery process of the commodities they trade in.

3.3 Hedging theory

The purpose of hedging is to reduce risk of cash price fluctuations and or to insure a future price to buy or sell a commodity. This is done by taking an opposite position in the futures market than that of the cash market. The principle is that if the cash market varies in a way which increases risk, the futures market will vary in the same direction and one market's loss will be compensated by an equal gain in the other. Table 1 illustrates a "classic" hedge of this type.

Table 1.--Classic hedge and basis change effects in a declining February futures market

Date	Action	Price in CND$	Pc-Pf Basis Change	Gain or Loss	Net Gain or loss
			Constant		
	Futures				
November	SELL	$73.00			
January	BUY	$72.20		$0.80	
	Cash				
November	BUY	$73.00			
January	SELL	$72.20	$0.00	($0.80)	$0.00
			Decreasing		
	Futures				
November	SELL	$73.00			
January	BUY	$72.20		$0.80	
	Cash				
November	BUY	$73.00			
January	SELL	$71.00	($1.20)	($2.00)	($1.20)
			Increasing		
	Futures				
November	SELL	$73.00			
January	BUY	$72.20		$0.80	
	Cash				
November	BUY	$73.00			
January	SELL	$74.00	$1.80	$1.00	$1.80

Pc=Cash Price, Pf=Futures Price

The operator may choose hedging as a tool to control the output price risk. When specifying hedging into the producers maximum utility model, another price function enters the Robison and Barry model; a futures market price for the proportion of the product which is hedged, equation 2 (page 21) then becomes:

$$y=(p+\epsilon)(q-h)+p_f h-C(q)-B \qquad (6)$$

where

y	=	income
$p+\varepsilon$	=	current street (cash, spot) price
ε	=	error term
q	=	output
h	=	output hedged
p_f	=	futures price
C	=	variable costs
B	=	fixed costs

with the assumptions

$$E(p+\varepsilon)=p, \qquad E(\varepsilon)=0$$

which are that the expected value of the error term is 0, and the expected value of the price is unbiased. This model incorporates some of the cost of risk in the error term which is assumed to be normally distributed with a mean of 0. This

model also assumes the producer knows with certainty the return from the futures market. However, since the producer does not know his returns with certainty, he or she maximizes a certainty equivalent (Robison and Barry) which balances the returns from a risk less alternative with potentially lower returns to that of a risky alternative with potentially higher returns. The higher returns of the risky alternative are required to provide incentive for the risk averse producer to engage in that activity. These higher returns are called the risk premium. The decision model is as follows:

$$\begin{aligned} &Max\ Y_{ce} = p_c(q-h) + p_{fc}h - C(q) - B \\ &\qquad\qquad s.t. \\ &-\frac{\lambda}{2}\left[(q-h)^2\sigma_e^2 + h\sigma_\varphi^2 + 2(q-h)h\rho\sigma_\varphi\sigma_e\right] \\ &\qquad term1 \quad term2 \quad term3 \end{aligned} \tag{7}$$

where λ, is the producer's level of risk aversion determining how much risk premium is required to make him ambivalent between a risky choice and a certain choice, and $\lambda/2$ gives the trade off at equilibrium between the expected profit of an alternative and the profit variance (Robison and Barry).

term 1 = variance of the profits of the unhedged output.

term 2 = variance of the hedge output and

term 3 = correlation effect of the covariance of the basis and the error term with an expectation factor of 0.

In practice, however, there are several reasons why the change in the futures market will not exactly compensate for losses in the cash market.

3.2.1 Hedging efficiency and the basis

Hedging efficiency is measured by the ability of the futures market position to compensate for the cash market position. Futures markets are able to counter cash market movements when the price series vary similarly. This relationship is typically measured using a hedging ratio equation as follows:

$$P_c = \alpha + \beta P_f + \varepsilon \qquad (8)$$

where P_c = cash price of the commodity

α = intercept

β = beta coefficient

P_f = futures price of the commodity

ε = error term

The efficiency of the hedge is typically measured as its ability to chose the β which minimizes the variance of the combined futures and cash prices as follows (Kolb, 1988):

$$Min\ \sigma_p^2 = \sigma_c^2 + \beta^2\sigma_f^2 + 2\beta\sigma_f\sigma_c\rho_{f,c} \qquad (9)$$

where

σ_p^2 = variance of the cash and futures position,

σ^2_c = cash price variance,

σ^2_f = futures price variance,

β = number of futures units which correspond to one cash unit

$\rho_{f,c}$ = correlation of futures and cash prices.

To solve for the optimal variance minimizing hedge ratio the first derivative is taken of equation 9 with respect to β and setting equal to zero as follows:

$$\frac{d\sigma^2_p}{d\beta} = 2\beta\sigma^2_f + 2\sigma_f\sigma_c\rho_{f,c} = 0 \qquad (10)$$

then solve equation 10 for β which yields

$$\beta^* = -\frac{\sigma_c}{\sigma_f}\rho_{f,c} \qquad (11)$$

The negative sign is due to the cash and futures positions being opposite in their markets. That is when the cash position is to buy, the futures position is to sell. The R^2 gives the percentage reduction in the cash price due to the futures price hedge (Kolb, 1988) which is a measure of the hedging efficiency.

The ability of the futures price to compensate for cash fluctuations, or the hedging effectiveness may be affected by several factors. The futures price may be a related commodity when the actual commodity is not found on an exchange or when delivery requirements for the same commodity can not be met due to different quality and or characteristics. This situation is referred to as a cross-hedge. Typically, cross-hedges are not as efficient as regular hedges (Kolb, 1988). The degree of a cross hedge is determined by the homogeneity of the products involved. If a product is essentially the same commodity covered by the futures market the hedge is likely to be more efficient as quality characteristics will be similar and the potential for delivery through the futures markets may control the differences in the price series through arbitrage. Hedging efficiency can also be affected through exchange rates.

If hedgers are required to use a futures market in a different country, exchange rate fluctuations over the hedging period and at the time of expiration of the futures contract can affect the quality of the hedge (Braga, Gillis, Carter and Loyns, Thompson and Bond). Tables 2 and 3 show the effects of changes in the exchange rate on a hedge. In a rising futures market, the loss of $.96 per cwt in a stable exchange rate scenario is increased to a loss of $3.17 per cwt if the exchange rate appreciated (i.e. the Canadian dollar rose $.03 in relation to the U.S. dollar) over the hedging period.

Table 2.--Example of exchange rate effects on a short hedge in a rising February futures market in $/cwt

Date	Action	Cnd/US$ exchange rate	US$ futures price	CND$ futures price	Net gain or loss
		Constant			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.20	$73.80	$88.56	($0.96)
		Appreciating			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.23	$73.80	$90.77	($3.17)
		Depreciating			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.17	$73.80	$86.35	$1.25

Table 3.--Example of exchange rate effects on a short hedge in a declining February futures market

Date	Action	Cnd/US$ exchange rate	US$ futures price $/cwt	CND$ futures price $/cwt	Net gain or loss $/cwt
		Constant			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.20	$72.20	$86.64	$0.96
		Appreciating			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.23	$72.20	$88.81	($1.21)
		Depreciating			
November	SELL	$1.20	$73.00	$87.60	
January	BUY	$1.17	$72.20	$84.47	$3.13

Conversely, a depreciation of the Canadian dollar of the same level changed the loss into a gain of $1.25 per cwt. Therefore the net result of a $.03 change in the exchange rate translated into a $2.21 per cwt change in the returns from the hedged position. In a futures market where the price is declining (in U.S. dollars) the results are similar. The same change in the exchange rate of $.03 translated into a difference of $2.17 per cwt (see Table 3). Therefore, hedging effectiveness can be affected by the variance in the exchange rate as well as the variance of the futures market and cash prices. To test for the total effect of basis and exchange rate variance on the level of hedging effectiveness of this type of hedge, the cash price variance in the hedger's currency must be compared to the variance of the futures price and exchange rate.

Braga (March, 1989) addresses this factor by using an adjusted basis where the futures price and U.S. market basis is divided by the exchange rate and the Canadian local basis as follows:

$$P_{c\$,t} = FP_{us\$,t,T} + B_{us\$,t,T}/ER_{c\$,t} + B_{c\$,t} \qquad (12)$$

where

$P_{c\$,t}$ = Canadian cash price at time t in Canadian dollars

$FP_{us\$,t,T}$ = Futures price in U.S. dollars at time t for contract expiring at time T

$B_{us\$,t,T}$ = U.S. market basis in U.S. dollars at time t for contract expiring at time T

$ER_{c\$,t}$ = Exchange rate of Canadian per U.S. dollars at time t

$B_{c\$,t}$ = Local Canadian Basis in Canadian dollars at time t

Braga (March, 1989) notes that changes in the exchange rate will change the resultant Canadian cash price of the hedged commodity even if no basis change occurs. He found that a currency hedge position should be used when hedging is done in a foreign currency.

Other factors may also affect the basis and therefore hedging effectiveness such as seasonal, cyclical, regional and contract maturity factors. Seasonality of input factors such as feed inputs and release of new market information such as Cattle on Feed Reports may affect the basis. Beef prices tend to follow an approximate ten year cycle. These cycles are not harmonized completely between the U.S. and Canada (see Figures 1 to 6). The U.S. cycle appears to lag behind the Canadian cycle by 2 to 3 years. This may affect the futures-cash relationship and therefore the basis and hedging efficiency. Regional factors may include differences in feed costs or changes in local supply and demand.

These factors affect the basis and therefore the hedging effectiveness. Seasonality and regional factors of the basis will be examined in the first part of the analysis.

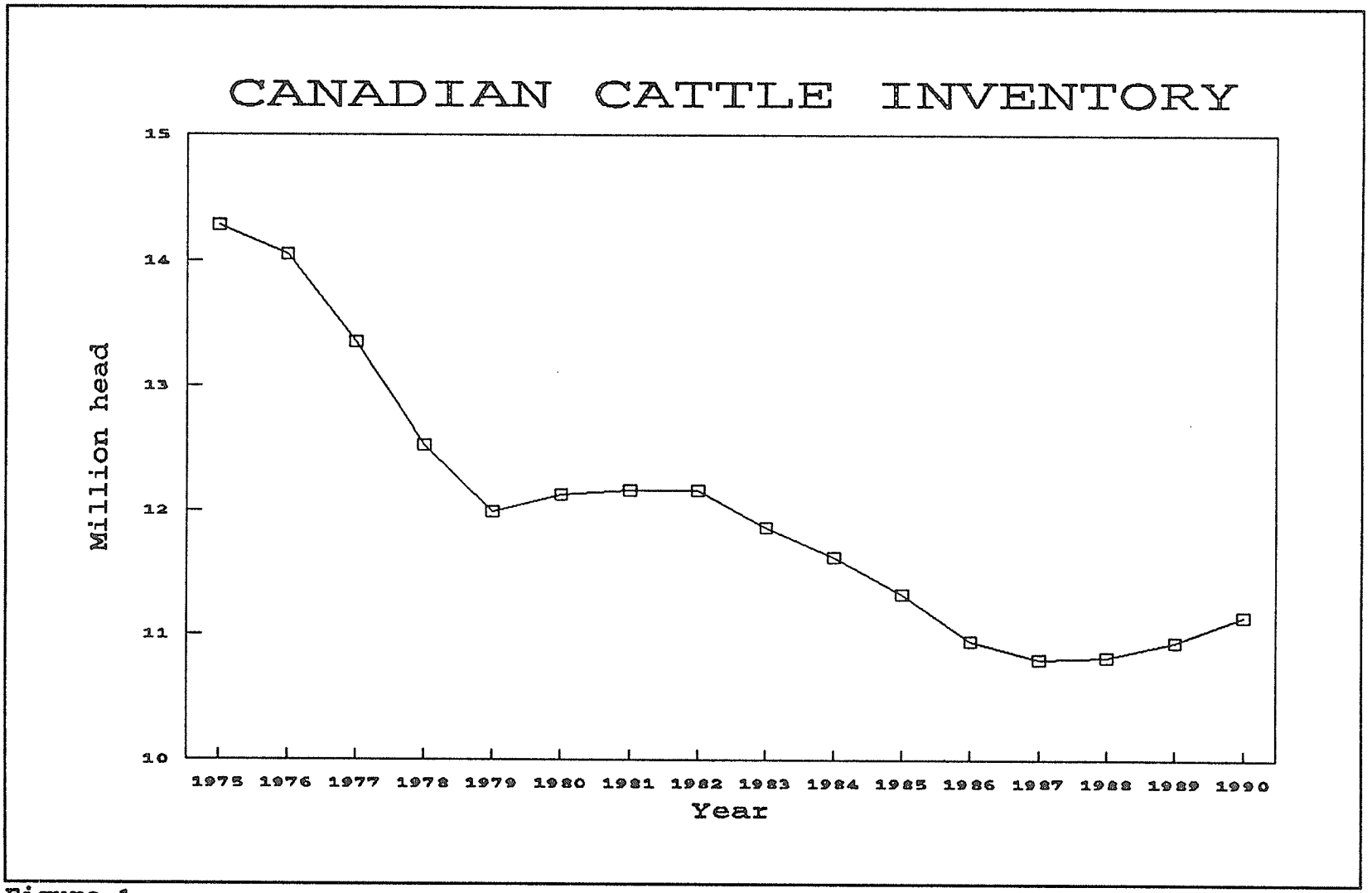
CANADIAN CATTLE INVENTORY
Million head
15
14
13
12
11
10
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

Figure 1.

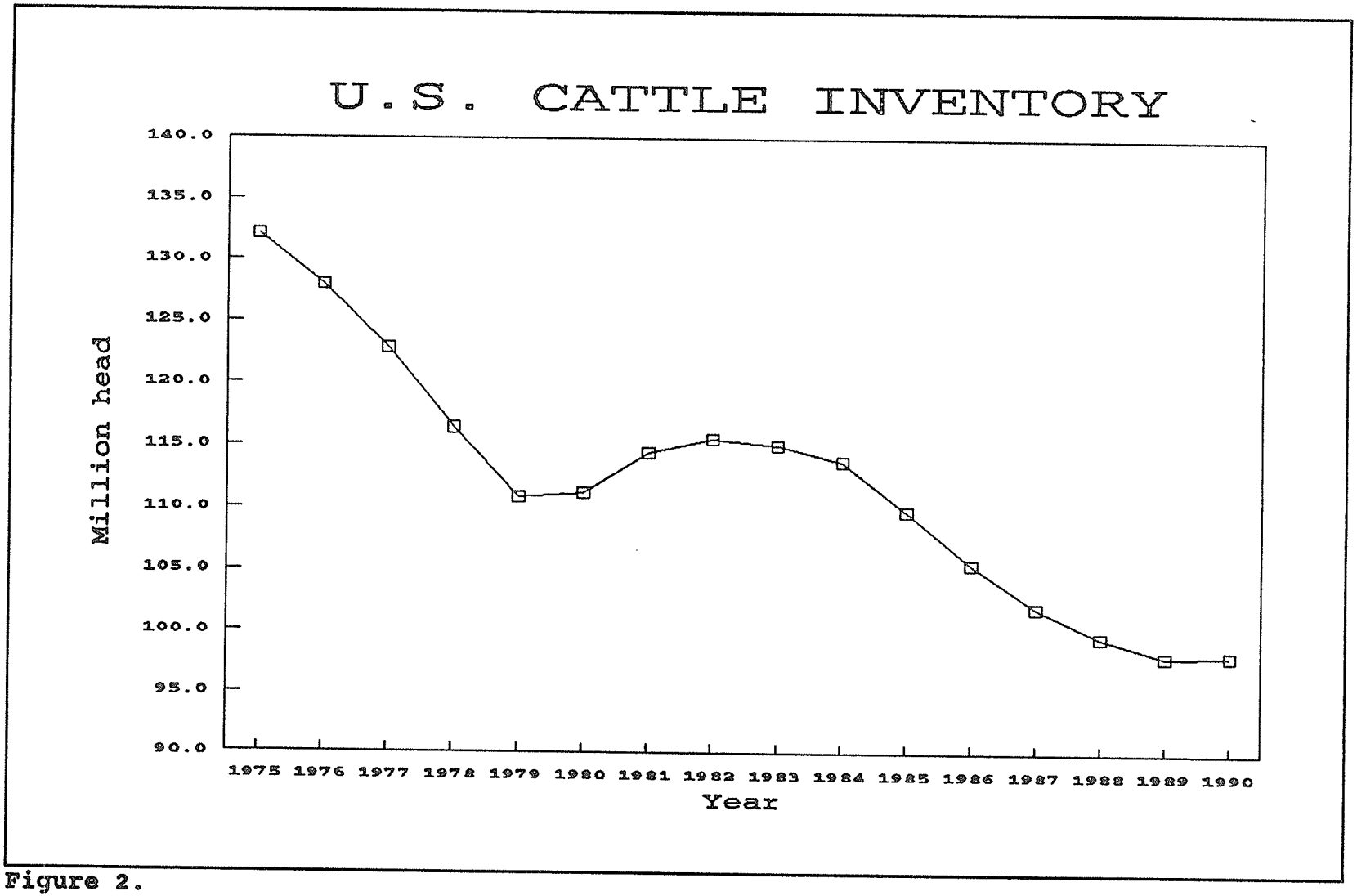
U.S. CATTLE INVENTORY
Million head
140.0
135.0
130.0
125.0
120.0
115.0
110.0
105.0
100.0
95.0
90.0
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

Figure 2.

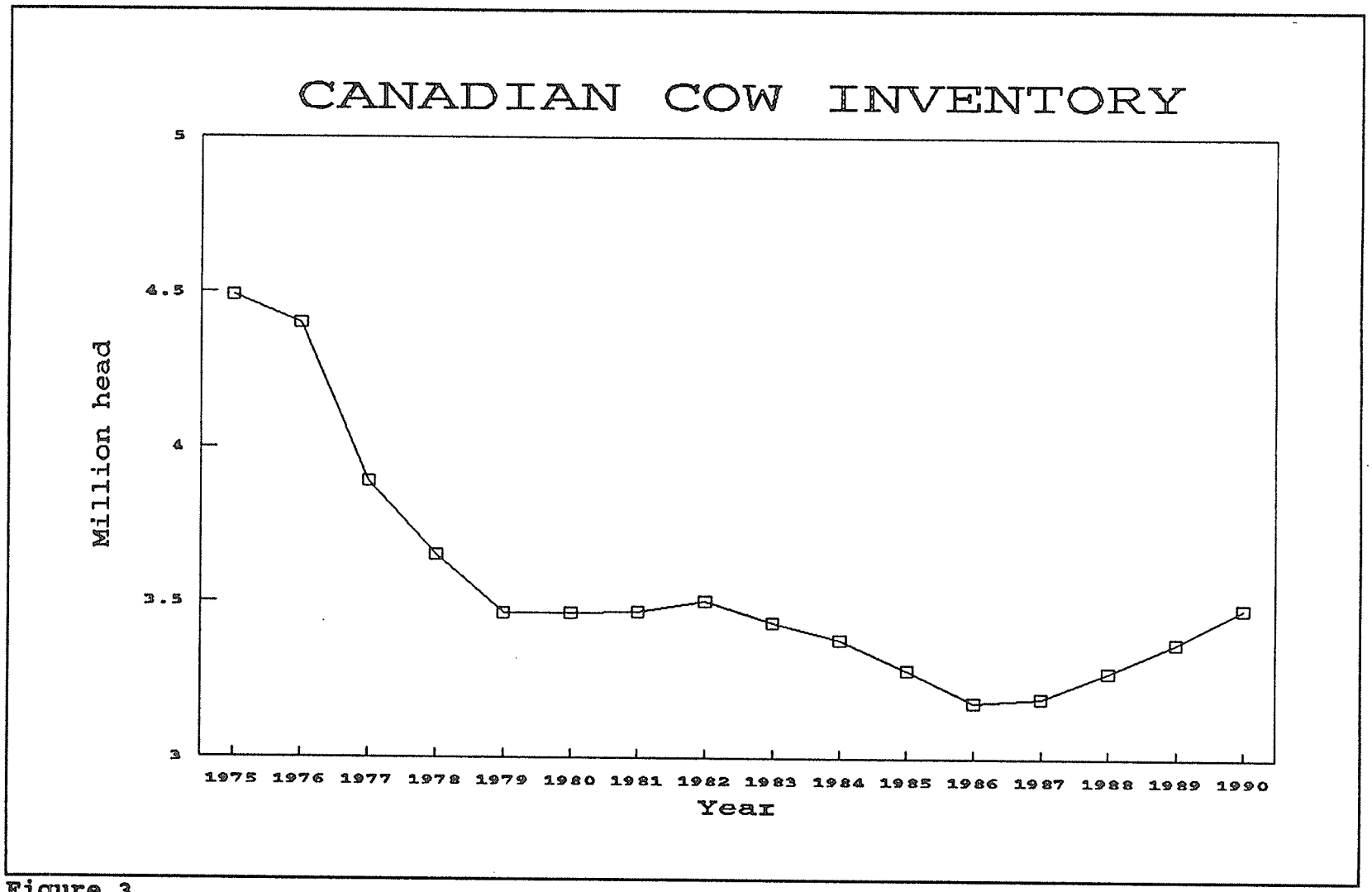
CANADIAN COW INVENTORY
Million head
5
4.5
4
3.5
3
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

Figure 3.

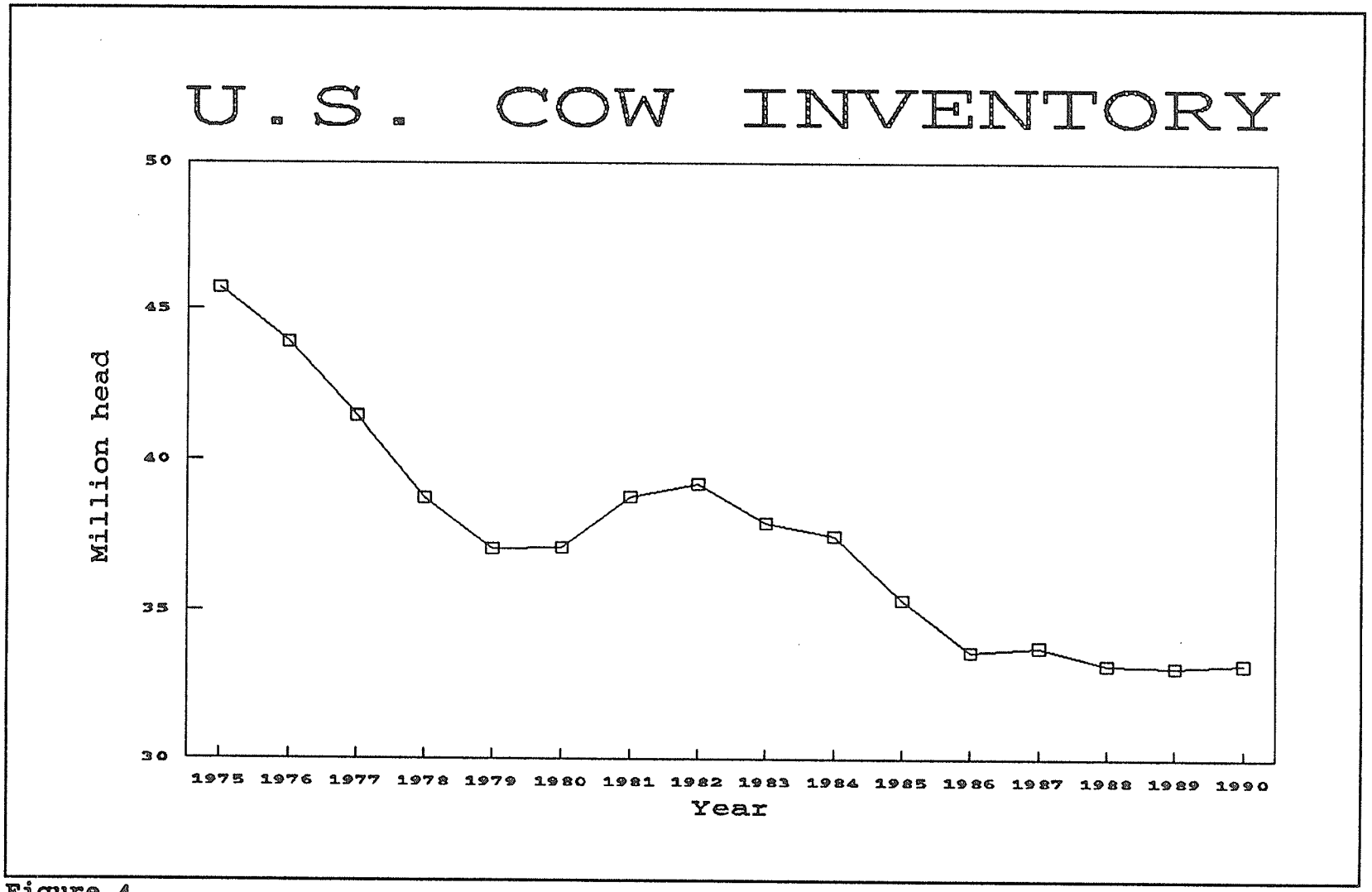
U.S. COW INVENTORY
Million head
50
45
40
35
30
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

Figure 4.

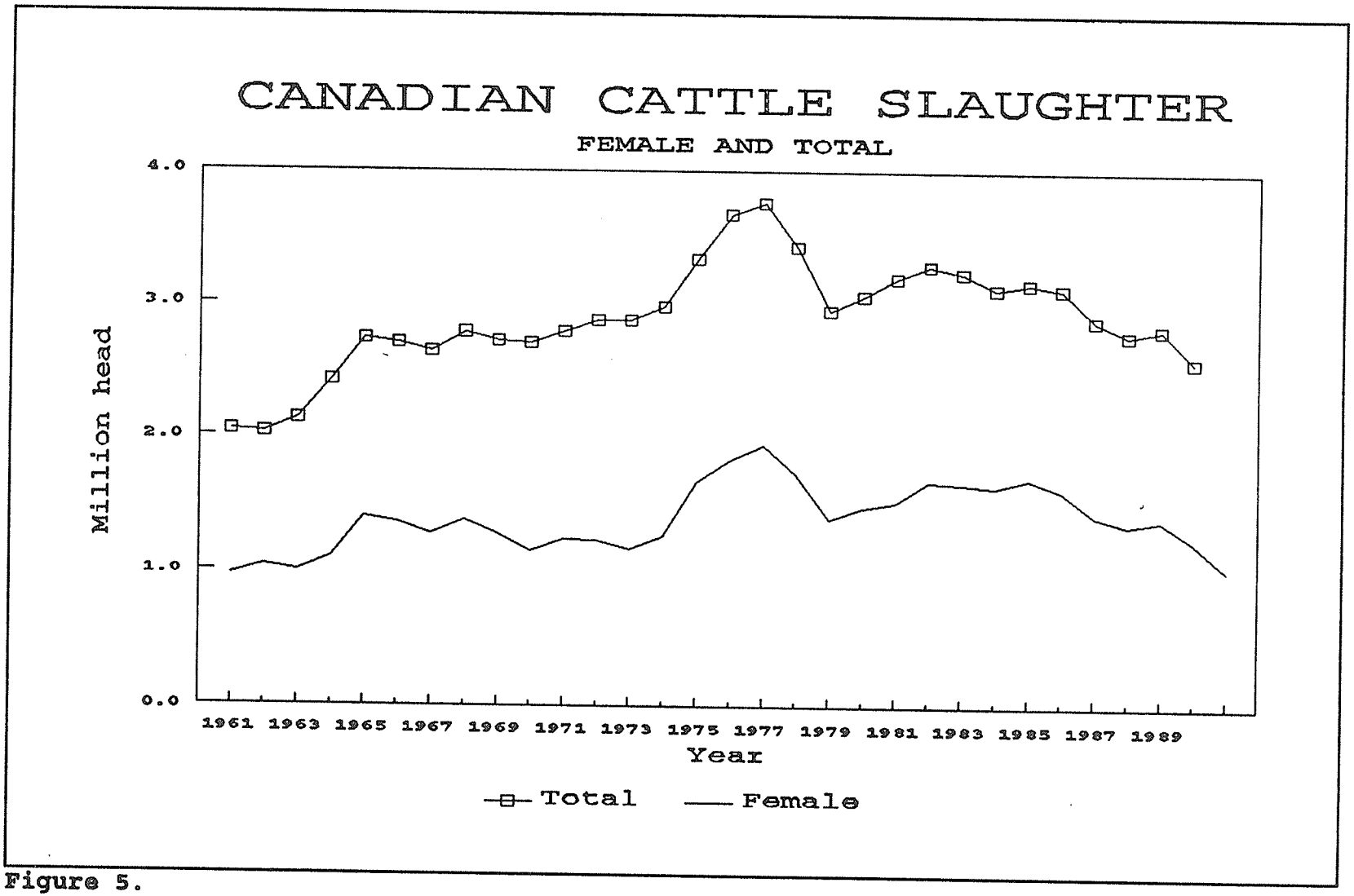
CANADIAN CATTLE SLAUGHTER
FEMALE AND TOTAL
Million head
4.0
3.0
2.0
1.0
0.0
1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989
Year
Total
Female

Figure 5.

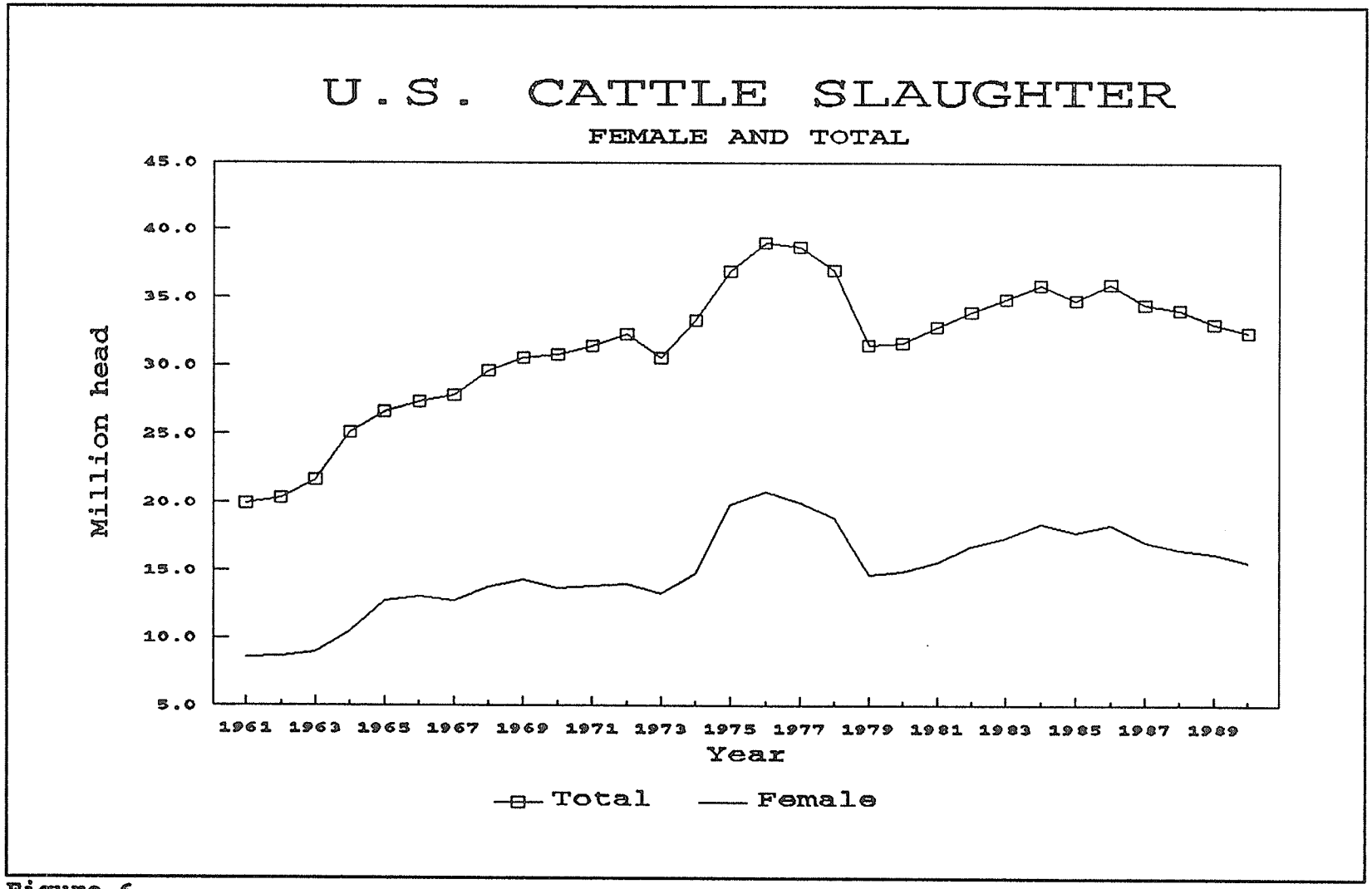
U.S. CATTLE SLAUGHTER
FEMALE AND TOTAL
Million head
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989
Year
Total
Female

Figure 6.

Hedging effectiveness including exchange rate effects will be examined in the second part.

CHAPTER IV

MODEL DEVELOPMENT AND METHODS OF RESEARCH

4.1 Model development

As mentioned in the objectives, the first goal of this study is to provide feedlot operators with information on live cattle futures, cash prices and basis over different markets, futures contracts and time periods. Characteristics of the cash and futures prices will be determined through univariate and ANOVA analysis to analyze their efficiency and degree of similarity. Then the basis and its variance will be calculated and compared for these markets, across futures contracts and over twelve years. Second, appropriate hedging ratios will be found for each market studied and analyzed as to its effectiveness through the use of a price level bivariate regression model.

4.1.1 The data

Average weekly prices for the Omaha market are taken from the Livestock, Meat and Wool Report published by the U.S. Department of Agriculture for 900 to 1100 pound choice steers in dollars per hundredweight ($/cwt). Winnipeg cash cattle prices are taken from the Canadian Livestock and Meat Trade Report, the weekly range is averaged for prices of A1 and A2

steers 1000 pounds and over ($/cwt). Alberta cash cattle prices are supplied by Canfax, Alberta, weekly average prices for A1 and A2 steers in $/cwt. Exchange rates are taken from the Bank of Canada Review, weekly average Canadian dollar per U.S. dollar.

Live Cattle Futures prices are supplied by the Commodity Futures Trading Commission. Weekly average settlement prices are used in $/cwt. Where data for any week is missing, that observation is dropped from the calculations.

4.1.2 The variables

The variables used to calculate the basis are the weekly average cash prices of all markets converted into U.S. dollars and the weekly average futures price also in U.S dollars. The basis is then calculated as futures price less the cash price. Weekly average prices are used for all univariate analysis. The regression model uses monthly average cash and futures prices, as several weeks do not have quotes for some or all of the markets used.

4.1.3 Considerations

4.1.3.1 Characteristics of cash and futures prices

Futures and cash prices are graphed and examined for differences in the basis over time and markets. These prices are tested for normal distributions. Futures prices are compared across futures contracts to test for degree of variance, normal distribution, skewness and kurtosis. The

cash and futures prices are compared by their mean, variance, skewness and kurtosis.

4.1.3.2 Regional cash price differences.

Exchange rate differences and or transportation and delivery costs could create a difference in the basis between regions. Local supply and demand factors may affect the cash price and therefore the basis (Carter and Loyns). The Alberta, Manitoba and Omaha markets are tested for regional differences using a Wilcoxon Sum Rank Test as explained in Appendix A.

4.1.3.3 The basis

The basis is the difference between the futures and slaughter (cash or spot) cattle prices. Specifically, U.S. dollar currency conversions are used on weekly average Alberta, Manitoba and Omaha slaughter cattle prices. These prices are then subtracted from Live Cattle futures prices for the same time periods for each market and Live Cattle futures contract, from 1977 to 1989. Six Live Cattle futures contracts are offered; February, April, June, August, October and December.

Basis is tested for monthly seasonality using OLS with dummy variables for the months of January to November. Seasonality in cash prices has been the emphasis of numerous studies (Murphy, 1987). Murphy tested seasonality in the futures markets and found some seasonality through chi-square testing, however, when using spectral analysis, no seasonal patterns

are found. He concluded that the chi-square test is influenced by a spurious correlation. Whether seasonality is in the cash or futures market is only a problem when they are affected differently or when cash markets which are using the same futures contract are affected differently , these factors would then affect the respective basis of these markets. The Canadian markets may, for example, have a lagged supply and demand cycle for cattle which may exhibit different seasonal tendencies than the futures markets which would follow the U.S. cycles. Another, more probable potential for this type of seasonality in the basis is the marketing of calves. The U.S. markets more calves in the fall whereas the Canadian markets sell more calves in the spring (Alberta Agriculture, Ron Gietz). This difference may make the Canadian cash price drop in the spring compared to the futures price.

The basis is plotted as the gap between the cash and futures prices and analyzed for trends and deviations of trends over the life of the contract. All comparisons are by futures contract, year and region (except for seasonality is tested over the years).

4.1.3.4 Independence of cash and futures prices and the hedging ratio

Monke and Petzel (1984) tested the interdependence of the international cotton market testing different staple lengths and qualities. These authors used a bivariate OLS model to

test these relationships to determine whether the markets are homogeneous enough to be considered and analyzed as one market. While this methodology is used to test across cash markets, the same principle may be used for testing for homogeneity of any markets. The authors specify that these tests must be analyzed in conjunction with information on market structure. The interdependence of the cash and futures market is what determines the efficiency of a hedge. If the two markets are independent the futures market will not behave in a manner similar to the cash market and therefore will not be able to provide adequate price risk protection. The correlation between the two markets gives the hedging efficiency while the beta coefficient gives the amount of change in one market which is correlated to a one unit change in the other (Kolb, 1988). In other words, the hedging ratio.

It is not uncommon for the hedging ratio to be different from one, especially in cross-hedging markets (Kahl, 1983; Witt, Schroeder and Hayenga, 1987), this means the futures position is not an equal and opposite position, but rather an equivalent position. Western Canadian cattle may be considered as a cross-hedged commodity due to differences in their grading systems. Several methods have developed which determine the optimal hedging ratio (Myers and Thompson, 1989). These methods include regressing the cash prices on futures prices, price changes of the cash prices on futures price changes and proportional price changes of the cash on

the proportional price change in the futures (Witt, Schroeder and Hayenga). Witt, Schroeder and Hayenga point out that the price level model is appropriate for an anticipatory hedge such as a cattle feeding hedge where feeder cattle are bought and hedged with the anticipation that they will be sold as slaughter cattle. One caveat the authors mention is that if autoregressive errors are large, the R-square statistics may be overstated. If this is the case then a stacked GLS equation model on price levels should be used. Therefore, a price level model will be run using OLS and test for autoregressive errors using a Durbin Watson statistic.

4.1.3.5 Exchange rate affect on the basis and hedge ratio

Canadian futures markets do not offer a live cattle contract for feedlot operators to use, therefore they must use the United States Chicago Mercantile Exchange (CME) to hedge their products (Gillis, 1989). This exposes the Canadian producer to exchange rate risks since all transactions at the CME are in U.S. dollars. Several authors have addressed this issue (Carter and Loyns, 1983; Thompson and Bond, 1987; Gillis, 1989). Novak and Unterschultz (1990) found the exchange rate to be a small factor when hedging Alberta feedlot cattle. However, these authors only analyzed the effects over a three-month hedging period and used real instead of nominal dollars. Since 70 to 90 per cent of the cattle in Alberta are on feed for nine to six months, using only a three month period only covers the final feeding

period. Only Wednesday exchange rate quotes of the third week in the month are used, since only three observations would cover the three month hedging period, day to day variance is not measured. Braga (1989) has discussed the relationship between basis changes and hedge results and defines gross basis changes as the local supply and demand change component and the exchange rate component. He states that a change in the Canadian per U.S. dollar exchange rate .... [has] an impact on the economic result of the hedge. Therefore an exchange rate component is used in the model.

4.2 The research method

4.2.1 Descriptive analysis

4.2.1.1 Skewness

Normality of the prices and basis series are tested by measuring the level of skewness, kurtosis and normality. Skewness is measured as the third moment of a series and is defined as follows:

$$Skewness = \frac{E(x-\mu)^3}{\sigma^3} \qquad (13)$$

Skewness measures the directional tendency of the deviations from the mean (SAS, 1988). The futures market has been found to have skewed prices for live cattle contracts (Helmuth). This alleged skewness has been hypothesized as providing a

risk premium to speculators (Koppenhaver). If the futures market is efficient it should reflect the characteristics of the cash market. Therefore a bias in the futures market may not indicate an inefficiency in providing a price discovery function. The cash and futures market as well as the basis will be tested for skewness.

4.2.1.2 Kurtosis

Kurtosis measures the density of the tails of a distribution and is a determinant of normality of the distribution of the data (Snedecor and Cochran). Kurtosis is the fourth moment of a series. Statistical measures may be misleading if the tails do not follow the normal distribution (SAS). Kurtosis is defined as follows:

$$Kurtosis = \frac{E(x-\mu)^4}{\sigma^4} - 3 \qquad (14)$$

4.2.1.3 Normality

The price and basis series are also tested for normality of distribution using the Shapiro-Wilk statistic. The methodology for calculating this statistic is included in Appendix E. As the number of observations is greater than 3, the W statistic is calculated using simulations following Royston's approximate normalizing transformation as below:

$$Z_n = \frac{(1 - W_n)^{\gamma} - \mu}{\sigma} \qquad (15)$$

where

Z_n = Royston's transformation

W_n = Shapiro-Wilk statistic

γ = exponential normalizing function

μ = population mean

σ = standard deviation

as adapted from SAS (1985). The larger the value of Z, the larger the departure from a normal distribution.

4.2.1.4 Basis

The basis used differs from that of Braga when incorporating exchange rate effects. Braga's method is to adjust all prices to Canadian dollars; however, discussion with Dennis McGivern of XL Foods and Maurice Kraut of the Canadian Grains Council indicated the standard practice of feedlots engaged in basis evaluation is to convert all monies to U.S. dollars. The equation appears as follows:

$$B_{us\$,i,t,T} = (CP_{d\$,i,t}/ER_{us\$,t}) - FP_{us\$,t,T} \qquad (16)$$

where

$B_{us\$,t,T}$ = Basis in U.S. dollars at time t for contract expiring at time T

$CP_{d,i,t}$ = Cash price in domestic currency for market i at time t

$ER_{us\$,t}$ = Exchange rate domestic per US price

$FP_{us\$,t,T}$ = Futures price in U.S. dollars at time t for contract expiring at time T

4.2.2 Regression Model

Following the rationale of Witt, Schroeder and Hayenga (1987) price levels are used for the OLS regression of cash prices in U.S. dollars on futures prices. This model is used since the hedge of the feedlot operator is an anticipatory hedge, the hedger is assumed to be risk averse and holds no current cash position since the cattle are not ready for slaughter. Lindahl found that comparisons between the R-square results of two cash price series regressed on the same futures contract provides consistent estimates of lower hedging risk if price level models are used. Therefore the price level model will give results which will be compared over the three markets. In addition, this model is the most parsimonious and the most straight forward for interpretation. The model is as follows:

$$CP_{us\$,i,t} = \alpha + FP_{us\$,t,T} + \varepsilon \qquad (17)$$

where

$CP_{us\$,i,t}$ = Monthly average cash price of slaughter cattle in U.S. dollars in market i (i=1 to 3 for Manitoba, Alberta and Omaha) at time t (t=1977 to 1988 over the life of each contract).

α = intercept term

$FP_{us\$,t,T}$ = monthly average settlement price of Live Cattle futures in U.S dollars at time t (t=1977 to 1988) for each contract offered T (T=1,...6, for February, April, June, August, October and December contracts)

ε = error term

The model is first subjected to an Ordinary Least Squares Method and is then adjusted for autocorrelation and rerun for a Generalized Least Squares solution. SAS Autoreg procedure is used.

The following tests of the regression coefficients are used in analyzing the degree of independence and or integration of the cash and futures prices. In each test the significance of the intercept term and the beta coefficient of the futures price are analyzed at the 5 percent significance level. The test A analyzes the prices to see if they are identical.

$$H_o: \quad \alpha = 0 \quad \text{and } \beta = 1$$

$$H_1: \quad \alpha = 0 \quad \text{and } \beta \neq 1$$

Test B analyzes the prices to see if they are independent.

$$H_o: \quad \beta = 0$$

$$H_1: \quad \beta \neq 0$$

The relationship is then tested as a constant fixed markup, such as futures prices are $3/cwt higher than cash, test C is as follows:

$$H_o: \quad \alpha \neq 0 \text{ and } \beta = 1$$

$$H_1: \quad \alpha = 0 \text{ and or } \beta \neq 1$$

Test D assumes a constant percent margin relationship between the two prices, such as futures prices are 3 percent lower than cash prices, the test is as follows:

$$H_o: \quad \alpha = 0 \text{ and } \beta \neq 1 \text{ and } \beta \neq 0$$

$$H_1: \quad \alpha \neq 0 \text{ and or } \beta = 1 \text{ and or } \beta = 0$$

Test E assumes a combined constant and percent relationship such as the futures price is $1/cwt and 5% higher than the cash price, the test is as follows:

$$H_o: \quad \alpha \neq 0 \text{ and } \beta \neq 1 \text{ and } \beta \neq 0$$

$$H_1: \quad \alpha = 0 \text{ and or } \beta = 1 \text{ and or}$$

$$\beta = 0$$

The degree to which the relationship is mixed between the prices is tested by test F which analyzes the intercept to future price ratio to see whether it falls within one standard deviation of the futures price coefficient. This criteria is consistent with that used by Monke and Petzel. If the ratio is within one standard deviation, the relationship is

integrated sufficiently to study as though one market, if larger, the markets are not integrated sufficiently and must be studied as different markets. The results of this test may be useful in forecasting basis and understanding cash and future price relationships.

4.2.3 Hedging efficiency - reduced risk

The efficiency of a hedge is measured as its ability to compensate for cash price risk (Lindahl). Therefore, the standard deviation of the basis will be compared to the standard deviation of the cash price as a measure of risk in the hedging and cash position, respectively. A hedging opportunity exists when the standard deviation of the basis is less than that of the cash as follows:

$$\sigma_b < \sigma_{pc} \qquad (18)$$

where σ_b = standard deviation of the basis

and σ_{pc} = standard deviation of the cash price

CHAPTER V

RESULTS AND ANALYSIS

This chapter will review and interpret the results of this study by first discussing cash and futures prices, then the basis and finally the hedging ratio and hedging effectiveness. Exchange rate affects are discussed in terms of the hedging effectiveness and price effects.

5.1 Cash and futures prices

The cash and futures prices, in U.S. dollars, are graphed over the life of each live cattle futures contract by year from 1980 to 1988 and region. These graphs may be found in Appendix B. The graphs indicate that concurrent prices of cash and futures behave differently over the life of the contract. This behaviour is due to the nature of the prices. Cash prices reflect current supply and demand situations while futures prices reflect expectations of future supply and demand (Garcia, Leuthold, and Sarhan). These prices do not theoretically have to converge until the cattle are ready to be marketed and may then be delivered on the futures contract. However, new information will affect both markets. Therefore there are times when the prices will react at the same time to market information. The direction of the reaction will depend on the expectations of producers and traders of the current

and future supply and demand situations. The prices are linked through the impact of new information.

5.1.1 Integration of Cash and Futures Prices

The amount of linkage or integration of these markets has been statistically tested with the results found in Tables 4 to 11. Integration of the markets is tested in six parts. The summary results may be found in Table 11. Test A and test D (page 52) reject the null hypothesis as Tables 34 to 39 indicate that the intercept term is significantly different from zero. Therefore the relationship between the cash and futures prices are not able to be defined as identical or as a constant percent margin markup basis. Test B checks for independence of the cash and futures and found that the Omaha 1977 February and April futures contracts are independent of the concurrent cash prices. Alberta cash prices for 1977 are also independent for the April futures contract. Manitoba, however has independent, concurrent cash and futures prices for the February 1988 contract.

Test C determines a constant fixed margin or markup (discount). This type of relationship is found for the Omaha 1979 February and April contracts, the Manitoba 1981 June and August 1988 contracts and the Alberta cash prices to the 1985 August futures contract. The amount of markup is equivalent to the intercept coefficient.

Test E categorizes all other markets, years and futures contracts as having a mixed fixed portion and percent markup

Table 4.--Test C of integration of cash and futures market over contract life by market (US$), 1977 to 1988.

Year	Manitoba futures coefficient	B^=1 t-test	Omaha futures coefficient	B^=1 t-test	Alberta futures coefficient	B^=1 t-test
			February Live Cattle Contract			
1977	0.45	4.23	0.24	5.43	0.48	4.00
1978	0.34	13.20	0.40	8.57	0.34	16.50
1979	0.70	4.29	0.81	1.90	0.69	5.17
1981	0.61	3.00	1.73	-5.62	0.63	2.64
1982	0.41	4.92	0.60	4.44	0.54	4.18
1983	0.55	11.25	0.38	20.67	0.57	10.75
1984	0.46	4.91	0.56	4.89	0.45	6.88
1985	0.50	25.00	0.55	22.50	0.50	25.00
1986	0.75	2.27	0.49	7.29	0.70	4.29
1987	0.42	6.44	0.60	3.64	0.45	6.88
1988	0.32	4.25	0.53	3.62	0.47	4.08
			April Live Cattle Contract			
1977	0.47	5.89	0.21	6.58	0.44	4.00
1978	0.35	5.91	0.54	4.18	0.45	5.50
1979	0.71	2.90	0.83	1.89	0.72	3.11
1980	0.63	6.17	0.65	7.00	0.65	5.83
1981	0.59	2.41	0.50	4.17	0.57	3.58
1982	0.44	4.00	0.50	4.55	0.68	2.67
1983	0.49	7.29	0.50	6.25	0.56	5.50
1984	0.35	5.91	0.45	5.00	0.36	5.82
1985	0.45	7.86	0.53	7.83	0.45	7.86
1986	0.51	4.90	0.54	6.57	0.54	5.75
1987	0.40	4.29	0.66	2.62	0.65	2.92
1988	0.51	3.27	0.57	3.91	0.55	3.46
			June Live Cattle Contract			
1977	0.43	6.33	0.36	7.11	0.43	6.33
1978	0.65	5.00	0.78	2.44	0.66	5.67
1979	0.65	5.00	0.74	3.71	0.65	5.00
1980	0.52	6.86	0.59	6.83	0.50	7.14
1981	0.66	1.89	0.46	6.75	0.53	4.27
1982	0.65	3.18	0.62	3.17	0.82	2.25
1983	0.49	10.20	0.50	10.00	0.50	10.00
1984	0.51	8.17	0.54	9.20	0.55	6.43
1985	0.41	5.90	0.59	5.13	0.43	6.33
1986	0.45	5.00	0.52	6.00	0.50	5.56
1987	0.58	3.82	0.71	4.14	0.66	3.78
1988	0.48	5.78	0.51	6.13	0.48	7.43

Table 4.--Continued

Year	Manitoba futures coefficient	B^=1 t-test	Omaha futures coefficient	B^=1 t-test	Alberta futures coefficient	B^=1 t-test
			August Live Cattle Contract			
1977	0.36	9.14	0.34	11.00	0.35	9.29
1978	0.62	6.33	0.83	2.43	0.64	6.00
1979	0.60	5.00	0.73	4.50	0.59	4.56
1980	0.57	5.38	0.62	5.43	0.56	5.50
1981	0.49	3.92	0.39	7.63	0.53	4.70
1982	0.55	6.43	0.53	6.71	0.60	5.71
1983	0.38	7.75	0.52	5.33	0.52	5.33
1984	0.59	10.25	0.58	14.00	0.54	7.67
1985	0.64	1.89	0.59	4.10	0.76	1.71
1986	0.45	6.11	0.53	6.71	0.48	6.50
1987	0.55	4.09	0.61	4.88	0.60	5.00
1988	0.58	0.47	0.59	8.20	0.67	4.13
			October Live Cattle Contract			
1977	0.40	10.00	0.33	13.40	0.40	10.00
1978	0.66	4.86	0.87	2.17	0.67	4.71
1979	0.64	3.60	0.70	5.00	0.66	3.78
1980	0.52	6.86	0.56	6.29	0.51	6.13
1981	0.40	4.29	0.32	7.56	0.49	5.10
1982	0.54	7.67	0.52	8.00	0.54	7.67
1983	0.41	7.38	0.62	6.33	0.51	7.00
1984	0.58	21.00	0.57	43.00	0.56	14.67
1985	0.66	3.09	0.61	6.50	0.66	4.25
1986	0.50	4.55	0.54	5.11	0.53	4.27
1987	0.30	5.00	0.48	5.20	0.53	3.36
1988	0.44	5.60	0.44	9.33	0.43	4.75
			December Live Cattle Contract			
1977	0.40	12.00	0.37	12.60	0.39	15.25
1978	0.69	3.88	0.91	1.12	0.69	4.43
1979	0.68	4.57	0.70	10.00	0.69	5.17
1980	0.51	6.13	0.58	4.67	0.48	6.50
1981	0.39	3.81	0.37	7.00	0.53	3.62
1982	0.56	11.00	0.53	11.75	0.58	14.00
1983	0.49	8.50	0.49	10.20	0.50	10.00
1984	0.46	13.50	0.44	14.00	0.47	13.25
1985	0.63	4.63	0.62	7.60	0.59	6.83
1986	0.44	7.00	0.61	4.88	0.46	7.71
1987	0.49	4.64	0.54	7.67	0.59	5.86
1988	0.51	6.13	0.53	7.83	0.46	7.71

Note: outlined coefficients not statistically different from 1 at 5 per cent level

Table 5.--Test F for integration of markets, February Futures Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
			Manitoba		
1977	0.53	0.45	0.34	0.79	0.11
1978	0.64	0.34	0.18	0.52	0.16
1979	0.32	0.70	0.24	0.94	0.46
1981	0.40	0.61	0.43	1.04	0.18
1982	0.58	0.41	0.42	0.83	-0.01
1983	0.45	0.55	0.13	0.68	0.42
1984	0.54	0.46	0.35	0.81	0.11
1985	0.50	0.50	0.06	0.56	0.44
1986	0.31	0.75	0.36	1.11	0.39
1987	0.58	0.42	0.31	0.73	0.11
1988	0.68	0.32	0.55	0.87	-0.23
			Omaha		
1977	0.71	0.24	0.19	0.43	0.05
1978	0.60	0.40	0.36	0.76	0.04
1979	0.20	0.81	0.45	1.26	0.36
1981	0.41	1.73	0.30	2.03	1.43
1982	0.62	0.60	0.10	0.70	0.50
1983	0.43	0.38	0.30	0.68	0.08
1984	0.46	0.56	0.06	0.62	0.50
1985	0.51	0.55	0.22	0.77	0.33
1986	0.41	0.49	0.36	0.85	0.13
1987	0.47	0.60	0.45	1.05	0.15
1988	0.51	0.53	0.17	0.70	0.36
			Alberta		
1977	0.50	0.48	0.34	0.82	0.14
1978	0.64	0.34	0.14	0.48	0.20
1979	0.32	0.69	0.21	0.90	0.48
1981	0.38	0.63	0.46	1.09	0.17
1982	0.47	0.54	0.38	0.92	0.16
1983	0.43	0.57	0.13	0.70	0.44
1984	0.55	0.45	0.25	0.70	0.20
1985	0.50	0.50	0.06	0.56	0.44
1986	0.35	0.70	0.23	0.93	0.47
1987	0.55	0.45	0.28	0.73	0.17
1988	0.53	0.47	0.45	0.92	0.02

Outlined ratios show significantly integrated at 5% level

Table 6.--Test F for integration of markets, April Futures Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
		Manitoba			
1977	0.52	0.47	0.25	0.72	0.22
1978	0.64	0.35	0.38	0.73	-0.03
1979	0.32	0.71	0.36	1.07	0.35
1980	0.39	0.63	0.23	0.86	0.40
1981	0.41	0.59	0.54	1.13	0.05
1982	0.56	0.44	0.48	0.92	-0.04
1983	0.51	0.49	0.24	0.73	0.25
1984	0.63	0.35	0.35	0.70	0.00
1985	0.53	0.45	0.22	0.67	0.23
1986	0.50	0.51	0.35	0.86	0.16
1987	0.59	0.40	0.48	0.88	-0.08
1988	0.50	0.51	0.52	1.03	-0.01
		Omaha			
1977	0.75	0.21	0.40	0.61	-0.19
1978	0.48	0.54	0.36	0.90	0.18
1979	0.19	0.83	0.32	1.15	0.51
1980	0.36	0.65	0.19	0.84	0.46
1981	0.49	0.50	0.38	0.88	0.12
1982	0.51	0.50	0.38	0.88	0.12
1983	0.50	0.50	0.28	0.78	0.22
1984	0.55	0.45	0.35	0.80	0.10
1985	0.47	0.53	0.19	0.72	0.34
1986	0.47	0.54	0.24	0.78	0.30
1987	0.35	0.66	0.45	1.11	0.21
1988	0.43	0.57	0.38	0.95	0.19
		Alberta			
1977	0.56	0.44	0.42	0.86	0.02
1978	0.56	0.45	0.33	0.78	0.12
1979	0.31	0.72	0.32	1.04	0.40
1980	0.36	0.65	0.23	0.88	0.42
1981	0.43	0.57	0.38	0.95	0.19
1982	0.35	0.68	0.42	1.10	0.26
1983	0.45	0.56	0.28	0.84	0.28
1984	0.62	0.36	0.35	0.71	0.01
1985	0.54	0.45	0.22	0.67	0.23
1986	0.47	0.54	0.28	0.82	0.26
1987	0.37	0.65	0.42	1.07	0.23
1988	0.46	0.55	0.45	1.00	0.10

Outlined ratios show significantly integrated at 5% level

Table 7.--Test F for integration of markets, June Futures Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
		Manitoba			
1977	0.55	0.43	0.30	0.73	0.13
1978	0.38	0.65	0.25	0.90	0.40
1979	0.37	0.65	0.26	0.91	0.39
1980	0.48	0.52	0.27	0.79	0.25
1981	0.37	0.66	0.57	1.23	0.09
1982	0.37	0.65	0.38	1.03	0.27
1983	0.50	0.49	0.17	0.66	0.32
1984	0.49	0.51	0.19	0.70	0.32
1985	0.56	0.41	0.32	0.73	0.09
1986	0.54	0.45	0.36	0.81	0.09
1987	0.43	0.58	0.38	0.96	0.20
1988	0.52	0.48	0.31	0.79	0.17
		Omaha			
1977	0.61	0.36	0.30	0.66	0.06
1978	0.23	0.78	0.32	1.10	0.46
1979	0.27	0.74	0.26	1.00	0.48
1980	0.42	0.59	0.23	0.82	0.36
1981	0.53	0.46	0.25	0.71	0.21
1982	0.39	0.62	0.42	1.04	0.20
1983	0.50	0.5	0.17	0.67	0.33
1984	0.46	0.54	0.16	0.70	0.38
1985	0.42	0.59	0.25	0.84	0.34
1986	0.48	0.52	0.27	0.79	0.25
1987	0.28	0.71	0.24	0.95	0.47
1988	0.49	0.51	0.28	0.79	0.23
		Alberta			
1977	0.55	0.43	0.30	0.73	0.13
1978	0.37	0.66	0.22	0.88	0.44
1979	0.36	0.65	0.26	0.91	0.39
1980	0.50	0.5	0.27	0.77	0.23
1981	0.47	0.53	0.35	0.88	0.18
1982	0.21	0.82	0.28	1.10	0.54
1983	0.50	0.5	0.17	0.67	0.33
1984	0.46	0.55	0.22	0.77	0.33
1985	0.55	0.43	0.28	0.71	0.15
1986	0.50	0.5	0.30	0.80	0.20
1987	0.35	0.66	0.31	0.97	0.35
1988	0.52	0.48	0.24	0.72	0.24

Outlined ratios show significantly integrated at 5% level

Table 8.--Test F for integration of markets, August Futures Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
		Manitoba			
1977	0.61	0.36	0.30	0.73	0.13
1978	0.39	0.62	0.25	0.90	0.40
1979	0.41	0.6	0.26	0.91	0.39
1980	0.45	0.57	0.27	0.79	0.25
1981	0.51	0.49	0.57	1.23	0.09
1982	0.46	0.55	0.38	1.03	0.27
1983	0.61	0.38	0.17	0.66	0.32
1984	0.43	0.59	0.19	0.70	0.32
1985	0.39	0.64	0.32	0.73	0.09
1986	0.54	0.45	0.36	0.81	0.09
1987	0.45	0.55	0.38	0.96	0.20
1988	0.43	0.58	0.31	0.79	0.17
		Omaha			
1977	0.63	0.34	0.21	0.55	0.13
1978	0.17	0.83	0.25	1.08	0.58
1979	0.27	0.73	0.23	0.96	0.50
1980	0.38	0.62	0.28	0.90	0.34
1981	0.60	0.39	0.25	0.64	0.14
1982	0.47	0.53	0.23	0.76	0.30
1983	0.49	0.52	0.31	0.83	0.21
1984	0.42	0.58	0.09	0.67	0.49
1985	0.42	0.59	0.33	0.92	0.26
1986	0.48	0.53	0.23	0.76	0.30
1987	0.37	0.61	0.27	0.88	0.34
1988	0.41	0.59	0.17	0.76	0.42
		Alberta			
1977	0.61	0.35	0.24	0.59	0.11
1978	0.37	0.64	0.22	0.86	0.42
1979	0.41	0.59	0.35	0.94	0.24
1980	0.45	0.56	0.32	0.88	0.24
1981	0.47	0.53	0.32	0.85	0.21
1982	0.45	0.6	0.23	0.83	0.37
1983	0.49	0.52	0.31	0.83	0.21
1984	0.47	0.54	0.18	0.72	0.36
1985	0.29	0.76	0.46	1.22	0.30
1986	0.52	0.48	0.27	0.75	0.21
1987	0.40	0.6	0.27	0.87	0.33
1988	0.33	0.67	0.27	0.94	0.40

Outlined ratios show significantly integrated at 5% level

Table 9.--Test F for integration of markets, October Futures Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
		Manitoba			
1977	0.59	0.4	0.22	0.62	0.18
1978	0.35	0.66	0.25	0.91	0.41
1979	0.37	0.64	0.39	1.03	0.25
1980	0.49	0.52	0.28	0.80	0.24
1981	0.60	0.4	0.46	0.86	-0.06
1982	0.47	0.54	0.21	0.75	0.33
1983	0.59	0.41	0.27	0.68	0.14
1984	0.43	0.58	0.07	0.65	0.51
1985	0.37	0.66	0.40	1.06	0.26
1986	0.51	0.5	0.36	0.86	0.14
1987	0.70	0.3	0.46	0.76	-0.16
1988	0.55	0.44	0.28	0.72	0.16
		Omaha			
1977	0.65	0.33	0.18	0.51	0.15
1978	0.11	0.87	0.22	1.09	0.65
1979	0.31	0.7	0.23	0.93	0.47
1980	0.44	0.56	0.28	0.84	0.28
1981	0.67	0.32	0.30	0.62	0.02
1982	0.48	0.52	0.21	0.73	0.31
1983	0.39	0.62	0.20	0.82	0.42
1984	0.43	0.57	0.03	0.60	0.54
1985	0.40	0.61	0.22	0.83	0.39
1986	0.47	0.54	0.30	0.84	0.24
1987	0.53	0.48	0.33	0.81	0.15
1988	0.56	0.44	0.17	0.61	0.27
		Alberta			
1977	0.58	0.4	0.22	0.62	0.18
1978	0.33	0.67	0.25	0.92	0.42
1979	0.35	0.66	0.35	1.01	0.31
1980	0.49	0.51	0.32	0.83	0.19
1981	0.52	0.49	0.33	0.82	0.16
1982	0.47	0.54	0.21	0.75	0.33
1983	0.50	0.51	0.23	0.74	0.28
1984	0.45	0.56	0.10	0.66	0.46
1985	0.37	0.66	0.29	0.95	0.37
1986	0.48	0.53	0.36	0.89	0.17
1987	0.47	0.53	0.46	0.99	0.07
1988	0.56	0.43	0.34	0.77	0.09

Outlined ratios show significantly integrated at 5% level

Table 10.--Test F for integration of markets, December Future Contract, 1977 to 1988.

Year	Intercept/ future price	future price coeff.	standard deviation	upper boundary	lower boundary
			Manitoba		
1977	0.59	0.4	0.19	0.59	0.21
1978	0.32	0.69	0.30	0.99	0.39
1979	0.34	0.68	0.28	0.96	0.40
1980	0.49	0.51	0.34	0.85	0.17
1981	0.59	0.39	0.64	1.03	-0.25
1982	0.44	0.56	0.15	0.71	0.41
1983	0.51	0.49	0.23	0.72	0.26
1984	0.53	0.46	0.14	0.60	0.32
1985	0.40	0.63	0.32	0.95	0.31
1986	0.55	0.44	0.30	0.74	0.14
1987	0.50	0.49	0.43	0.92	0.06
1988	0.48	0.51	0.24	0.75	0.27
			Omaha		
1977	0.62	0.37	0.19	0.56	0.18
1978	0.09	0.91	0.30	1.21	0.61
1979	0.32	0.7	0.12	0.82	0.58
1980	0.42	0.58	0.38	0.96	0.20
1981	0.62	0.37	0.36	0.73	0.01
1982	0.47	0.53	0.15	0.68	0.38
1983	0.51	0.49	0.19	0.68	0.30
1984	0.56	0.44	0.14	0.58	0.30
1985	0.39	0.62	0.20	0.82	0.42
1986	0.39	0.61	0.30	0.91	0.31
1987	0.46	0.54	0.23	0.77	0.31
1988	0.45	0.53	0.18	0.71	0.35
			Alberta		
1977	0.59	0.39	0.15	0.54	0.24
1978	0.31	0.69	0.26	0.95	0.43
1979	0.33	0.69	0.24	0.93	0.45
1980	0.52	0.48	0.34	0.82	0.14
1981	0.47	0.53	0.52	1.05	0.01
1982	0.42	0.58	0.12	0.70	0.46
1983	0.50	0.5	0.19	0.69	0.31
1984	0.52	0.47	0.14	0.61	0.33
1985	0.43	0.59	0.24	0.83	0.35
1986	0.53	0.46	0.26	0.72	0.20
1987	0.41	0.59	0.27	0.86	0.32
1988	0.52	0.46	0.63	1.09	-0.17

Outlined ratios show significantly integrated at 5% level

Table 11.--Integration relationship between cash and futures by contract and year

Year	Omaha	Manitoba	Alberta
		February	
1977	Independent	Mixed	Mixed
1978	Mixed	Semi-mixed	Semi-mixed
1979	Constant	Semi-mixed	Semi-mixed
1981	Semi-mixed	Mixed	Mixed
1982	Mixed	Mixed	Mixed
1983	Mixed	Mixed	Semi-mixed
1984	Semi-mixed	Mixed	Mixed
1985	Mixed	Mixed	Mixed
1986	Mixed	Semi-mixed	Semi-mixed
1987	Mixed	Mixed	Mixed
1988	Mixed	Independent	Mixed
		April	
1977	Independent	Mixed	Independent
1978	Mixed	Mixed	Mixed
1979	Constant	Semi-Mixed	Semi-Mixed
1980	Semi-Mixed	Semi-Mixed	Semi-Mixed
1981	Mixed	Mixed	Mixed
1982	Mixed	Mixed	Mixed
1983	Mixed	Mixed	Mixed
1984	Mixed	Mixed	Mixed
1985	Mixed	Mixed	Mixed
1986	Mixed	Mixed	Mixed
1987	Mixed	Mixed	Mixed
1988	Mixed	Mixed	Mixed
		June	
1977	Mixed	Mixed	Mixed
1978	Semi-Mixed	Semi-Mixed	Semi-Mixed
1979	Semi-Mixed	Semi-Mixed	Semi-Mixed
1980	Mixed	Mixed	Mixed
1981	Mixed	Constant	Mixed
1982	Mixed	Mixed	Semi-Mixed
1983	Mixed	Mixed	Mixed
1984	Mixed	Mixed	Mixed
1985	Mixed	Mixed	Mixed
1986	Mixed	Mixed	Mixed
1987	Semi-Mixed	Mixed	Mixed
1988	Mixed	Mixed	Mixed

Table 11.--Continued

	August		
1977	Semi-Mixed	Mixed	Semi-Mixed
1978	Semi-Mixed	Semi-Mixed	Semi-Mixed
1979	Semi-Mixed	Mixed	Mixed
1980	Mixed	Mixed	Mixed
1981	Mixed	Mixed	Mixed
1982	Mixed	Mixed	Mixed
1983	Mixed	Mixed	Mixed
1984	Semi-Mixed	Mixed	Mixed
1985	Mixed	Mixed	Constant
1986	Mixed	Mixed	Mixed
1987	Mixed	Mixed	Mixed
1988	Semi-Mixed	Constant	Semi-Mixed

	October		
1977	Semi-Mixed	Mixed	Mixed
1978	Semi-Mixed	Semi-Mixed	Semi-Mixed
1979	Semi-Mixed	Mixed	Mixed
1980	Mixed	Mixed	Mixed
1981	Semi-Mixed	Mixed	Mixed
1982	Mixed	Mixed	Mixed
1983	Semi-Mixed	Mixed	Mixed
1984	Semi-Mixed	Semi-Mixed	Semi-Mixed
1985	Mixed	Mixed	Semi-Mixed
1986	Mixed	Mixed	Mixed
1987	Mixed	Mixed	Mixed
1988	Mixed	Mixed	Mixed

	December		
1977	Semi-Mixed	Mixed	Semi-Mixed
1978	Semi-Mixed	Semi-Mixed	Semi-Mixed
1979	Semi-Mixed	Semi-Mixed	Semi-Mixed
1980	Mixed	Mixed	Mixed
1981	Mixed	Mixed	Mixed
1982	Mixed	Mixed	Semi-Mixed
1983	Mixed	Mixed	Mixed
1984	Mixed	Mixed	Mixed
1985	Semi-Mixed	Mixed	Mixed
1986	Mixed	Mixed	Mixed
1987	Mixed	Mixed	Mixed
1988	Mixed	Mixed	Mixed

Note: Significant at 5 per cent level.

relationship. The degree of the integration is then tested using the intercept from the regression model equation 16 with the futures price level (Table 11). If the degree of integration is such that the intercept or fixed proportion is large relative to the price of the futures, where the magnitude is measured as over plus or minus one standard deviation of the futures beta coefficient, the relationship is said to be semi-mixed and therefore cannot be treated as integrated (Test F). While 96 per cent of the times tested shows a mixed relationship, the relationship is only significant for 75 per cent of the cases. The average price for the contract and year is used for the test futures price. Only two months data is available for the 1980 February futures contract, therefore those observations are deleted. The February live cattle futures contract is the least integrated with the cash markets with two-thirds of the years studied showing an integrated relationship. The April contract had the highest degree of integration with 81 per cent of the years showing some integration. The June to December contracts had 78, 72, 69 and 72 per cent respectively markets with a significant degree of integration.

These percentages of periods with significant mixed integration would have been higher had 1978 and 1979 not been included. These years are characterized by a marked increase in prices for beef over the previous time period (Livestock Market Review, 1978 and 1979). Prices were up 40 per cent for

slaughter cattle in 1979 over 1978 levels which were 45 per cent higher than 1976 levels. The increase in prices is attributed to the decrease in beef production in Canada associated with lower supply at the end of the production cycle. The U.S. cycle appears to have lagged behind as is evidenced in Figures 1 to 6 (pages 35 to 40). Since futures markets for live cattle are in the U.S., they reflect the supply and demand situation in that region, rather than the Canadian situation.

5.1.2 Distribution of cash and futures prices

5.1.2.1 Skewness

The test for significance of skewness for small samples is from Snedecor and Cochran with this test methodology found in Appendix C. Out of the 33 occurrences of statistically significant skewness in the futures prices, 20 are negative (Table 12). The October and December contracts showed particularly higher proportions of negatively significant skewness.

The cash prices in U.S. dollars, are analyzed for skewness as well (Tables 13 to 18). The Omaha market has significant skewness for 28 per cent of the time periods studied, Manitoba and Alberta have 30 and 23 per cent respectively. A negative skewness is found for 35 per cent of the skewed periods for Omaha. Manitoba and Alberta have 21 and 34 per cent respectively. These markets showed different time periods of skewness although the percentages are similar

Table 12.--Futures live cattle contract prices over life of contract in US$/cwt

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			February Contract			
1977	53	42.61	2.84	-0.41	0.91	-1.14
1978	61	41.59	2.76	-0.27	0.94	-1.00
1979	61	54.51	5.81	-0.08	0.96	-0.47
1981	55	68.78	3.43	-0.46	0.93	-0.93
1982	58	65.59	3.85	-0.65	0.95	0.46
1983	61	60.51	2.06	-0.08	0.96	-0.77
1984	52	62.58	3.09	1.23	0.83	0.46
1985	53	64.71	0.84	0.63	0.94	0.06
1986	57	62.09	3.14	-0.32	0.94	-1.05
1987	58	57.15	2.57	0.64	0.96	0.89
1988	58	62.81	4.00	0.18	0.97	-0.50
			April Contract			
1977	53	41.78	2.99	0.16	0.88	-1.58
1978	63	42.83	4.35	0.93	0.90	0.49
1979	62	59.05	7.78	0.75	0.93	0.11
1980	70	69.55	3.20	-0.86	0.93	0.26
1981	53	69.38	3.87	-0.30	0.94	-0.99
1982	61	65.68	3.98	-0.82	0.93	0.48
1983	61	62.09	3.28	1.37	0.89	2.27
1984	53	64.83	3.49	0.69	0.87	-0.89
1985	52	65.72	1.59	-0.59	0.97	0.85
1986	59	61.78	3.09	-0.04	0.94	-0.60
1987	59	58.95	4.05	1.40	0.82	1.21
1988	61	66.05	4.51	0.33	0.95	-0.54
			June Contract			
1977	56	43.12	2.20	0.30	0.93	-1.07
1978	65	45.35	6.00	1.03	0.87	0.18
1979	68	62.09	7.74	0.37	0.94	-0.92
1980	74	70.67	3.20	-0.85	0.92	0.02
1981	51	71.58	2.95	-0.35	0.95	-0.78
1982	60	65.95	4.04	-0.53	0.94	-0.08
1983	58	63.47	2.87	0.52	0.93	-0.62
1984	53	65.64	1.83	-0.17	0.97	-0.25
1985	52	65.88	2.33	-1.63	0.80	2.25
1986	57	60.22	3.11	-0.35	0.95	-0.13
1987	59	59.64	4.18	1.03	0.82	-0.28
1988	62	67.01	3.42	0.21	0.92	-1.30

Table 12.--Continued

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			August Contract			
1977	60	42.80	1.82	0.15	0.95	-0.61
1978	66	45.90	5.76	0.61	0.90	-0.78
1979	71	62.70	6.13	0.32	0.94	-0.90
1980	79	70.37	3.09	-1.00	0.90	0.26
1981	51	70.21	3.53	0.12	0.92	-1.29
1982	57	63.43	2.99	-1.07	0.89	0.48
1983	59	61.83	2.20	0.08	0.97	-0.45
1984	53	64.26	0.87	-0.29	0.96	-0.78
1985	54	63.38	3.82	-1.74	0.71	1.85
1986	56	57.67	2.85	-1.01	0.86	-0.09
1987	54	58.99	3.22	0.38	0.90	-1.25
1988	61	65.33	2.47	-0.25	0.95	-0.93
			October Contract			
1977	63	42.11	2.05	-0.51	0.92	-0.54
1978	66	47.26	6.06	0.06	0.89	-1.46
1979	71	63.10	5.29	-0.06	0.96	-0.92
1980	79	68.83	3.16	-0.99	0.90	0.33
1981	55	67.73	3.56	0.51	0.92	-0.86
1982	60	61.30	2.81	-0.55	0.94	-0.43
1983	57	59.65	1.67	0.07	0.96	-1.03
1984	53	62.68	0.67	-0.25	0.97	-0.27
1985	62	61.80	3.01	-1.30	0.80	0.50
1986	57	57.33	3.19	-0.65	0.93	-0.28
1987	57	59.65	4.59	0.46	0.90	-0.84
1988	61	66.09	3.40	0.06	0.95	-0.43
			December Contract			
1977	62	41.97	2.31	-1.02	0.92	0.94
1978	62	50.61	5.69	-0.42	0.89	-1.19
1979	69	65.68	4.65	-0.37	0.95	-0.68
1980	79	69.55	3.06	-0.59	0.93	-0.59
1981	68	68.39	4.12	0.16	0.93	-0.88
1982	60	61.14	2.24	-0.32	0.95	-0.69
1983	51	61.37	1.96	0.73	0.96	1.91
1984	51	64.34	1.18	1.52	0.82	1.90
1985	62	63.53	2.79	-1.12	0.86	0.45
1986	61	57.98	2.47	-0.75	0.91	-0.35
1987	60	61.35	4.29	-0.03	0.92	-1.24
1988	62	68.46	3.96	-0.19	0.93	-1.09

Note: outlined estimates statistically significant at 5% level

Table 13.--Slaughter cattle price characteristics during Feb. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	52	38.80	2.06	0.60	0.97	0.52
1978	59	40.70	2.21	-0.01	0.96	-0.77
1979	57	53.17	5.41	-0.05	0.93	0.00
1981	54	66.44	3.15	0.34	0.96	-0.48
1982	56	63.68	3.24	0.03	0.94	-1.11
1983	60	63.68	4.60	0.44	0.93	-0.89
1984	52	63.40	3.29	-0.01	0.90	-1.44
1985	53	64.78	2.19	-0.27	0.95	-0.07
1986	57	58.21	3.96	-0.29	0.95	-0.72
1987	56	57.95	2.57	-0.49	0.92	-0.78
1988	58	64.89	2.99	0.15	0.96	-0.23
			Manitoba			
1977	52	39.13	2.70	0.44	0.97	0.63
1978	61	38.41	2.40	-0.41	0.94	-0.78
1979	61	51.96	6.83	-0.30	0.89	-0.53
1981	54	64.72	3.21	-0.38	0.92	-1.08
1982	58	61.78	2.94	-0.78	0.92	-0.08
1983	57	59.30	4.29	1.46	0.84	1.63
1984	52	58.42	2.77	-0.01	0.96	-0.99
1985	52	58.73	2.29	0.23	0.93	-1.16
1986	55	54.28	2.78	-0.53	0.93	-0.83
1987	58	54.53	2.80	0.11	0.89	-1.47
1988	57	61.19	2.30	-0.13	0.95	-0.95
			Alberta			
1977	53	38.78	2.63	0.25	0.98	-0.25
1978	61	38.44	2.49	-0.45	0.95	-0.52
1979	61	52.70	7.10	-0.40	0.90	-0.40
1981	54	65.17	3.07	-0.46	0.95	-0.68
1982	58	61.56	3.71	-0.19	0.94	-0.95
1983	61	59.62	4.65	1.17	0.87	0.81
1984	51	59.74	2.82	0.17	0.98	-0.39
1985	53	59.69	2.36	-0.04	0.94	-1.13
1986	57	54.89	3.40	-0.49	0.92	-0.88
1987	58	54.85	3.05	-0.06	0.94	-1.16
1988	58	62.60	2.72	-0.22	0.96	-0.79

Note: 1980 had only 2 observations and was deleted
outlined estimates statistically significant at 5% level

Table 14.--Slaughter cattle price characteristics during Apr. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	53	38.78	1.81	0.92	0.94	1.25
1978	61	42.24	3.83	1.17	0.89	1.39
1979	57	56.62	7.15	1.19	0.87	1.07
1980	66	66.96	4.42	-0.14	0.94	0.95
1981	51	65.95	3.47	0.44	0.94	-0.68
1982	60	64.29	3.29	-0.27	0.93	-1.04
1983	60	64.29	4.46	0.19	0.95	-0.93
1984	53	63.97	3.61	-0.19	0.88	-1.57
1985	52	63.44	2.42	-0.78	0.91	-0.35
1986	59	57.28	3.63	0.01	0.98	-0.57
1987	57	58.90	3.32	0.18	0.94	0.31
1988	61	66.40	3.48	0.62	0.93	-0.35
			Manitoba			
1977	52	38.50	3.04	0.42	0.95	0.06
1978	63	39.44	3.01	0.38	0.96	1.18
1979	62	55.13	7.12	-0.02	0.92	-0.16
1980	70	64.31	3.99	-0.85	0.93	0.32
1981	52	64.86	2.85	-0.03	0.91	-1.47
1982	61	61.12	3.11	-0.59	0.91	-0.83
1983	57	59.75	4.19	1.30	0.87	1.38
1984	53	58.80	2.87	-0.24	0.93	-1.19
1985	51	57.85	2.13	0.67	0.92	-0.49
1986	57	53.68	2.65	-0.12	0.94	-1.01
1987	59	55.58	3.01	-0.22	0.93	-1.09
1988	60	62.26	2.59	0.58	0.97	0.55
			Alberta			
1977	53	38.08	2.85	0.36	0.97	-0.35
1978	63	39.79	3.47	0.80	0.93	1.83
1979	62	56.16	7.31	0.08	0.94	-0.07
1980	70	65.15	4.02	-0.75	0.93	-0.09
1981	52	65.40	2.76	-0.18	0.93	-1.19
1982	61	61.32	3.77	-0.03	0.94	-1.06
1983	61	60.42	4.51	0.93	0.91	0.46
1984	52	60.07	2.84	-0.30	0.93	-1.06
1985	52	58.73	2.00	0.29	0.93	-1.14
1986	59	54.18	3.20	-0.18	0.93	-1.18
1987	59	56.42	3.84	0.37	0.96	-0.02
1988	61	63.91	2.92	0.45	0.96	0.03

Note: outlined estimates statistically significant at 5% level

Table 15.--Slaughter cattle price characteristics during Jun. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	55	38.79	1.68	0.43	0.96	-0.30
1978	63	44.79	5.97	1.22	0.83	0.49
1979	63	59.39	8.40	0.81	0.85	-0.72
1980	71	67.24	3.62	0.78	0.93	0.98
1981	49	66.35	2.52	0.13	0.96	-0.87
1982	60	65.47	3.98	-0.16	0.95	-0.68
1983	57	63.87	4.30	0.27	0.95	-0.78
1984	53	63.80	3.39	-0.16	0.92	-1.36
1985	52	62.07	3.02	-0.42	0.91	-1.14
1986	56	56.62	3.77	0.41	0.96	-0.63
1987	57	61.06	4.48	0.79	0.89	0.19
1988	61	67.79	3.92	0.62	0.90	-0.82
			Manitoba			
1977	55	37.83	2.19	-0.30	0.94	-0.89
1978	65	42.44	6.48	1.83	0.73	2.39
1979	68	57.58	7.54	0.11	0.90	-0.75
1980	74	64.53	3.26	-0.19	0.95	-1.04
1981	50	65.51	2.36	-0.22	0.95	-0.91
1982	60	61.82	4.05	0.22	0.96	-0.13
1983	54	59.80	3.75	1.32	0.90	2.31
1984	53	58.49	2.73	-0.11	0.94	-1.15
1985	51	57.10	1.82	0.82	0.93	0.17
1986	55	52.90	2.51	0.44	0.94	-0.45
1987	59	57.17	3.73	0.17	0.96	-0.15
1988	61	63.55	2.95	0.72	0.93	-0.25
			Alberta			
1977	56	37.56	2.14	-0.12	0.98	-0.35
1978	65	42.93	6.92	1.75	0.73	2.08
1979	68	58.56	7.44	0.21	0.91	-0.94
1980	74	65.34	3.38	-0.25	0.95	-0.89
1981	50	66.16	2.32	-0.72	0.93	0.17
1982	60	61.96	4.59	0.31	0.95	-0.72
1983	58	60.17	3.94	0.86	0.94	1.23
1984	53	59.65	2.58	-0.21	0.95	-0.91
1985	52	58.09	1.94	0.57	0.91	-0.75
1986	57	53.19	3.06	0.41	0.94	-0.76
1987	59	58.27	4.49	0.32	0.96	-0.35
1988	62	64.56	2.94	0.23	0.97	-0.32

Note: outlined estimates statistically significant at 5% level

Table 16.--Slaughter cattle price characteristics during Aug. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	58	38.84	1.71	0.37	0.96	-0.52
1978	64	46.38	6.33	0.67	0.87	-0.92
1979	66	61.00	7.89	0.57	0.87	-1.10
1980	77	67.81	3.64	0.47	0.96	0.37
1981	49	65.64	2.74	-0.25	0.96	-0.73
1982	57	65.19	3.97	0.07	0.96	-0.57
1983	58	62.85	3.30	-0.01	0.93	-1.19
1984	53	64.13	3.34	-0.44	0.90	-1.13
1985	54	60.21	4.15	-0.61	0.93	-0.39
1986	55	56.93	3.79	0.20	0.96	-0.78
1987	53	62.90	3.92	0.75	0.87	-0.73
1988	60	67.28	3.91	0.99	0.84	-0.33
			Manitoba			
1977	59	37.76	1.99	-0.51	0.93	-0.65
1978	66	44.42	7.06	1.09	0.78	-0.24
1979	71	59.54	6.40	0.29	0.86	-1.49
1980	79	64.70	3.09	-0.23	0.95	-0.91
1981	50	65.05	2.45	0.05	0.95	-1.03
1982	56	60.99	3.96	0.79	0.94	0.76
1983	55	58.54	2.31	0.30	0.97	-0.42
1984	53	58.54	2.74	-0.16	0.94	-1.14
1985	53	55.95	2.96	-0.69	0.94	0.93
1986	54	52.86	2.39	0.52	0.93	-0.02
1987	54	59.33	3.06	0.31	0.93	-0.60
1988	60	63.47	2.95	0.84	0.91	-0.11
			Alberta			
1977	60	37.52	1.89	-0.62	0.94	-0.37
1978	66	45.20	7.52	0.98	0.79	-0.47
1979	71	60.57	6.31	0.22	0.87	-1.51
1980	79	65.63	3.28	-0.31	0.95	-0.72
1981	50	65.44	2.64	-0.33	0.95	-0.75
1982	57	60.95	4.19	1.02	0.90	0.88
1983	59	58.98	2.93	0.28	0.97	-0.17
1984	52	59.64	2.49	-0.06	0.95	-0.92
1985	54	56.60	3.69	-0.89	0.90	0.38
1986	56	53.42	2.80	0.42	0.95	-0.53
1987	54	60.54	3.37	0.46	0.93	-0.84
1988	61	64.23	2.90	0.57	0.96	-0.08

Note: outlined estimates statistically significant at 5% level

Table 17.--Slaughter cattle price characteristics during Oct. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	61	39.24	1.79	0.11	0.96	-0.83
1978	63	48.14	6.31	0.15	0.90	-1.37
1979	66	62.29	7.86	0.19	0.89	-1.35
1980	78	67.59	3.29	0.36	0.97	0.86
1981	53	65.13	2.40	-0.23	0.96	-0.71
1982	60	64.42	4.22	0.22	0.97	-0.58
1983	56	61.92	3.28	0.59	0.89	-0.86
1984	53	64.49	3.00	-0.57	0.93	-0.61
1985	62	59.41	4.52	-0.40	0.93	-0.87
1986	56	58.04	3.12	0.11	0.94	-0.69
1987	56	63.59	3.65	0.43	0.94	-0.78
1988	60	67.73	3.77	0.81	0.89	-0.45
			Manitoba			
1977	63	38.00	1.98	-0.70	0.92	-0.37
1978	66	46.71	7.24	0.43	0.84	-1.38
1979	71	60.48	6.22	0.05	0.85	-1.66
1980	79	64.93	3.25	-0.26	0.94	-1.06
1981	54	64.28	2.27	0.38	0.94	-0.82
1982	59	60.40	4.02	1.03	0.92	1.02
1983	54	57.72	2.57	0.57	0.95	-0.22
1984	53	58.75	2.46	0.01	0.93	-1.22
1985	61	55.42	3.16	-0.44	0.96	-0.03
1986	55	53.96	2.55	0.46	0.91	-1.00
1987	57	60.22	2.84	0.18	0.91	-1.41
1988	60	63.53	2.99	0.72	0.92	-0.28
			Alberta			
1977	63	37.97	2.19	-0.45	0.96	-0.46
1978	66	47.62	7.64	0.33	0.85	-1.41
1979	71	61.26	6.30	0.00	0.87	-1.61
1980	79	65.37	3.02	-0.48	0.94	-0.67
1981	54	64.46	3.18	-0.01	0.95	-1.12
1982	60	60.53	4.19	1.21	0.87	1.19
1983	57	58.48	3.07	0.59	0.95	-0.11
1984	52	59.64	2.45	0.10	0.93	-1.26
1985	62	56.37	3.72	-0.63	0.92	-0.31
1986	57	54.55	2.90	0.04	0.93	-1.07
1987	57	61.60	3.43	-0.09	0.94	-1.09
1988	61	64.71	2.92	0.29	0.97	-0.45

Note: outlined estimates statistically significant at 5% level

Table 18.--Slaughter cattle price characteristics during Dec. futures contract by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	60	40.13	1.80	-0.08	0.95	-0.97
1978	60	50.40	5.54	-0.31	0.88	-1.24
1979	64	63.64	7.45	-0.15	0.91	-1.14
1980	78	66.78	2.66	-0.03	0.97	0.84
1981	66	64.81	3.06	-0.23	0.97	-0.71
1982	59	63.75	4.61	0.40	0.93	-0.90
1983	51	62.55	3.10	0.45	0.90	-1.14
1984	51	65.18	2.33	-0.55	0.94	-0.17
1985	62	59.41	4.50	-0.41	0.93	-0.86
1986	60	58.59	3.07	-0.20	0.95	-0.72
1987	59	64.02	3.32	0.33	0.96	-0.43
1988	61	68.48	3.64	0.37	0.95	-0.74
			Manitoba			
1977	62	38.23	2.26	-0.37	0.95	-0.54
1978	62	49.03	6.71	-0.11	0.85	-1.46
1979	69	61.31	5.94	-0.22	0.87	-1.48
1980	79	64.74	3.05	-0.37	0.93	-1.01
1981	67	64.08	2.83	0.04	0.97	-0.56
1982	57	59.77	4.16	1.32	0.88	1.48
1983	51	57.84	2.66	0.44	0.96	-0.54
1984	51	59.12	2.30	-0.13	0.93	-1.23
1985	61	55.53	3.20	-0.51	0.95	-0.09
1986	59	54.49	2.76	2.76	0.90	-1.42
1987	59	60.54	2.65	-0.03	0.93	-1.23
1988	59	63.40	3.10	0.71	0.91	-0.42
			Alberta			
1977	62	38.18	2.41	-0.23	0.97	-0.43
1978	62	49.86	7.05	-0.21	0.86	-1.27
1979	69	62.13	6.04	-0.30	0.88	-1.38
1980	79	65.36	3.01	-0.47	0.94	-0.67
1981	67	63.87	3.69	-0.28	0.95	-0.82
1982	60	59.91	4.55	1.13	0.88	0.84
1983	50	59.11	2.84	0.63	0.96	0.01
1984	51	59.97	2.40	-0.24	0.94	-1.13
1985	62	56.47	3.75	-0.69	0.91	-0.31
1986	61	54.86	3.04	-0.02	0.94	-1.13
1987	60	61.83	3.23	-0.25	0.96	-0.74
1988	62	64.82	2.95	0.21	0.97	-0.59

Note: outlined estimates statistically significant at 5% level

when comparing Omaha and Manitoba. Alberta has fewer occurrences of skewness, however of these, a higher proportion are negatively skewed when compared to Manitoba. Since the

As prices are converted to U.S. dollars, the exchange rate may have an impact on the findings, therefore the Manitoba and Alberta cash slaughter cattle prices are also analyzed for skewness in Canadian dollars (Tables 19 to 24). The occurrence of skewness decreased only slightly for Manitoba and increased for Alberta. Negative skewness is more evident in the Manitoba market, while it decreased in the Alberta market. The exchange rate appears to have a smoothing effect on some of the cash price variations.

These findings indicate that futures prices are negatively skewed more often than the cash prices over the life of each contract from 1977 to 1988, which has implications for reduced futures market efficiency in the price forecasting role. The year end contracts of October and December are consistently negatively skewed.

5.1.2.2 Kurtosis

Kurtosis measures the proportion of the sample or population which occurs in the tails of the distribution. Kurtosis may be the result of shocks which create outlier disturbances. The outliers may be one or several observations. The test for significance of kurtosis levels is from Snedecor and Cochran, with the table in Appendix D.

Table 19.--Slaughter cattle price characteristics during Feb. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	52	38.67	2.33	0.83	0.94	1.43
1978	61	41.03	3.61	-0.14	0.94	-1.10
1979	61	59.71	8.84	-0.27	0.91	-0.39
1981	54	75.87	3.78	-0.25	0.89	-1.40
1982	58	74.06	3.67	-0.83	0.91	-0.14
1983	57	72.10	5.96	1.11	0.88	0.46
1984	52	72.15	3.54	-0.05	0.95	-1.08
1985	52	76.64	2.57	0.14	0.95	-1.09
1986	55	74.44	3.88	-0.74	0.92	-0.29
1987	58	75.47	3.55	0.20	0.93	-1.14
1988	57	80.76	3.22	0.30	0.94	-0.91
			Alberta			
1977	53	38.31	2.23	0.66	0.95	0.25
1978	61	41.07	3.70	-0.27	0.94	-0.93
1979	61	60.57	9.14	-0.38	0.91	-0.29
1981	54	76.39	3.71	0.00	0.96	-0.80
1982	58	73.79	4.55	-0.33	0.94	-0.88
1983	61	73.45	6.25	0.86	0.92	0.03
1984	51	73.72	3.57	0.13	0.97	-0.59
1985	53	77.89	2.58	-0.28	0.94	-1.03
1986	57	75.30	4.63	-0.78	0.89	-0.59
1987	58	75.90	3.92	0.01	0.97	-0.83
1988	58	82.57	3.58	0.24	0.94	-0.84

Note: 1980 had only 2 observations and was deleted
outlined estimates statistically significant at 5% level

Table 20.--Slaughter cattle price characteristics during Apr. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	52	38.39	2.38	0.85	0.93	1.45
1978	63	42.76	4.44	0.47	0.97	0.66
1979	62	63.72	8.91	-0.06	0.92	-0.18
1980	70	75.24	4.17	-0.92	0.92	0.61
1981	52	76.28	3.38	-0.22	0.89	-1.39
1982	61	73.50	3.80	-0.57	0.91	-0.79
1983	57	73.86	5.57	1.07	0.89	0.50
1984	53	73.02	4.03	-0.10	0.95	-1.12
1985	51	76.54	2.44	0.22	0.96	-0.86
1986	57	73.98	3.78	-0.45	0.95	-0.45
1987	59	76.18	3.49	-0.21	0.95	-1.02
1988	60	81.30	3.11	0.09	0.96	-0.86
			Alberta			
1977	53	37.96	2.23	0.69	0.95	0.52
1978	63	43.14	4.95	0.80	0.94	1.36
1979	62	64.90	9.12	0.02	0.93	-0.08
1980	70	76.23	4.25	-0.75	0.93	-0.10
1981	52	76.92	3.39	0.07	0.95	-0.90
1982	61	73.74	4.70	-0.15	0.95	-0.95
1983	61	74.71	5.75	0.78	0.93	0.02
1984	52	74.57	4.02	-0.12	0.95	-1.09
1985	52	77.69	2.44	-0.26	0.95	-0.84
1986	59	74.68	4.48	-0.48	0.93	-0.79
1987	59	77.29	4.31	-0.01	0.97	-0.51
1988	61	83.42	3.30	0.02	0.96	-0.59

Note: outlined estimates statistically significant at 5% level

Table 21.--Slaughter cattle price characteristics during Jun. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	55	38.14	1.73	-0.55	0.92	-0.76
1978	65	46.47	8.05	1.54	0.79	1.53
1979	68	66.65	9.20	0.04	0.90	-0.76
1980	74	75.42	3.43	-0.17	0.93	-1.23
1981	50	77.44	2.50	-0.54	0.93	-0.67
1982	60	74.78	5.49	0.46	0.95	0.15
1983	54	74.04	5.07	1.09	0.92	1.13
1984	53	73.28	4.35	0.01	0.94	-1.17
1985	51	76.34	2.23	0.31	0.98	-0.40
1986	55	72.97	3.60	0.05	0.96	-0.26
1987	59	77.95	4.34	0.14	0.98	-0.16
1988	61	82.14	2.96	-0.10	0.96	-0.74
			Alberta			
1977	56	37.85	1.85	-0.05	0.96	-0.58
1978	65	47.01	8.56	1.50	0.79	1.29
1979	68	67.79	9.08	0.13	0.90	-0.95
1980	74	76.37	3.65	-0.23	0.93	-1.18
1981	50	78.21	2.71	-0.18	0.97	-0.45
1982	60	74.95	6.22	0.36	0.96	-0.54
1983	58	74.50	5.16	0.72	0.95	0.65
1984	53	74.71	4.11	-0.11	0.95	-1.13
1985	52	77.61	2.39	-0.18	0.96	-0.81
1986	57	73.38	4.31	0.08	0.96	-0.77
1987	59	79.40	5.10	0.16	0.98	-0.14
1988	62	83.45	3.36	-0.21	0.97	-0.25

Note: outlined estimates statistically significant at 5% level

Table 22.--Slaughter cattle price characteristics during Aug. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	59	38.47	2.00	-0.23	0.96	-0.70
1978	66	49.03	8.69	0.92	0.82	-0.59
1979	71	69.09	7.75	0.22	0.87	-1.55
1980	79	75.43	3.30	-0.17	0.94	-1.13
1981	50	77.59	2.27	-0.51	0.93	-0.54
1982	56	74.42	5.65	0.66	0.95	0.19
1983	55	72.25	3.13	0.42	0.96	-0.39
1984	53	74.15	4.33	-0.41	0.93	-0.90
1985	53	75.10	3.62	-0.94	0.94	1.01
1986	54	73.10	3.40	0.06	0.96	0.16
1987	54	80.29	3.39	0.37	0.96	-0.45
1988	60	80.90	3.32	-0.10	0.96	-0.85
			Alberta			
1977	60	38.24	2.15	0.06	0.95	-0.82
1978	66	49.96	9.24	0.82	0.83	-0.80
1979	71	70.28	7.70	0.17	0.86	-1.60
1980	79	76.46	3.54	-0.22	0.94	-1.08
1981	50	78.06	2.67	-0.15	0.97	-0.49
1982	57	74.52	6.04	0.63	0.95	-0.05
1983	59	72.77	3.71	0.27	0.96	-0.43
1984	52	75.61	3.67	-0.53	0.96	-0.34
1985	54	75.95	4.59	-1.11	0.88	0.48
1986	56	73.88	3.84	0.09	0.96	-0.58
1987	54	81.83	3.59	0.69	0.94	-0.24
1988	61	81.79	3.69	-0.41	0.93	-0.83

Note: outlined estimates statistically significant at 5% level

Table 23.--Slaughter cattle price characteristics during Oct. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	63	39.19	2.38	0.08	0.97	-0.45
1978	66	52.37	9.11	0.30	0.85	-1.58
1979	71	70.44	7.42	-0.06	0.85	-1.68
1980	79	75.67	3.52	-0.15	0.92	-1.27
1981	54	76.94	2.28	-0.09	0.95	-0.90
1982	59	73.81	5.62	0.91	0.93	0.48
1983	54	71.01	3.15	0.62	0.95	-0.14
1984	53	75.10	3.32	-0.43	0.96	0.04
1985	61	74.56	3.78	-0.66	0.95	0.11
1986	55	74.83	3.38	0.50	0.92	-0.80
1987	57	80.88	3.10	0.35	0.95	-0.80
1988	60	79.98	3.45	0.13	0.97	-0.69
			Alberta			
1977	63	39.26	2.92	0.41	0.96	-0.29
1978	66	53.44	9.53	0.21	0.85	-1.62
1979	71	71.40	7.51	-0.11	0.86	-1.64
1980	79	76.21	3.30	-0.26	0.95	-0.93
1981	54	77.18	3.43	-0.07	0.95	-1.01
1982	60	74.04	5.98	0.79	0.93	0.22
1983	57	71.96	3.72	0.67	0.95	0.03
1984	52	76.34	2.83	-0.20	0.97	-0.58
1985	62	75.84	4.55	-0.87	0.89	-0.21
1986	57	75.66	3.79	-0.03	0.94	-0.10
1987	57	82.60	3.63	0.08	0.98	-0.47
1988	61	81.38	3.66	-0.12	0.95	-0.95

Note: outlined estimates statistically significant at 5% level

Table 24.--Slaughter cattle price characteristics during Dec. futures contract by year and market (CND$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Manitoba			
1977	62	40.21	3.23	0.26	0.96	-0.56
1978	62	55.68	8.40	0.25	0.83	-1.64
1979	69	71.74	6.80	-0.35	0.87	-1.42
1980	79	75.66	3.51	-0.16	0.92	-1.28
1981	67	76.48	2.96	-0.55	0.95	-0.13
1982	57	73.28	5.83	1.07	0.89	0.52
1983	51	71.30	3.31	0.38	0.96	-0.65
1984	51	76.46	2.55	0.22	0.94	-1.07
1985	61	75.29	4.02	-0.92	0.91	0.09
1986	59	75.61	3.63	0.14	0.91	-1.29
1987	59	80.89	3.03	0.36	0.95	-0.67
1988	59	79.00	3.72	0.39	0.96	-0.55
			Alberta			
1977	62	40.26	3.57	0.20	0.95	-0.79
1978	62	56.70	8.77	-0.37	0.84	-1.47
1979	69	72.73	6.91	-0.45	0.88	-1.28
1980	79	76.40	3.59	-0.01	0.96	-0.81
1981	67	76.25	4.19	-0.49	0.96	-0.32
1982	60	73.55	6.27	0.82	0.92	-0.01
1983	50	72.85	3.49	0.59	0.96	-0.01
1984	51	77.63	2.45	-0.19	0.95	-0.90
1985	62	76.56	4.67	-1.18	0.82	0.22
1986	61	76.13	4.03	-0.05	0.95	-1.03
1987	60	82.46	3.65	0.11	0.97	-0.54
1988	62	80.58	3.38	0.22	0.97	-0.55

Note: outlined estimates statistically significant at 5% level

The futures contracts show 27 occurrences of statistically significant kurtosis. Of these, 20 are negative. Negative kurtosis indicates a flatter distribution (Snedecor and Cochran) which indicates a less significant mean value as the outliers would be more significant than in a normal distribution.

The cash prices in both dollar units have significant kurtosis distributions (Tables 13 to 24). Manitoba has over half of the total series tested exhibiting significant kurtosis (51%). Alberta has 41 per cent while Omaha has 37 per cent when tested in U.S. dollars. In order to isolate the price effect, Manitoba and Alberta prices are also tested for kurtosis in Canadian dollars. The incidence of kurtosis declined in both markets to 42 per cent in Manitoba and 31 per cent in Alberta.

5.1.2.3 Normality

When measuring the occurrences of normal distribution of cash prices in US$, Alberta has the highest percentage of the time periods studied of 40.83 per cent, Omaha follows with 39.83 per cent and Manitoba has a lower percentage of normal series with 26.67 per cent. When analyzing by quarters of years studied no distinct trends are apparent. However, the February, June and December futures contracts have over 40 per cent of the time periods showing a normal distribution, while April has the lowest (22.33%). When analyzing the Canadian market cash prices in Canadian dollars, thus eliminating

exchange rate effects, Alberta has still greater occurrences of normal distribution at 56.83 per cent while Manitoba had 43.33. This indicates that the exchange rate has effects which are not normally distributed.

These results indicate that care should be taken when forecasting prices through standard statistical procedures as confidence intervals may be misstated due to the non-normal distribution of the data. Kurtosis levels indicate that shocks are frequent and of varying levels which make a mean price less significant. This indicates that forecasting of prices is difficult for producers making other risk reducing methods, such as hedging more attractive.

5.1.3 Differences between markets

The variances, means, skewness and kurtosis' of the markets for cash prices are tested for differences between markets by futures contract (Tables 25 and 26). Significant differences are found in the variances between Omaha and Alberta for all futures contracts except February and April. Manitoba and Alberta cash price variances are all significantly different except for the June and August contracts. Omaha and Alberta are significantly different for April futures contracts which are not found to be different with the Manitoba market. The August contract is not found to be significantly different for Alberta and Omaha while Manitoba and Omaha are different. Therefore, variances of the prices are different which may affect efficiency of hedging.

Table 25.--F-test for variance of cash price differences between markets over life of futures contract (US$), 1977 to 1988

Futures contract	Lower variance	d.f	Greater variance	d.f.	Criteria level	F1/F2 result
			Omaha vs. Manitoba			
February	10.30	616	10.52	615	1.13	1.02
April	10.07	690	11.42	696	1.13	1.13
June	13.03	704	16.71	697	1.13	1.28
August	11.90	709	16.46	704	1.13	1.38
October	11.97	731	15.48	724	1.13	1.29
December	12.04	735	14.11	731	1.13	1.17
			Manitoba vs. Alberta			
February	10.30	616	11.90	624	1.13	1.16
April	11.42	696	13.10	704	1.13	1.15
June	13.03	704	14.52	713	1.13	1.11
August	11.90	709	13.47	718	1.13	1.13
October	11.97	731	14.06	738	1.13	1.17
December	12.04	735	14.06	743	1.13	1.17
			Omaha vs. Alberta			
February	10.52	615	11.90	624	1.13	1.13
April	10.07	690	13.10	704	1.13	1.30
June	14.52	713	16.71	697	1.13	1.15
August	13.47	718	16.46	704	1.13	1.13
October	14.06	738	15.48	724	1.13	1.17
December	14.06	743	14.11	731	1.13	1.17

Note: outlined coefficients indicate statistically different variances at 5% level

Table 26.--Wilcoxon Sum Rank Test for Differences between cash slaughter cattle markets over futures contract life, (US$)

Futures Contract	Mean		skewness		kurtosis	
	Z est.	Z test	Z est.	Z test	Z est.	Z test
			Omaha vs. Manitoba			
February	1.36	0.17	0.66	0.51	0.43	0.66
April	1.18	0.24	1.02	0.31	0.72	0.47
June	1.41	0.16	0.26	0.80	-0.43	0.67
August	1.59	0.11	0.03	0.98	-0.90	0.37
October	1.59	0.11	-0.23	0.82	-1.65	0.10
December	1.65	0.10	-0.66	0.51	-1.18	0.24
			Manitoba vs. Alberta			
February	0.53	0.60	-0.13	0.90	0.46	0.65
April	-0.03	0.98	0.17	0.86	-0.29	0.77
June	0.55	0.58	-0.14	0.89	-0.20	0.84
August	0.63	0.62	-0.32	0.75	0.98	0.98
October	0.49	0.62	-0.95	0.34	-1.76	0.08
December	0.43	0.67	-1.13	0.26	-0.95	0.34
			Omaha vs. Alberta			
February	1.12	0.26	1.34	0.18	0.39	0.69
April	1.56	0.12	0.37	0.71	0.72	0.47
June	1.24	0.21	0.75	0.45	-0.35	0.73
August	1.30	0.19	0.40	0.69	-1.16	0.25
October	1.18	0.24	0.92	0.36	0.06	0.95
December	1.24	0.21	0.64	0.53	-0.35	0.73

Note: none were statistically different at 95% level
outlined values are statistically different at 10% level

As significant differences are found in the variances a Wilcoxon Sum Rank Test is used to test for significant differences between the means, skewness and kurtosis of the cash prices. The mean for the cash prices (in U.S. dollars) are tested, none are significantly different at the 5 per cent level however, Omaha and Manitoba are significantly different for the December contract at the 10 per cent level. Skewness of cash prices are not significantly different and kurtosis of the cash prices are only significantly different for the October contract for Manitoba and Alberta, and Manitoba and Omaha.

5.2 Basis Characteristics

The basis is analyzed through graphical and statistical analysis. The graphs for 1980 to 1988 may be found in Appendix B. The graphs indicate that the basis in the Canadian markets behaved similarly when compared to the U.S. market. Certain calendar months and futures contract months appear to exhibit different behaviour such as inverted markets or a wider or narrower basis. Canadian basis levels are narrower in general before 1981. Trends apparent in the graphs are analyzed by year, region and futures contract through observation.

5.2.1. Graphical Analysis

5.2.1.1 Analysis by years

1980 The February contract did not have enough observations to be compared with the other years studied and will not be included in the comparison. This year in general, showed better convergence between the cash and futures contracts toward the maturation of the contracts, particularly for Alberta and Manitoba. The demand for beef in Canada is strong, although the first half of the year demand is slower due to lower prices in substitute commodities, while supplies of beef remained stable. (Livestock Market Review, 1980).

1981 The February and December contracts had closer basis convergence for Alberta and Manitoba while the August and June futures contracts had cash and futures prices which diverged over the contract life. However, all the markets had a closer convergence of prices toward the maturation of the futures contracts in this year when compared to the other years analyzed. Consumer demand decreased due to substitute commodity price decreases. The supply of beef remained stable, which created fluctuating and sometimes depressed prices in Canada (Livestock Market Review, 1981). The

convergence at maturation of the contract may have been due to corrections from previous fluctuations in price. The Omaha cash market showed decreased livestock prices when compared to the 1980 levels throughout the year (Livestock and Meat Statistics, Supplement, 1981)

1982 All markets showed the February futures contract prices as diverging from the cash prices while the October contracts converged for Alberta and Manitoba. The Omaha market showed convergence of the prices for all contracts except the February contract. This year experienced an increase in returns to producers due to lower feed grain prices. Prices for beef in Canada fluctuated but stayed at or above their 1981 levels, fluctuations are primarily due to the increase in cow and heifer marketings which increased 15 and 6 per cent respectively (Livestock Market Review, 1982) while U.S. prices increased for the first part of the year but decreased from the July calendar month to the end of the year, finishing at a lower price for choice slaughter steers than the previous year. (Livestock and Meat Statistics, 1983).

1983 All Canadian market basis diverged at the closing of the futures contracts except for the October futures contract which converged at the end of the contract, but is erratic over the life of the contract. The Canadian markets had lower prices in general in the latter portion of the year. Manitoba showed a decrease in A1,2 steer price of 4 per cent while Alberta experienced a decrease of 2 per cent. The Omaha cash market converged more closely throughout the year with the futures prices than the Canadian markets. Omaha prices increased gradually from the January calendar month to June, and then fluctuated slightly and finished lower in December than the previous year.

1984 All markets had a wider convergence pattern than previous years across contracts. Alberta experienced severe drought conditions in this year as well as strikes by several packing plants which resulted in some closures (Livestock Market Review, 1984). Supplies of beef are large due to liquidation of herds, however, prices are higher than the previous year. Exports of live cattle to the U.S. increased 33.4 per cent from the previous year's level. U.S. inventories are decreasing through this period (Cattle, Feb. 1985) with prices higher in the beginning of the year and fluctuating

and finishing higher than December 1983 (Livestock, Meat and Wool Market News).

1985 The February and December futures contracts had prices which diverged from the cash markets in Manitoba and Alberta. The Omaha market had a narrower basis than the Canadian markets. 1985 prices are lower in Omaha than 1984 and trended lower consistently throughout the year (Livestock, Meat and Wool Market News). The U.S. had the lowest number of cattle and calves on hand since 1963 (Cattle, 1986). Canadian markets increased cow slaughter and decreased their slaughter cattle exports to the U.S. (Livestock Market Review, 1985). Western Canadian producers, particularly in Alberta, faces declining asset values (Livestock Market Review) due mainly to the decline in oil revenues, and decreased feed supplies due to drought, are forced to increase their cow slaughter. Alberta decreased slaughter cattle marketings while Manitoba increased it's marketings by 11.5 per cent.

1986 All markets and futures contracts showed a basis which is narrower than the previous year. Alberta joined the National Tripartite Stabilization program for slaughter cattle and feeder calves.

This program is proposed to have bid up the cost of feeder calves (Livestock Market Review, 1986). Cow slaughter decreased by 22 per cent in Western Canada due to the improved crop and forage conditions (Livestock Market Review). Finished cattle prices are slightly higher in Winnipeg but lower for Alberta than the previous year (Livestock Market Review). Omaha prices continued the downward trend from 1985 (Livestock, Meat and Wool Market News).

1987 Manitoba had a notably wider basis for the April contract when compared to Omaha and Alberta. The Manitoba April contract closing basis is the widest for all markets and contracts in the year. The Canadian supply of beef is reduced due to herd rebuilding which created record high cattle prices (Livestock Market Review, 1987). The Winnipeg steer price is higher than the 1986 price by $6.18 per hundred weight, while the Calgary price increased by $9.38 per hundred weight. Omaha cash prices also increased $6.79 per hundred weight (US dollars)(Livestock, Meat and Wool Market News).

1988 Generally, the Canadian markets had the widest basis across contracts in this year. Western Canada experienced severe drought conditions

requiring federal assistance as prices dropped more than $6 per hundredweight in one quarter (Livestock Market Review, 1988). Omaha cash prices continued their upward trend from 1987 throughout 1988 (Livestock, Meat and Wool Market News).

In general, the earlier years studied have closer convergence of the basis than the later years and Omaha have closer convergence of the basis towards maturation of the futures contracts when compared to the Canadian markets. The Omaha basis did not widen beyond $.30 per hundred weight for all years and contracts while 1981 is the only year the Canadian markets had a $.30 per hundred weight basis at the close of the futures contract, while all others are larger. It is expected that the Canadian markets have a wider basis due to transportation and delivery costs. The basis may have widened since 1981 due to changes in slaughter weights and higher lean meat yield in carcasses developed in cattle since the futures contract specifications are developed. These cattle may demand a premium over the contract price.

5.2.1.2 Analysis by Contract

February This contract generally had a wider basis throughout the contract when compared to the other contracts offered. This may be due to more slaughter cattle becoming available after the Christmas season and the cash price dropping in response. U.S.D.A. inventory estimates are

released in early February and may cause a reaction in the futures market due to a change in expectations of future supply while current supplies may not be affected thereby having little effect on the cash prices.

April — This contract had a relatively narrow basis which may be due to the beginning of the "barbecue" season which has a typically higher demand for beef products and may be driving the slaughter cattle cash price up relative to the futures prices.

June — This contract had a slightly wider basis than the April contract which may be due to the onset of this contract falling between cattle on feed reports and correcting when information is released. Cash cattle prices are expected to remain strong during the summer season.

August — This contract had the narrowest basis. This may be consistent with the late July 13 State Cattle on feed report being released prior to the start of the contract so that information in both markets is current and summer demand is strong.

October — This contract showed the most volatility as the cash prices vacillated around the futures prices which also showed volatility. This would be a difficult situation for a hedger as margin calls may become frequent. The October futures contract

may be more volatile due to fluctuations in cash prices in the latter part of the year which may be due to cow and calf culling.

December The December contract basis are relatively narrow throughout the life of the contract. This contract represents a slower time for marketing slaughter cattle and therefore, one would expect fewer bids which may hold the cash price high.

For a short hedger a narrowing of the basis towards maturation of the contract is desirable (if basis is futures-cash), therefore the February contract is the least desirable from a profit maximizing goal. The contracts with the least basis variability should be the most attractive to the risk minimizing hedger. This relationship will be tested statistically.

5.2.1.3 Analysis by market

Omaha The Omaha market had the closest convergence of the cash and futures prices when compared to the Canadian markets studied. The June futures contract had the narrowest basis at expiration of the contract. The December futures contract is the least volatile.

Manitoba Manitoba and Alberta are similar in their behaviour when compared to the Omaha market. February contract prices trended similarly to the concurrent

cash prices until expiration of the contract. October and December futures contracts had inverted markets a greater proportion of the time when compared to the other contracts offered, especially during 1987. An inverted market is caused by an increased demand for the commodity in the cash market at the time and/or there is an expected increase in the supply of the commodity in the futures (Horn, 1984). This may be the case if packing houses do not have enough cattle to slaughter for wholesale demand and/or cattle are being held too long by the feedlot creating the expectation of increased future supplies.

These graphs suggest a closer relationship between the Canadian markets cash prices when compared to the Omaha cash prices. However, the strength of this relationship has been measured through statistical testing as in the subsection 5.2.2.4 below.

Some calendar months appear to have a widened basis during the life of the contract. The most prominent of these months include: August, 1983; June, 1984; September, 1984; February, 1985; August, 1985; January, 1986; February, 1986; July, 1988 and November, 1988. These periods are generally characterized by slow retail movement of beef to Montreal and high U.S. interest in importing Canadian slaughter cattle, due to low U.S. prices and a weakening of the Canadian dollar.

(Weekly Livestock Market Review). These periods are also characterized by over supply of slaughter cattle in the Canadian market and/or cattle which have lost condition by gaining fat (Weekly Livestock Market Review).

The August calendar months of 1983 and 1985 are characterized by severe drought in the U.S. which affected the corn crop, therefore, many cattle are slaughtered without finishing on a feedlot, that is they are not grain fed, which brought the U.S. prices down. Canadian markets did not have as severe a drought and had the Feed Grain Market Adjustment Program to subsidize the cost of feed in 1985. These demand and supply differences are masked in part by exchange rate fluctuations and imports of slaughter cattle from the U.S.

When analyzed over contracts some calendar months appear to have a widened basis. This is tested through statistical analysis.

5.2.2 Statistical analysis of the basis

5.2.2.1 Inverted markets

An average negative basis indicates an inverted market. Tables 27 to 32 report the statistical moments of the basis. A negative mean basis is found for 29 out of 71 periods studied for the Omaha basis or 41 per cent, while Manitoba and Alberta have only 3 per cent of the periods studied exhibiting a typically inverted market (1987). This is a period of herd rebuilding and smaller beef supplies in Canada.

Table 27.--February live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	53	3.82	2.92	-0.04	0.94	-1.16
1978	59	0.93	3.77	0.45	0.89	-1.20
1979	57	0.91	2.06	-0.46	0.96	0.29
1981	54	2.39	2.55	0.19	0.96	-0.76
1982	56	1.74	3.82	0.66	0.91	-0.57
1983	60	-3.14	3.56	-0.31	0.98	-0.03
1984	52	-0.83	3.37	-0.63	0.87	-1.02
1985	53	-0.07	2.49	-0.21	0.96	-0.58
1986	57	3.88	3.21	-0.41	0.88	-1.32
1987	56	-0.71	2.39	0.37	0.94	-0.93
1988	58	-2.08	3.46	-0.05	0.94	-0.88
			Manitoba			
1977	52	3.43	2.47	0.30	0.96	-0.83
1978	61	3.18	4.50	0.24	0.91	-1.31
1979	61	2.55	3.12	-0.89	0.93	0.44
1981	54	4.07	2.56	-0.23	0.98	0.25
1982	58	3.81	2.77	0.21	0.98	-0.42
1983	57	1.33	3.54	-1.07	0.91	1.05
1984	52	4.16	3.18	-0.40	0.97	-0.35
1985	52	5.94	2.43	-0.62	0.92	-0.68
1986	55	7.85	1.96	0.01	0.96	-0.86
1987	58	2.62	3.04	0.27	0.95	-0.89
1988	57	1.66	3.10	0.79	0.91	-0.20
			Alberta			
1977	53	3.83	2.10	0.33	0.95	-0.86
1978	61	3.15	4.71	0.14	0.91	-1.37
1979	61	1.81	3.27	-0.89	0.92	0.27
1981	54	3.62	2.52	-0.39	0.96	-0.56
1982	58	4.03	2.55	0.34	0.96	-0.51
1983	61	0.89	3.56	-1.03	0.91	0.71
1984	51	2.73	3.25	-0.37	0.95	-0.83
1985	53	5.02	2.54	-0.44	0.94	-0.76
1986	57	7.20	2.06	0.02	0.98	-0.53
1987	58	2.30	3.17	0.41	0.96	-0.45
1988	58	0.21	3.32	0.18	0.96	-0.61

Note: 1980 had only 2 observations and was deleted
outlined values statistically significant at 5% level

Table 28.--April live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	53	3.01	2.95	0.07	0.94	-1.04
1978	61	0.66	3.62	0.76	0.88	-0.52
1979	57	1.96	2.59	-0.31	0.98	-0.18
1980	66	2.67	3.15	-0.47	0.94	-0.51
1981	51	3.54	3.03	0.37	0.94	-0.93
1982	60	1.34	3.14	0.84	0.92	0.17
1983	60	-2.15	4.29	-0.33	0.96	-0.66
1984	53	0.86	3.47	-0.95	0.83	-0.47
1985	52	2.29	2.29	-0.39	0.97	-0.33
1986	59	4.50	3.62	-0.51	0.90	-0.10
1987	57	0.18	2.50	0.14	0.95	-1.08
1988	61	-0.34	3.43	-0.53	0.92	-0.79
			Manitoba			
1977	52	3.22	2.24	0.30	0.96	-0.30
1978	63	3.38	4.57	0.25	0.92	-1.25
1979	62	3.92	3.60	-0.73	0.95	0.17
1980	70	5.25	2.94	0.25	0.99	0.34
1981	52	4.51	2.14	-0.58	0.97	0.50
1982	61	4.56	3.24	0.25	0.96	-0.57
1983	57	2.53	4.59	-0.41	0.96	0.15
1984	53	6.03	3.37	-0.83	0.91	-0.17
1985	51	7.83	2.26	-1.01	0.94	1.44
1986	57	8.11	2.61	-0.37	0.94	-0.85
1987	59	3.37	3.07	0.25	0.98	-0.49
1988	60	3.84	3.35	0.27	0.93	-1.08
			Alberta			
1977	53	3.70	1.98	0.45	0.96	-0.38
1978	63	3.04	4.51	0.26	0.94	-0.96
1979	62	2.89	3.59	-0.81	0.93	0.15
1980	70	4.40	2.70	0.34	0.97	0.10
1981	52	3.98	2.47	-0.66	0.94	-0.14
1982	61	4.36	2.33	0.26	0.96	-0.73
1983	61	1.67	4.24	-0.61	0.95	-0.07
1984	52	4.69	3.27	-0.81	0.89	-0.40
1985	52	6.99	2.06	-0.63	0.96	0.79
1986	59	7.60	2.73	-0.44	0.93	-0.78
1987	59	2.52	2.43	-0.35	0.95	-0.73
1988	61	2.15	3.47	-0.27	0.95	-0.92

Note: outlined values statistically significant at 5% level

Table 29.--June live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	55	4.34	2.57	0.18	0.96	-0.84
1978	63	0.67	2.53	1.39	0.88	2.26
1979	63	2.48	2.85	0.23	0.97	-0.63
1980	71	3.43	3.22	-0.39	0.95	-0.64
1981	49	5.32	3.19	-0.13	0.94	-1.04
1982	60	0.48	2.11	1.14	0.91	1.21
1983	57	-0.34	3.94	-0.97	0.91	0.51
1984	53	1.84	2.73	0.01	0.96	-0.78
1985	52	3.82	2.06	0.01	0.94	-1.19
1986	56	3.71	3.76	0.09	0.93	-1.20
1987	57	-1.28	1.85	-0.19	0.97	-0.71
1988	61	-0.84	3.16	-0.52	0.94	-0.37
			Manitoba			
1977	55	5.24	2.19	0.11	0.97	-0.73
1978	65	2.91	3.56	0.49	0.94	-0.65
1979	68	4.52	3.44	-0.68	0.96	0.25
1980	74	6.14	2.82	0.49	0.97	0.23
1981	50	6.06	1.72	0.29	0.99	0.58
1982	60	4.14	2.32	0.16	0.98	-0.16
1983	54	3.85	4.10	-0.96	0.92	1.14
1984	53	7.14	2.17	-0.24	0.97	-0.59
1985	51	8.74	2.14	-0.41	0.96	-0.43
1986	55	7.28	3.10	-0.02	0.96	-0.92
1987	59	2.47	2.53	-0.35	0.94	-0.89
1988	61	3.52	2.68	-0.12	0.98	-0.44
			Alberta			
1977	56	5.56	2.09	-0.52	0.97	0.11
1978	65	2.42	3.65	0.38	0.96	-0.48
1979	68	3.53	3.43	-0.70	0.96	0.48
1980	74	5.33	2.67	0.60	0.96	0.13
1981	50	5.43	2.10	-0.09	0.96	-0.92
1982	60	4.00	1.89	0.10	0.97	-0.52
1983	58	3.29	3.70	-1.12	0.90	1.46
1984	53	5.98	1.91	0.18	0.97	-0.17
1985	52	7.79	2.14	-0.02	0.95	-1.06
1986	57	7.03	3.17	0.09	0.94	-1.11
1987	59	1.37	2.24	-0.10	0.96	-0.72
1988	62	2.45	2.96	-0.41	0.97	-0.03

Note: outlined values statistically significant at 5% level

Table 30.--August live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	58	4.02	2.75	0.00	0.96	-0.82
1978	64	-0.35	1.80	0.46	0.97	0.37
1979	66	1.61	3.09	0.35	0.94	-0.96
1980	77	2.53	3.04	-0.08	0.97	-0.57
1981	49	4.58	4.15	-0.40	0.91	-1.14
1982	57	-1.69	3.23	0.44	0.97	0.07
1983	58	-0.96	2.56	-0.11	0.95	-1.04
1984	53	0.13	2.98	0.49	0.89	-1.16
1985	54	3.17	2.27	0.24	0.95	-0.95
1986	55	0.85	3.52	0.94	0.91	0.33
1987	53	-3.83	2.18	-0.40	0.97	0.42
1988	60	-1.99	2.93	0.31	0.94	-0.69
			Manitoba			
1977	59	4.99	2.47	-0.02	0.96	-0.91
1978	66	1.48	3.25	-0.17	0.97	-0.41
1979	71	3.16	3.34	-0.20	0.97	-0.54
1980	79	5.66	2.58	0.48	0.98	1.06
1981	50	5.11	2.09	-0.39	0.94	-0.40
1982	56	2.43	3.00	-0.46	0.97	0.02
1983	55	3.41	2.45	0.05	0.99	-0.36
1984	53	5.72	2.44	-0.10	0.97	-0.81
1985	53	7.39	2.12	-0.41	0.95	-0.72
1986	54	4.72	3.01	0.20	0.98	0.18
1987	54	-0.35	1.89	0.46	0.97	0.02
1988	60	1.93	2.49	0.32	0.97	-0.45
			Alberta			
1977	60	5.29	2.50	-0.47	0.95	-0.56
1978	66	0.69	3.24	-0.34	0.96	-0.63
1979	71	2.13	3.32	-0.14	0.98	-0.13
1980	79	4.74	2.61	0.64	0.96	0.29
1981	50	4.73	2.53	-0.32	0.94	-0.92
1982	57	2.48	3.19	-0.95	0.91	0.46
1983	59	2.84	2.34	0.26	0.95	-0.80
1984	52	4.60	2.15	0.30	0.95	-0.71
1985	54	6.78	1.96	-0.13	0.93	-1.29
1986	56	4.25	2.99	0.50	0.94	-0.62
1987	54	-1.55	2.09	0.03	0.97	0.80
1988	61	1.10	2.12	-0.04	0.98	0.45

Note: outlined values statistically significant at 5% level

Table 31.--October live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	61	2.94	3.12	-0.07	0.94	-1.15
1978	63	-1.06	1.73	-0.53	0.98	0.95
1979	66	0.82	3.58	0.14	0.94	-1.05
1980	78	1.20	3.15	-0.21	0.97	-0.26
1981	53	2.57	4.53	-0.22	0.93	-1.17
1982	60	-3.11	3.93	0.12	0.98	-0.10
1983	56	-2.21	2.92	-0.64	0.91	-0.67
1984	53	-1.81	2.64	0.45	0.93	-0.82
1985	62	2.39	2.57	-0.44	0.92	-1.02
1986	56	-0.60	2.57	0.13	0.98	-0.18
1987	56	-3.83	3.55	0.71	0.91	-0.16
1988	60	-1.65	3.81	-0.13	0.94	-1.03
			Manitoba			
1977	63	4.11	2.94	-0.05	0.93	-1.15
1978	66	0.54	3.20	-0.38	0.97	0.24
1979	71	2.61	3.31	-0.09	0.97	-0.66
1980	79	3.91	3.10	-0.33	0.98	1.59
1981	54	3.39	2.46	-0.39	0.96	-0.68
1982	59	0.88	3.39	-0.83	0.93	0.46
1983	54	2.00	2.52	-0.21	0.98	-0.34
1984	53	3.93	2.23	-0.23	0.92	-1.20
1985	61	6.35	1.84	-0.67	0.95	0.14
1986	55	3.31	2.37	-0.32	0.97	-0.57
1987	57	-0.57	2.93	0.93	0.90	0.11
1988	60	2.66	3.61	0.50	0.95	-0.47
			Alberta			
1977	63	4.13	3.26	-0.32	0.91	-1.24
1978	66	-0.36	3.13	-0.27	0.96	-0.70
1979	71	1.83	3.04	0.35	0.94	-0.89
1980	79	3.46	2.85	-0.09	0.94	1.68
1981	54	3.21	2.80	-0.33	0.94	-1.06
1982	60	0.77	3.44	-0.93	0.91	0.35
1983	57	1.17	2.53	-0.24	0.92	-1.17
1984	52	3.04	2.33	0.17	0.95	-1.11
1985	62	5.43	2.35	-0.28	0.92	-1.19
1986	57	2.78	2.26	0.20	0.96	-0.52
1987	57	-1.95	2.70	0.61	0.94	-0.32
1988	61	1.38	3.24	0.25	0.97	-0.39

Note: outlined values statistically significant at 5% level

Table 32.--December live cattle contract basis characteristics by year and market (US$), 1977 to 1988

Year	No. obs.	Mean	Standard deviation	Skewness	Normality	Kurtosis
			Omaha			
1977	60	1.90	3.13	-0.04	0.94	-0.93
1978	60	-0.03	1.82	-0.50	0.97	0.81
1979	64	2.19	3.67	-0.13	0.94	-0.99
1980	78	2.72	2.87	-0.24	0.97	-0.65
1981	66	3.54	4.17	-0.25	0.95	-0.94
1982	59	-2.59	4.01	-0.02	0.98	-0.17
1983	51	-1.18	3.30	-0.36	0.93	-1.04
1984	51	-0.83	2.64	0.24	0.94	-1.11
1985	62	4.12	2.60	-0.48	0.93	-0.74
1986	60	-0.52	1.81	0.28	0.98	-0.02
1987	59	-2.56	3.43	0.21	0.95	-0.90
1988	61	-0.01	4.16	-0.10	0.93	-1.15
			Manitoba			
1977	62	3.74	3.75	0.12	0.94	-1.15
1978	62	1.58	3.20	-0.55	0.96	0.08
1979	69	4.36	3.22	-0.08	0.96	-0.94
1980	79	4.81	3.15	0.03	0.98	-0.34
1981	67	4.26	2.35	-0.35	0.97	-0.58
1982	57	1.41	3.45	-1.09	0.90	0.91
1983	51	3.52	2.66	-0.54	0.95	-0.08
1984	51	5.22	2.45	-0.30	0.91	-1.29
1985	61	7.97	1.85	-0.76	0.95	0.32
1986	59	3.41	2.39	0.11	0.97	-0.48
1987	59	0.77	2.67	0.51	0.91	-0.95
1988	59	5.01	4.54	0.35	0.93	-1.05
			Alberta			
1977	62	3.79	4.07	-0.20	0.93	-1.09
1978	62	0.75	3.07	-0.54	0.95	-0.42
1979	69	3.55	3.19	0.06	0.94	-1.09
1980	79	4.18	3.34	-0.11	0.96	-0.11
1981	67	4.46	2.58	-0.38	0.95	-0.79
1982	60	1.23	3.41	-1.13	0.88	0.67
1983	50	2.13	2.54	-0.41	0.95	-0.66
1984	51	4.37	2.59	-0.04	0.93	-1.28
1985	62	7.05	2.35	-0.19	0.96	-0.82
1986	61	3.12	2.70	0.47	0.97	0.14
1987	60	-0.47	3.01	0.13	0.97	-0.83
1988	62	3.65	3.80	-0.20	0.93	-1.17

Note: outlined values statistically significant at 5% level

5.2.2.2 Skewness

The basis, in U.S. dollars, exhibits significant skewness or bias for 18 per cent of the periods studied for Omaha, 25 per cent of the time for Manitoba and 23 per cent of the periods for Alberta. A negatively skewed basis indicates outliers where the cash price is higher than the futures. Omaha would be expected to exhibit more of negative basis due to the higher number of inverted market occurrences. Of these occurrences 46 per cent of Omaha's skewed basis are negative, however, Manitoba has 78 per cent of the occurrences as negative while Alberta has 81 per cent. This may be due to Omaha exhibiting more fluctuation in prices which even out the skewness as tested below.

5.2.2.3 Kurtosis

The basis for Omaha shows significant kurtosis for 42 per cent of the periods studied of which only 2 are positive, Manitoba and Alberta have 28 per cent of the periods studied with significant kurtosis with 5 and 2 being positive respectively. These numbers indicate a non-normal distribution for the basis, therefore, standard statistical procedures may not forecast the basis well.

5.2.2.4 Normality

The Manitoba basis shows the highest occurrence of normality as opposed to it's results for the cash price. 67.5 per cent of the time periods studied have normal

distributions. Alberta follows with 60.5 per cent of the periods having a normal distribution. The Omaha market has the least normally distributed distributions of basis with 42 per cent. The August contract has the largest percentage of basis series with normal distributions (72.33%). February, June and December contracts also have over 50% of the periods studied showing normal basis distributions. The October and April contracts have the least amount of occurrences of normal distributions with 44.33 and 49.67 per cent respectively.

The earlier two quarters have a higher percentage of normal distribution of basis occurrences. The normality of the basis is analyzed in US$ for U.S. and Canadian markets.

5.2.2.5 Test for Differences

Table 33 shows the results for the Wilcoxon Sum Rank Test by futures contract. All contracts in all periods reflect a statistically significant different mean between the Canadian and Omaha basis, however Manitoba and Alberta did not show significantly different basis as is indicated by the graphs above. The standard deviation, skewness and kurtosis of the basis, however, show no significant differences between markets.

This result indicates that the basis is significantly different for the U.S. and Canada when measured in the same terms (U.S. dollars), although the distributions of the basis are not significantly different. Therefore, the performance of the futures markets should be similar for the U.S. and

Table 33.--Wilcoxon Sum Rank Test for Differences between live cattle basis characteristics by markets over futures contract life, (US$)

Futures Contract	mean		Std. deviation		skewness		kurtosis	
	Z est.	Z test	Z est.	Z test	Z est.	Z test	Z est.	Z test
Omaha vs. Manitoba								
February	-2.76	0.01	0.59	0.55	0.13	0.90	-1.18	0.24
April	-3.44	0.00	0.38	0.71	0.32	0.75	-1.18	0.24
June	-2.92	0.00	0.87	0.39	-0.03	0.98	-0.84	0.40
August	-2.66	0.01	1.07	0.29	1.27	0.20	-1.24	0.21
October	-3.03	0.00	1.24	0.21	0.92	0.36	-1.10	0.27
December	-2.97	0.00	0.49	0.62	0.43	0.67	-0.55	0.58
Manitoba vs. Alberta								
February	-0.59	0.55	0.39	0.69	0.03	0.97	-0.39	0.69
April	-1.13	0.26	-0.55	0.58	0.03	0.98	-0.52	0.60
June	-0.90	0.37	-0.12	0.91	-0.61	0.54	-0.06	0.95
August	-0.72	0.47	0.03	0.98	-0.03	0.98	-0.32	0.75
October	-0.66	0.51	-0.09	0.93	0.87	0.39	-1.24	0.21
December	-0.89	-0.89	0.35	0.73	0.06	0.95	-0.55	0.58
Omaha vs. Alberta								
February	-2.30	0.02	0.43	0.67	0.39	0.69	-1.02	0.31
April	-2.74	0.01	0.87	0.39	0.78	0.44	-0.90	0.37
June	-2.40	0.02	0.55	0.58	0.46	0.64	-0.66	0.51
August	-2.28	0.02	1.07	0.29	1.18	0.24	-1.13	0.26
October	-2.40	0.02	1.36	0.17	0.03	0.98	0.69	0.49
December	-2.63	0.01	0.61	0.54	0.35	0.73	-0.09	0.93

Note: outlined coefficients are statistically significant at 5% level

Canada as is found by Novak and Unterschultz, when measuring in U.S. dollars.

5.2.2.6 Seasonality of the basis

Monthly seasonality of the basis is tested by futures contract and market with the results to be found in Table 34. The only statistically significant seasonality for Omaha is found in the May calendar months of the April, October and December futures contracts, as well as the April and June calendar month basis of the December futures contract. All seasonality found in this market is negative. Therefore the basis is significantly lower during the month of May for those futures contracts. This is consistent with the summer increase for beef which drives up the cash price closer to the futures price, decreasing the basis.

The Manitoba basis shows significant seasonality for the February calendar month of the February and October futures contracts. The effect is positive, indicating a widening of the basis during that time. A widening of the basis is typically due to a decrease in the cash cattle price, since the futures price is usually higher than the cash price. Negative seasonality is found for the June calendar month of the October and December futures contracts.

Table 34.--Monthly seasonality of the basis by market and futures contract (US$), 1977 to 1988

Calendar Month	Manitoba Beta coeff.	Manitoba t-test	Omaha Beta coeff.	Omaha t-test	Alberta Beta coeff.	Alberta t-test
February Live Cattle Contract						
January	0.43	0.35	0.39	0.30	0.22	0.17
February	2.46	2.07	1.14	0.93	1.93	1.55
March	1.07	1.56	0.04	0.06	0.27	0.38
April	0.44	0.32	-1.17	-0.80	-1.37	-0.93
May	-1.59	-1.16	-2.34	-1.60	-2.60	-1.81
June	-0.99	-0.73	-2.20	-1.51	-1.40	-0.97
July	0.45	0.34	-0.76	-0.53	0.19	0.13
August	0.86	0.62	0.70	0.49	0.28	0.19
September	0.07	0.05	1.00	0.70	-0.23	-0.16
October	-0.20	-0.14	1.04	0.73	-1.42	-0.99
November	-0.74	-0.54	0.57	0.40	-1.63	-1.13
intercept	3.16	3.33	0.50	0.51	3.35	3.38
F-value|D.W.	1.78	0.71	1.46	0.60	1.85	0.61
April Live Cattle Contract						
January	0.08	0.06	-0.08	-0.06	-0.09	-0.07
February	1.74	1.37	0.45	0.35	1.47	1.16
March	0.94	1.58	0.00	0.01	0.35	0.60
April	1.00	0.84	-0.69	-0.57	-0.60	-0.51
May	-2.15	-1.60	-3.15	-2.28	-2.70	-2.02
June	-1.66	-1.23	-2.67	-1.93	-1.61	-1.20
July	0.03	0.02	-0.93	-0.67	0.28	0.21
August	0.27	0.20	0.26	0.20	0.05	0.04
September	-0.18	-0.14	0.60	0.44	-0.12	-0.09
October	-0.37	-0.27	0.68	0.51	-1.05	-0.79
November	-0.59	-0.44	0.39	0.29	-1.20	-0.90
intercept	4.56	4.88	1.96	2.09	4.33	4.67
F-value|D.W.	1.84	0.95	1.61	0.78	1.50	0.91
June Live Cattle Contract						
January	0.79	0.61	0.47	0.35	0.56	0.44
February	2.15	1.70	0.98	0.76	1.68	1.33
March	1.22	1.96	0.20	0.31	0.50	0.81
April	0.41	0.33	-1.27	-0.99	-1.17	-0.95
May	-1.28	-1.11	-2.23	-1.86	-1.94	-1.68
June	-0.88	-0.76	-1.36	-1.14	-0.93	-0.81
July	1.00	0.79	-0.01	-0.01	1.09	0.86
August	1.21	0.94	1.13	0.86	0.80	0.62
September	0.70	0.54	1.44	1.09	0.64	0.49
October	0.63	0.49	1.61	1.22	-0.20	-0.15
November	0.37	0.29	1.24	0.94	-0.39	-0.30
intercept	4.46	4.88	1.79	1.92	4.37	4.79
F-value|D.W.	1.86	0.75	2.22	0.62	1.81	0.71

Table 34.--Continued

Calendar Month	Manitoba Beta coeff.	Manitoba t-test	Omaha Beta coeff.	Omaha t-test	Alberta Beta coeff.	Alberta t-test
August Live Cattle Contract						
January	0.88	0.68	0.38	0.28	0.70	0.52
February	2.23	1.74	0.83	0.61	1.82	1.36
March	0.75	1.19	-0.16	-0.24	0.09	0.14
April	0.80	0.65	-1.11	-0.83	-0.94	-0.73
May	-1.73	-1.40	-2.53	-1.90	-2.20	-1.74
June	-1.63	-1.36	-2.16	-1.65	-1.62	-1.30
July	-0.82	-0.71	-1.11	-0.91	-0.62	-0.53
August	0.36	0.32	0.46	0.39	-0.05	-0.04
September	0.48	0.38	1.18	0.87	0.40	0.30
October	0.31	0.25	1.31	0.96	-0.53	-0.39
November	0.14	0.11	0.10	0.73	-0.63	-0.47
intercept	3.87	4.27	1.10	1.14	3.80	4.01
F-value | D.W.	1.93	0.78	2.01	0.56	1.42	0.71
October Live Cattle Contract						
January	0.57	0.46	-0.03	-0.02	0.34	0.27
February	2.77	2.20	1.07	0.79	2.04	1.62
March	0.57	0.92	-0.37	-0.54	-0.13	-0.20
April	0.24	0.20	-1.45	-1.05	-1.50	-1.19
May	-2.19	-1.82	-2.96	-2.18	-2.87	-2.32
June	-2.63	-2.15	-2.05	-1.54	-2.72	-2.24
July	-0.45	-0.39	-0.93	-0.71	-0.40	-0.34
August	0.79	0.69	1.09	0.87	0.39	0.33
September	0.26	0.23	1.19	0.98	0.18	0.16
October	0.28	0.26	1.35	1.15	-0.55	-0.50
November	0.11	0.09	0.98	0.72	-0.65	-0.51
intercept	2.95	3.39	0.18	0.19	2.88	3.22
F-value | D.W.	2.80	0.88	2.61	0.65	2.53	0.75
December Live Cattle Contract						
January	0.72	0.70	-0.03	-0.02	0.22	0.20
February	1.15	1.19	-0.20	-0.18	0.58	0.56
March	0.65	1.20	-0.37	-0.59	-0.11	-0.19
April	-0.86	-0.91	-2.60	-2.37	-2.76	-2.74
May	-1.95	-1.85	-2.56	-2.16	-2.78	-2.48
June	-2.27	-2.30	-3.66	-3.28	-2.51	-2.38
July	-0.71	-0.73	-1.48	-1.33	-0.66	-0.64
August	0.03	0.03	0.20	0.19	-0.65	-0.63
September	-0.01	-0.01	0.67	0.62	-0.29	-0.28
October	0.35	0.38	1.34	1.28	-0.59	-0.60
November	0.10	0.11	0.97	0.95	-0.75	-0.78
intercept	3.68	5.87	1.07	1.50	3.72	5.50
F-value | D.W.	1.90	0.86	3.56	0.63	2.10	0.80

Note: outlined values statistically significant at 5% level

Alberta basis seasonality appears to follow the Omaha pattern more than that of Manitoba. The only difference between Alberta and Omaha being that the June calendar month is also significantly different for the October futures contract.

All the t-test estimates are low (2.02 to 3.15 for dummy variables), therefore, using these estimates to predict basis may not create reliable forecasts.

5.3 Hedging Ratios

This section will report and analyze the results from the bivariate regression model equation 16, adjusted for autocorrelation. These results are found in Tables 35 to 40, and are analyzed over time, futures contract and market.

5.3.1 Hedging ratio over time

The year 1977 shows a low hedging ratio over markets and contracts. This year is characterized by a stabilization of slaughter cattle prices from the previous year (Livestock Market Review, 1977). When averaged by year and segmented into quartiles over the period from 1977 to 1988, the first three years shows an average hedge ratio of .56. That is, for every unit of cattle to be hedged, only 56 per cent of the corresponding amount of futures contract cattle are required to provide the hedge. The next quartile covering 1988 to 1982 had a similar hedge ratio of .57, while the next quartile had an average ratio of .52 and the last quartile covering 1986 to

Table 34.--Autoregressive adjusted hedge ratios during Feb. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	30.09	0.24	1.67	0.38	0.83
1978	25.10	0.40	5.61	0.85	0.57
1979	10.76	0.81	8.14	0.93	0.87
1981	28.24	1.73	4.57	0.81	0.63
1982	40.43	0.60	4.14	0.83	0.51
1983	26.32	0.38	16.92	0.97	1.54
1984	28.66	0.56	6.41	0.90	0.36
1985	33.31	0.55	21.59	0.99	1.03
1986	25.36	0.49	8.88	0.93	0.37
1987	26.79	0.60	4.71	0.79	0.74
1988	32.06	0.53	3.86	0.73	0.41
			Manitoba		
1977	22.62	0.45	3.43	0.78	0.32
1978	26.57	0.34	7.37	0.93	0.52
1979	17.36	0.70	10.22	0.95	0.74
1981	27.72	0.61	4.56	0.81	0.55
1982	38.49	0.41	3.50	0.81	0.57
1983	27.05	0.55	14.34	0.96	1.33
1984	33.79	0.46	4.10	0.84	0.38
1985	32.44	0.50	23.77	0.99	0.71
1986	19.45	0.75	6.63	0.88	0.32
1987	33.03	0.42	4.89	0.85	0.70
1988	42.47	0.32	1.96	0.57	0.42
			Alberta		
1977	21.46	0.48	3.86	0.82	0.34
1978	26.67	0.34	8.10	0.94	0.64
1979	17.58	0.69	11.30	0.97	0.55
1981	26.33	0.63	4.55	0.80	0.53
1982	30.57	0.54	4.84	0.86	0.75
1983	26.22	0.57	15.97	0.97	1.22
1984	34.33	0.45	5.42	0.86	0.39
1985	32.41	0.50	23.57	0.99	0.55
1986	21.70	0.70	9.09	0.93	0.33
1987	31.52	0.45	5.40	0.86	0.73
1988	33.38	0.47	3.48	0.67	0.44

Note: 1980 had only 2 observations and was deleted
outlined coefficients statistically significant at 5% level

Table 35.--Autoregressive adjusted hedge ratios during Apr. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	31.21	0.21	1.77	0.31	1.15
1978	20.63	**0.54**	4.68	0.85	0.45
1979	11.23	**0.83**	9.53	0.96	0.59
1980	24.84	**0.65**	12.59	0.95	0.59
1981	34.13	**0.50**	4.17	0.87	0.43
1982	33.24	**0.50**	4.67	0.83	0.57
1983	30.96	**0.50**	6.66	0.91	0.49
1984	35.57	**0.45**	4.25	0.83	0.68
1985	30.83	**0.53**	8.76	0.91	1.18
1986	28.73	**0.54**	7.51	0.89	0.35
1987	20.63	**0.66**	5.12	0.85	0.31
1988	28.12	**0.57**	5.07	0.81	0.28
			Manitoba		
1977	21.91	**0.47**	5.11	0.90	0.20
1978	27.35	**0.35**	3.26	0.75	0.47
1979	18.91	**0.71**	7.38	0.93	0.56
1980	27.01	**0.63**	10.17	0.92	0.96
1981	28.63	**0.59**	3.45	0.80	0.59
1982	36.46	**0.44**	3.18	0.82	0.54
1983	31.96	**0.49**	7.07	0.88	0.54
1984	40.79	**0.35**	3.04	0.77	0.58
1985	35.01	**0.45**	6.65	0.85	1.10
1986	30.66	**0.51**	4.93	0.81	0.35
1987	34.90	**0.40**	2.98	0.79	0.32
1988	32.77	**0.51**	3.35	0.64	0.32
			Alberta		
1977	23.28	**0.44**	0.76	0.76	0.57
1978	24.06	**0.45**	4.41	0.82	0.38
1979	18.35	**0.72**	8.25	0.94	0.44
1980	25.34	**0.65**	10.88	0.93	0.98
1981	30.04	**0.57**	4.55	0.81	0.37
1982	22.72	**0.68**	5.85	0.88	0.80
1983	27.83	**0.56**	7.45	0.90	0.42
1984	40.33	**0.36**	3.17	0.75	0.60
1985	35.56	**0.45**	6.54	0.86	1.07
1986	28.93	**0.54**	6.40	0.87	0.34
1987	21.80	**0.65**	5.56	0.88	0.43
1988	30.31	**0.55**	4.22	0.71	0.35

Note: outlined coefficients statistically signficant at 5% level

Table 36.--Autoregressive adjusted hedge ratios during Jun. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	26.43	0.36	4.05	0.69	1.01
1978	10.47	0.78	8.26	0.96	0.47
1979	16.82	0.74	11.12	0.98	0.36
1980	29.66	0.59	10.62	0.92	0.52
1981	38.15	0.46	5.79	0.92	0.58
1982	25.42	0.62	4.95	0.85	0.95
1983	31.52	0.50	10.94	0.95	1.18
1984	30.52	0.54	11.57	0.94	1.57
1985	27.64	0.59	7.28	0.91	0.63
1986	28.78	0.52	6.94	0.89	0.46
1987	16.87	0.71	9.52	0.96	0.55
1988	32.74	0.51	6.40	0.92	0.44
			Manitoba		
1977	23.86	0.43	4.67	0.82	0.67
1978	17.37	0.65	9.93	0.97	0.28
1979	23.00	0.65	9.36	0.96	0.59
1980	33.88	0.52	7.46	0.87	0.65
1981	26.46	0.66	3.67	0.75	1.12
1982	24.56	0.65	5.97	0.87	0.89
1983	31.89	0.49	10.44	0.94	1.03
1984	32.29	0.51	8.28	0.90	1.50
1985	37.08	0.41	3.96	0.74	0.33
1986	32.36	0.45	4.21	0.75	0.56
1987	25.58	0.58	5.44	0.92	0.30
1988	34.98	0.48	5.07	0.87	0.38
			Alberta		
1977	23.76	0.43	4.80	0.82	0.65
1978	16.64	0.66	10.68	0.98	0.27
1979	22.42	0.65	9.19	0.96	0.48
1980	35.34	0.50	6.84	0.87	0.65
1981	33.63	0.53	4.77	0.81	0.47
1982	14.09	0.82	10.38	0.93	1.57
1983	31.68	0.50	10.41	0.94	1.11
1984	30.26	0.55	8.24	0.89	1.70
1985	36.23	0.43	4.58	0.80	0.31
1986	29.86	0.50	5.55	0.82	0.51
1987	21.12	0.66	7.05	0.93	0.44
1988	34.93	0.48	6.45	0.87	0.34

Note: outlined coefficients statistically signficant at 5% level

Table 37.--Autoregressive adjusted hedge ratios during Aug. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	27.13	0.34	5.82	0.79	1.38
1978	7.87	0.83	12.49	0.96	1.10
1979	17.15	0.73	13.19	0.98	0.31
1980	27.09	0.62	9.51	0.91	0.71
1981	41.80	0.39	5.00	0.87	0.36
1982	29.75	0.53	7.15	0.92	1.04
1983	30.12	0.52	5.67	0.87	0.90
1984	27.20	0.58	22.58	0.97	2.76
1985	26.41	0.59	5.75	0.88	0.61
1986	27.51	0.53	8.05	0.92	0.62
1987	22.11	0.61	7.92	0.93	0.50
1988	26.53	0.59	11.64	0.95	1.46
			Manitoba		
1977	26.01	0.36	5.18	0.85	0.75
1978	18.06	0.62	9.70	0.97	0.60
1979	25.49	0.60	7.19	0.94	0.56
1980	31.42	0.57	7.06	0.85	0.89
1981	36.03	0.49	3.74	0.81	0.56
1982	29.02	0.55	7.98	0.91	1.08
1983	37.51	0.38	4.65	0.77	0.73
1984	27.59	0.59	13.33	0.94	2.50
1985	24.68	0.64	3.38	0.77	0.52
1986	31.28	0.45	5.03	0.81	0.67
1987	26.49	0.55	5.22	0.87	0.67
1988	28.00	0.58	6.63	0.88	1.08
			Alberta		
1977	26.30	0.35	4.90	0.85	0.72
1978	17.09	0.64	10.60	0.98	0.56
1979	25.84	0.59	6.90	0.94	0.53
1980	31.43	0.56	6.71	0.85	0.97
1981	33.29	0.53	5.59	0.85	0.34
1982	28.45	0.60	8.44	0.92	1.02
1983	30.25	0.52	5.62	0.85	0.80
1984	30.12	0.54	9.36	0.91	2.02
1985	18.53	0.76	5.57	0.88	0.64
1986	29.81	0.48	6.33	0.86	0.65
1987	23.42	0.60	7.80	0.93	0.45
1988	21.70	0.67	7.97	0.90	1.27

Note: outlined coefficients statistically signficant at 5% level

Table 38.--Autoregressive adjusted hedge ratios during Oct. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	27.25	0.33	6.99	0.82	1.54
1978	25.37	0.87	13.71	0.96	1.44
1979	19.40	0.70	11.74	0.96	0.82
1980	30.47	0.56	7.52	0.83	1.14
1981	45.15	0.32	3.70	0.72	0.67
1982	29.71	0.52	9.22	0.93	1.12
1983	23.00	0.62	9.63	0.86	2.41
1984	27.03	0.57	7.89	1.00	3.34
1985	24.93	0.61	9.79	0.95	1.05
1986	26.88	0.54	6.01	0.87	0.52
1987	31.43	0.48	4.67	0.86	0.21
1988	37.23	0.44	7.53	0.92	0.32
			Manitoba		
1977	24.67	0.40	6.33	0.90	0.50
1978	16.36	0.66	9.07	0.96	0.70
1979	23.37	0.64	6.51	0.91	0.66
1980	33.44	0.52	7.81	0.87	0.90
1981	40.36	0.40	2.94	0.73	0.50
1982	28.55	0.54	9.04	0.91	1.26
1983	35.35	0.41	4.94	0.77	1.50
1984	27.13	0.58	26.25	0.98	2.54
1985	23.12	0.66	6.25	0.90	0.88
1986	29.08	0.50	4.67	0.82	0.57
1987	41.91	0.30	2.17	0.81	0.18
1988	36.59	0.44	4.40	0.81	0.75
			Alberta		
1977	24.56	0.40	6.84	0.92	0.53
1978	15.83	0.67	9.92	0.97	0.65
1979	22.08	0.66	7.00	0.91	0.72
1980	33.63	0.51	6.67	0.83	0.97
1981	34.99	0.49	4.79	0.85	0.52
1982	28.58	0.54	9.03	0.92	1.14
1983	29.88	0.51	7.02	0.84	1.79
1984	28.06	0.56	20.10	0.97	2.01
1985	22.78	0.66	8.74	0.94	0.69
1986	27.37	0.53	4.82	0.86	0.60
1987	27.98	0.53	3.85	0.83	0.28
1988	37.34	0.43	3.67	0.75	0.72

Note: outlined coefficients statistically signficant at 5% level

Table 39.--Autoregressive adjusted hedge ratios during Dec. futures contract by year and market (US$), 1977 to 1988

Year	inter-cept term	Hedging ratio (beta)	t statistic	Hedging efficiency (R-square)	Durbin-Watson statistic
			Omaha		
1977	26.08	0.37	7.23	0.85	0.94
1978	4.36	0.91	11.47	0.94	1.31
1979	20.74	0.70	20.79	0.98	0.88
1980	29.37	0.58	6.34	0.77	0.64
1981	42.08	0.37	4.08	0.78	0.29
1982	28.47	0.53	14.36	0.96	1.32
1983	31.22	0.49	10.23	0.93	0.81
1984	35.79	0.44	12.58	0.94	1.24
1985	24.86	0.62	13.22	0.97	0.82
1986	22.50	0.61	7.52	0.89	1.12
1987	28.13	0.54	8.76	0.94	0.16
1988	30.65	0.53	8.21	0.94	0.57
			Manitoba		
1977	24.58	0.40	8.41	0.93	0.57
1978	16.04	0.69	9.08	0.94	0.77
1979	22.34	0.68	10.47	0.94	0.84
1980	34.06	0.51	6.40	0.83	0.84
1981	40.28	0.39	2.40	0.91	0.30
1982	26.71	0.56	14.10	0.94	1.59
1983	31.38	0.49	7.81	0.89	0.77
1984	34.09	0.46	10.57	0.93	0.96
1985	25.42	0.63	7.97	0.92	0.71
1986	32.06	0.44	5.66	0.88	0.81
1987	30.89	0.49	4.55	0.89	0.14
1988	32.58	0.51	6.04	0.91	0.45
			Alberta		
1977	24.94	0.39	8.97	0.94	0.67
1978	15.86	0.69	9.64	0.95	0.61
1979	21.78	0.69	11.40	0.94	1.01
1980	36.13	0.48	6.05	0.84	0.58
1981	31.99	0.53	4.21	0.82	0.35
1982	25.88	0.58	17.20	0.96	1.60
1983	30.57	0.50	10.47	0.93	0.73
1984	33.75	0.47	11.16	0.95	0.90
1985	27.23	0.59	10.51	0.94	0.70
1986	31.01	0.46	6.53	0.90	0.80
1987	25.02	0.59	8.95	0.94	0.12
1988	35.80	0.46	6.24	0.91	0.35

Note: outlined coefficients statistically signficant at 5% level

1988 has a hedge ratio of .53.

These results indicate a fewer number of contracts is needed over time across markets and contracts to hedge a unit of output.

5.3.2 Hedge ratios over futures contracts

The hedge ratio ranges from .53 to .56 when averaged over years and markets for the futures contracts. The June and August futures contracts have the highest ratios (.55 and .56 respectively) while April and October have the lowest at .53 each.

5.3.3 Hedge ratio over markets

When the hedging ratio is averaged over years and contracts to obtain market averages, Omaha has the highest ratio at .57 while Manitoba has the lowest at .51. Alberta has a hedge ratio of .54.

The Omaha market is expected to have a hedge ratio which is closer to one than the Canadian markets as the hedge is not a cross-hedge.

5.4 Hedging effectiveness

Hedging effectiveness is first measured in terms of cash prices (U.S. dollars) risk reduction through comparison of the R-square from equation 16 adjusted for autocorrelation. These results are found in Tables 35 to 40. These results are compared over time, by contract and region. Then exchange rate effects on the hedge efficiency are removed and a

comparison of the basis risk in Canadian dollars is made with the cash price risk in Canadian dollars as measured by the standard deviation.

5.4.1 R-square measures of efficiency

As mentioned in section 2.3 (Witt, Schroeder and Hayenga), high levels of autocorrelation may overstate the R square measure and therefore the efficiency of the hedge. However, when tested, only the December, 1987 futures contract has a significant autocorrelation coefficient over .80 at .84. The autocorrelation coefficients may be found in Appendix F with their respective t-test estimates.

5.4.1.1 R square efficiency over time

When averaged over markets and contracts by year and dividing the yearly averages into quartiles, no distinct pattern emerges. The quartiles ranged from hedging efficiency measures of 86 per cent to 89 per cent.

These results indicate no change over the periods studied of the efficiency of hedging.

5.4.1.2 R square efficiency over contracts

When averaged over years and markets, hedging efficiency measures ranges from 82 per cent to 91 per cent, with the October futures contract being the least effective and the December contract being the most. The June and August futures contracts also shows high efficiency measures at 89 per cent.

These results indicate a risk minimizing hedger would

prefer to use the June, August and December contracts to the other contracts offered.

5.4.1.3 R square efficiency over markets

When averaged over years and contracts, Alberta has a slightly higher R square of 88 per cent compared to Omaha's 87 per cent, while Manitoba has 85 per cent. Omaha would have been expected to have the highest degree of efficiency due to the lack of cross-hedging effects.

These comparisons are all in U.S. dollars, however, a Canadian producer will realize efficiencies in Canadian dollars, this is examined below.

5.4.2 Hedging effectiveness and basis risk

Assuming that the hedger intends to minimize his or her risk, they will choose to hedge only if the risk of the basis or hedge is lower than that of the cash price. Therefore tables 41 to 46 show the results from comparing the standard deviations of cash cattle prices and the basis over years and markets in Canadian dollars to find the risk minimizing position. These results are analyzed over time, contract and market.

Table 40.--Standard Deviation Test for Manitoba and Alberta basis and cash prices (CND$) for Feb. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	2.47	2.33	-0.14	CASH
1978	4.82	3.61	-1.21	CASH
1979	3.59	8.84	5.25	HEDGE
1981	3.02	3.78	0.76	HEDGE
1982	3.32	3.67	0.35	HEDGE
1983	4.39	5.96	1.57	HEDGE
1984	3.94	3.54	-0.40	CASH
1985	3.18	2.57	-0.61	CASH
1986	2.70	3.88	1.18	HEDGE
1987	4.20	3.55	-0.65	CASH
1988	4.06	3.22	-0.84	CASH
		Alberta		
1977	2.10	2.84	0.74	HEDGE
1978	5.04	2.76	-2.28	CASH
1979	3.76	5.81	2.05	HEDGE
1981	2.97	3.43	0.46	HEDGE
1982	3.06	3.85	0.79	HEDGE
1983	4.41	2.06	-2.35	CASH
1984	4.03	3.09	-0.94	CASH
1985	3.33	0.84	-2.49	CASH
1986	2.84	3.14	0.30	HEDGE
1987	4.37	2.57	-1.80	CASH
1988	4.35	4.00	-0.35	CASH

Table 41.--Standard Deviation Test for Manitoba and Alberta basis and cash prices (CND$) for Apr. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	2.26	2.38	0.12	HEDGE
1978	4.98	4.44	-0.54	CASH
1979	4.14	8.91	4.77	HEDGE
1980	3.44	4.17	0.73	HEDGE
1981	2.53	3.38	0.85	HEDGE
1982	3.92	3.80	-0.12	CASH
1983	5.69	5.57	-0.12	CASH
1984	4.18	4.03	-0.15	CASH
1985	3.01	2.44	-0.57	CASH
1986	3.60	3.78	0.18	HEDGE
1987	4.21	3.49	-0.72	CASH
1988	4.35	3.11	-1.24	CASH
		Alberta		
1977	2.00	2.99	0.99	HEDGE
1978	4.92	4.35	-0.57	CASH
1979	4.13	7.78	3.65	HEDGE
1980	3.16	3.20	0.04	HEDGE
1981	2.91	3.87	0.96	HEDGE
1982	2.82	3.98	1.16	HEDGE
1983	5.26	3.28	-1.98	CASH
1984	4.05	3.49	-0.56	CASH
1985	2.74	1.59	-1.15	CASH
1986	3.77	3.09	-0.68	CASH
1987	3.33	4.05	0.72	HEDGE
1988	4.51	4.51	-0.00	INDIFFERENT

Table 42 .--Standard Deviation Test for Manitoba and Alberta basis an cash prices (CND$) for Jun. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	2.23	1.73	-0.50	CASH
1978	3.88	8.05	4.17	HEDGE
1979	3.99	9.20	5.21	HEDGE
1980	3.30	3.43	0.13	HEDGE
1981	2.05	2.50	0.45	HEDGE
1982	2.83	5.49	2.66	HEDGE
1983	5.08	5.07	-0.01	CASH
1984	2.73	4.35	1.62	HEDGE
1985	2.87	2.23	-0.64	CASH
1986	4.28	3.60	-0.68	CASH
1987	3.44	4.34	0.90	HEDGE
1988	3.46	2.96	-0.50	CASH
		Alberta		
1977	2.13	2.20	0.07	HEDGE
1978	3.98	6.00	2.02	HEDGE
1979	3.98	7.74	3.76	HEDGE
1980	3.12	3.20	0.08	HEDGE
1981	2.50	2.95	0.45	HEDGE
1982	2.31	4.04	1.73	HEDGE
1983	4.59	2.87	-1.72	CASH
1984	2.41	1.83	-0.58	CASH
1985	2.87	2.33	-0.54	CASH
1986	4.37	3.11	-1.26	CASH
1987	3.05	4.18	1.13	HEDGE
1988	3.82	3.42	-0.40	CASH

Table 43.--Standard Deviation Test for Manitoba and Alberta basis and cash prices (CND$) for Aug. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	2.42	2.00	-0.42	CASH
1978	3.35	8.69	5.34	HEDGE
1979	3.71	7.75	4.04	HEDGE
1980	2.99	3.30	0.31	HEDGE
1981	2.42	2.27	-0.15	CASH
1982	3.60	5.65	2.05	HEDGE
1983	2.99	3.13	0.14	HEDGE
1984	3.00	4.33	1.33	HEDGE
1985	2.69	3.62	0.93	HEDGE
1986	4.03	3.40	-0.63	CASH
1987	2.63	3.39	0.76	HEDGE
1988	3.36	3.32	-0.04	CASH
		Alberta		
1977	2.45	1.82	-0.63	CASH
1978	3.34	5.76	2.42	HEDGE
1979	3.69	6.13	2.44	HEDGE
1980	3.03	3.09	0.06	HEDGE
1981	2.93	3.53	0.60	HEDGE
1982	3.83	2.99	-0.84	CASH
1983	2.85	2.20	-0.65	CASH
1984	2.64	0.87	-1.77	CASH
1985	2.49	3.82	1.33	HEDGE
1986	4.01	2.85	-1.16	CASH
1987	2.91	3.22	0.31	HEDGE
1988	2.86	2.47	-0.39	CASH

Table 44.--Standard Deviation Test for Manitoba and Alberta basis and cash prices (CND$) for Oct. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	2.85	2.38	-0.47	CASH
1978	3.33	9.11	5.78	HEDGE
1979	3.71	7.42	3.71	HEDGE
1980	3.63	3.52	-0.11	CASH
1981	2.88	2.28	-0.60	CASH
1982	4.07	5.62	1.55	HEDGE
1983	3.07	3.15	0.08	HEDGE
1984	2.74	3.32	0.58	HEDGE
1985	2.36	3.78	1.42	HEDGE
1986	3.20	3.38	0.18	HEDGE
1987	4.07	3.10	-0.97	CASH
1988	4.84	3.45	-1.39	CASH
		Alberta		
1977	3.16	2.05	-1.11	CASH
1978	3.26	6.06	2.80	HEDGE
1979	3.40	5.29	1.89	HEDGE
1980	3.33	3.16	-0.17	CASH
1981	3.28	3.56	0.28	HEDGE
1982	4.13	2.81	-1.32	CASH
1983	3.09	1.67	-1.42	CASH
1984	2.87	0.67	-2.20	CASH
1985	3.01	3.01	0.00	HEDGE
1986	3.05	3.19	0.14	HEDGE
1987	3.75	4.59	0.84	HEDGE
1988	4.34	3.40	-0.94	CASH

Table 46.--Standard Deviation Test for Manitoba and Alberta basis and cash prices (CND$) for Dec. futures contract, 1977 to 1988

Year	Standard Deviation Basis	Standard Deviation Cash	Difference (CASH-BASIS)	Risk Minimizing Position
		Manitoba		
1977	3.71	3.23	-0.48	CASH
1978	3.39	8.40	5.01	HEDGE
1979	3.64	6.80	3.16	HEDGE
1980	3.69	3.51	-0.18	CASH
1981	2.75	2.96	0.21	HEDGE
1982	4.14	5.83	1.69	HEDGE
1983	3.27	3.31	0.04	HEDGE
1984	3.16	2.55	-0.61	CASH
1985	2.52	4.02	1.50	HEDGE
1986	3.32	3.63	0.31	HEDGE
1987	3.55	3.03	-0.52	CASH
1988	5.68	3.72	-1.96	CASH
		Alberta		
1977	4.03	2.31	-1.72	CASH
1978	3.25	5.69	2.44	HEDGE
1979	3.60	4.65	1.05	HEDGE
1980	3.91	3.06	-0.85	CASH
1981	3.02	4.12	1.10	HEDGE
1982	4.09	2.24	-1.85	CASH
1983	3.12	1.96	-1.16	CASH
1984	3.34	1.18	-2.16	CASH
1985	3.20	2.79	-0.41	CASH
1986	3.75	2.47	-1.28	CASH
1987	4.00	4.29	0.29	HEDGE
1988	4.75	3.96	-0.79	CASH

5.4.2.1 Hedging effectiveness over time

When calculating the percentage of occurrences when the basis standard deviation is lower than the cash, indicating the opportunity to hedge, by year and dividing into quartiles, a pattern develops where the two earlier quartiles from 1977 to 1982 showed higher proportions of hedging opportunities (67 per cent). The latter quartiles indicates only 33 to 39 per cent of the periods studied as having risk minimizing hedging potential.

This would indicate a decreasing need for hedging on the U.S. markets. This may be due to the decrease in cash price risk since the late 1970s. Novak and Unterschultz note that basis risk has also decreased since that time.

The years which exhibits the most opportunities for hedging are 1978, 1979, 1981, 1982, 1986 and 1987. These years, according to the Livestock Market Review, are periods of lower slaughterings of cattle and higher cattle prices. Therefore, the hedge would have reduced the risk of variance of the prices, but would have stopped the producer from receiving benefits of higher cattle prices. An extreme example of this is 1987, where record high cattle prices existed (Livestock Market Review).

5.4.2.2 Hedging effectiveness by contract

When determining the proportion of periods when hedging would decrease risk by futures contract, the range of hedging

effectiveness ranged from 45 per cent for February to 58 per cent for June and August. October has higher hedging effectiveness when measured with this methodology at 54 per cent when compared with December and April at 46 per cent. The results for October may be different due to the lack of including the Omaha market which had a highly fluctuating basis for this contract (see graphs in Appendix B).

5.4.2.3 Hedging effectiveness by market

When comparing the proportions of opportunities for effective hedging, Manitoba has a higher percentage at 55 per cent compared to Alberta which has 48 per cent.

5.5 Exchange rate effects on hedging

Exchange rate effects can be measured by comparing the standard deviation of the cash cattle prices in U.S. dollars with the standard deviation of the cash cattle prices in Canadian dollars on Tables 13 to 24. The exchange rate increases the variance of the cash prices in all cases in Canada except for 1977 for the February, April and June contracts. Over one third of the periods studied have exchange rate effects of $1.00 per hundred weight or more.

These results indicate that the exchange rate does have a significant impact on the effectiveness of hedging for the Canadian cattle producer.

Chapter VI

CONCLUSIONS AND RECOMMENDATIONS

The objectives of this study are to provide feedlot operators with information on the live cattle futures contracts, cash slaughter cattle prices and the relationship between these prices as well as the basis. This chapter summarizes the main conclusions on these subjects. Then conclusions regarding the hedge ratio and hedging efficiency are reported. Limitations and recommendations are then discussed. The final section of this chapter provides suggestions for further research.

6.1 Conclusions

6.1.1 Price and basis conclusions

6.1.1.1 Futures prices

Futures prices exhibit non-normal distributions. Therefore, non parametric models may be required for estimating and forecasting futures prices. This type of model may require a higher level of sophistication in use of estimating methods of the manager to implement and interpret.

6.1.1.2 Cash prices

The distribution characteristics of cash prices are tested in U.S. dollars for Omaha while both U.S and Canadian dollars are used for testing distribution of Canadian market prices. Negative skewness is found for a substantial portion of the periods studied for all markets. Low W statistics (or high Z statistics in the Shapiro-Wilk test indicate a non normal distribution. Non normal distributions are also evidenced by the proportion of periods studied exhibiting significant kurtosis levels. Non parametric estimating may need to be used for forecasting cash prices. The variances between the markets are found to be significantly different, which may be part of the reason for differing hedging effectiveness as described later.

6.1.1.3 Integration of cash and futures prices

Concurrent cash and futures prices are found to be interrelated. A mixed fixed and percent proportion relationship was found for 75 per cent of the periods studied. This means there is an element of the basis which is determined by a constant markup such as $23 per hundredweight, as expressed by the intercept term, and a portion which is a percentage of the cash price. The relationship is hypothesized to be due to links between current and futures expectations of supply and demand as well as the impact of new information in both the cash and futures.

6.1.1.4 Basis

The mean basis is found to be significantly different between the Canadian markets and Omaha. The Omaha basis narrows (i.e., decreased in size) more than the Canadian markets toward the expiration of the futures contract. The exchange rate appears to have an impact through widening the basis when the Canadian dollar depreciated. This impact has a negative effect on short hedgers such as feedlot operators. The Omaha market exhibits more inverted markets than the Canadian markets.

The basis also exhibits significant skewness and Canadian markets are mostly negatively skewed, while Omaha's are over 50 per cent positively skewed. Positive kurtosis is also found in the basis contributing to a non normal distribution. The normality test indicated a non normal distribution.

The basis is found to exhibit slight seasonality for April, May and June calendar months, which has lower basis.

6.1.2 Hedging ratios

The minimum variance hedging ratio, which is found through regression analysis minimizing the errors for cash price variance, found in this study over the contract life is .53 for the last six years studied. Manitoba shows the lowest ratio at .51 while Alberta has an average ratio of .54. These ratios are lower when compared to other studies which either are for previous hedging periods (Carter and Loyns, 60 per cent) or are only for shorter hedging periods (Novak and

Unterschultz, 64 per cent).

6.1.3 Hedging effectiveness

The R square measure of hedging effectiveness yielded higher efficiency measures than the standard deviation method for the Canadian markets. This is due to the changing of the exchange rates. Therefore, while comparisons of Canadian and U.S. hedging must be made in the same dollars, hedging efficiency needs to be tested by measuring the actual levels of variance from the hedge and cash prices and comparing the results in domestic dollars. This method indicates lower opportunities for efficient hedging which are apparent for 55 per cent of the periods studied for Manitoba and 48 per cent for Alberta.

This implies caution when comparing R square measures of efficiency between different countries. Of the opportunities for reduced variance through hedging, June and August exhibits the highest hedging efficiency which corresponds to the R square analysis except that December is less efficient using this methodology compared to the R square method.

6.2 Implications

This study implies that the June and August and December futures contracts provide the best hedging opportunities. The basis is significantly different between the Canadian and U.S. markets and the exchange rate does have an impact on hedging effectiveness. However, hedging opportunities can still be

found when the cash price variances are high, however, these opportunities also corresponded to times of higher cash prices, so the hedger may reduce his or her risk while not receiving the benefits of higher prices.

The April, May and June months had narrower basis which would be beneficial to the feedlot operator who is short in the futures market, if profit maximizing.

6.3 Limitations

Small sample measurements of skewness and kurtosis are not highly reliable. Therefore the lack of normal distribution found in this study may have been due to the limited number of observations used. A large sample for this type of test would be 500 observations.

As noted, a non normal distribution of prices may have affected the reliability of the t-test estimates. However, this factor is not deemed to be highly significant due to the low kurtosis and skewness values.

This study anticipates a risk minimizing hedger using a naive hedge and hold position. Therefore, a hedger with other objective functions or those who do not carry their cattle over the full term of the futures contract (approximately one year) will not receive the same benefits from hedging. A longer hedge period tends to improve the hedge effectiveness (Novak and Unterschultz).

6.4 Suggestions for further research

The first suggestion would be to test the results over differing hedging periods such as a 90 day, 120 day and 260 day hedge.

While integration of the cash and futures prices is hypothesized to be linked through impact of information, this theory should be analyzed, using release times of information, timing of response to different types of information and the direction and amplitude of the responses.

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Appendix A

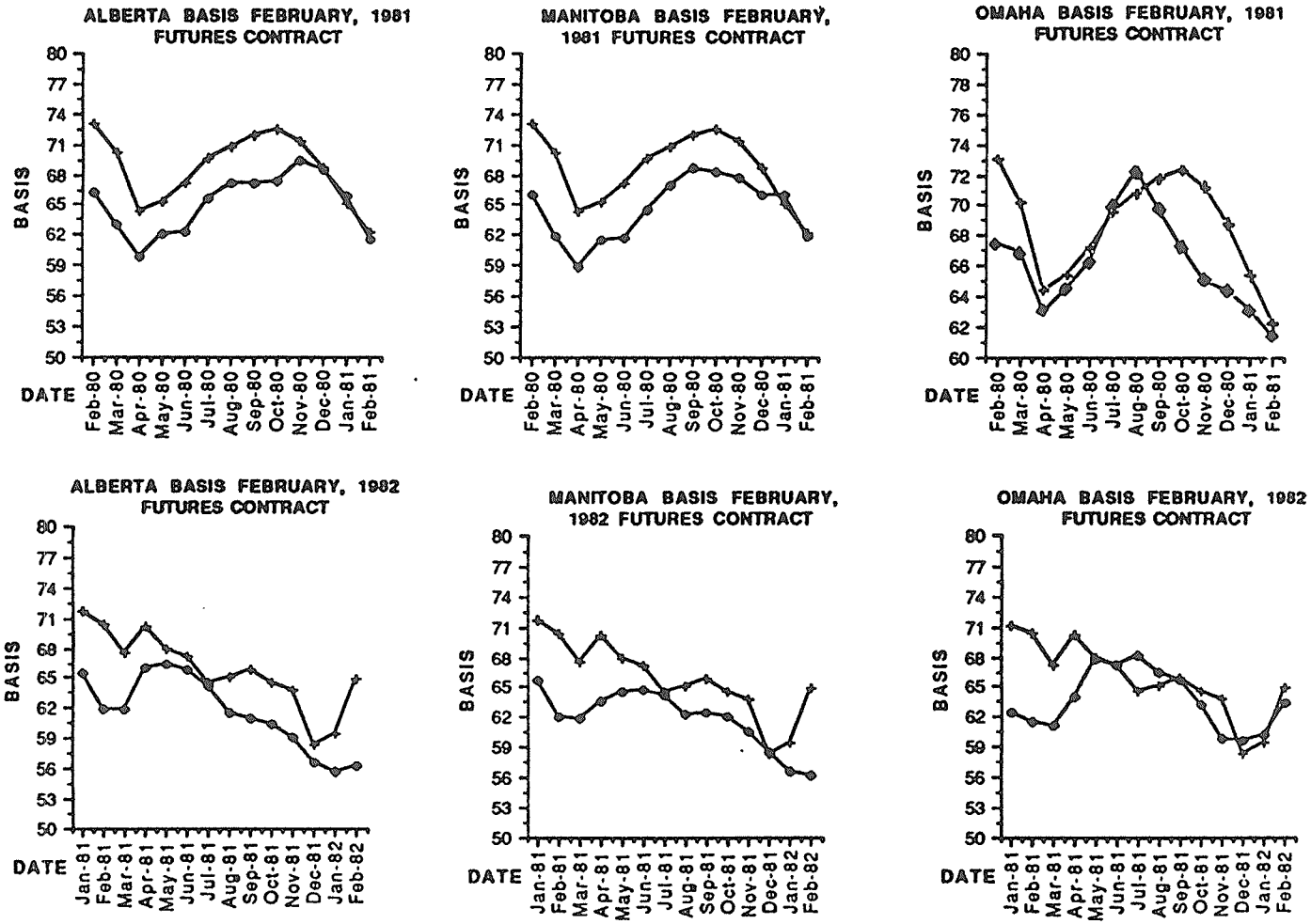
WILCOXON SUM RANK TEST

The Wilcoxon sum rank test is used as a substitute for a t-test in paired samples (Snedecor and Cochran). This method does not assume a normal distribution, and therefore may be used to test other types of distributions. The absolute values of the differences between the paired units are taken and are ranked with the smallest being the first rank. The signs are then restored to the rankings. The sum of the signs are taken to obtain the total value of positive and negative differences. The number with the smaller sum is then used for the test. This number is then compared with the table below (ignoring the sign) reproduced from Snedecor and Cochran Table A 9. If the number is less than or equal to the corresponding number in the table for the same number of pairs the null hypothesis that the pairs are equal is rejected at the 5% level.

Appendix B

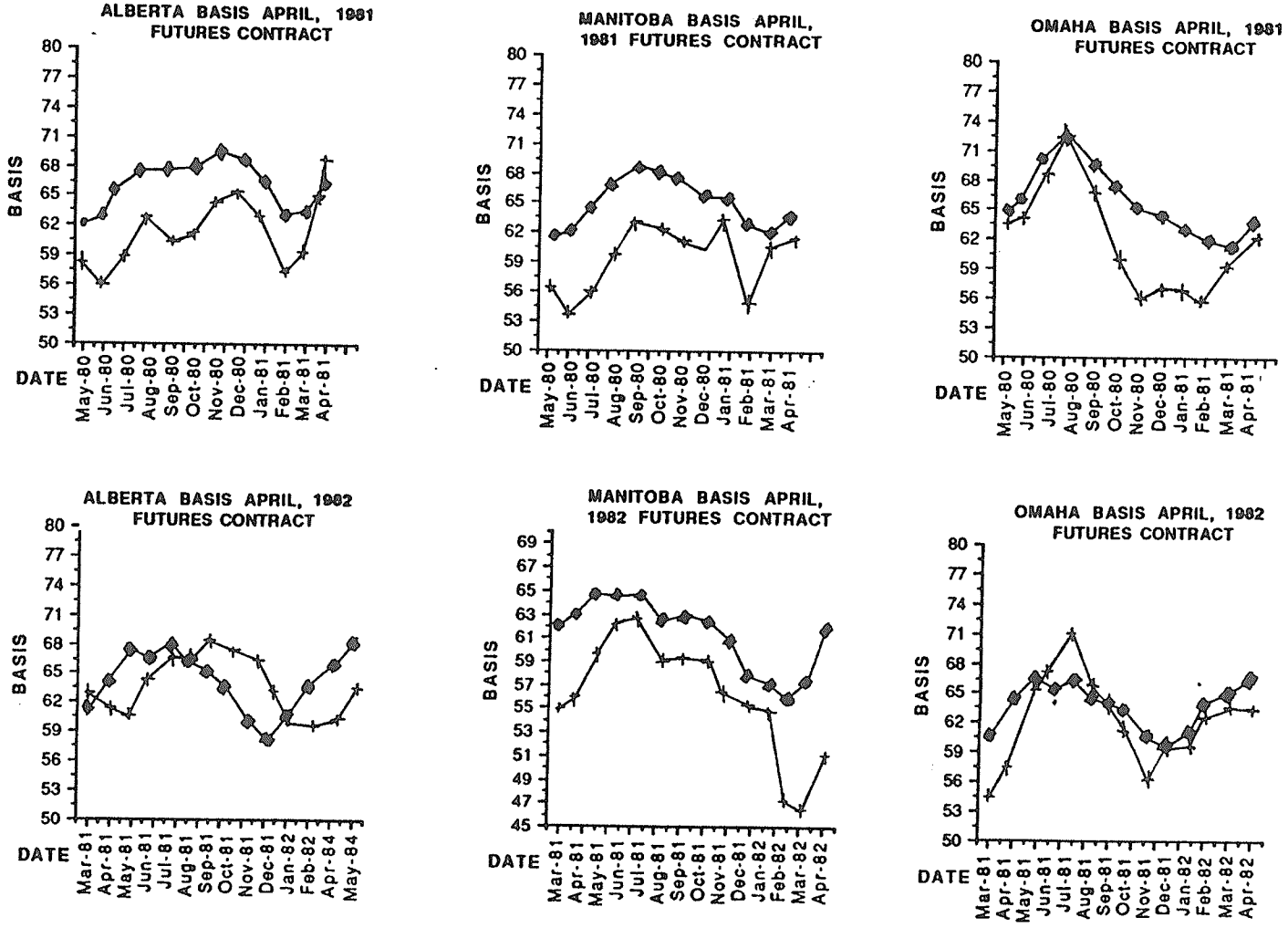
FUTURES-CASH AND BASIS GRAPHS

Basis Movement over Life of Contract



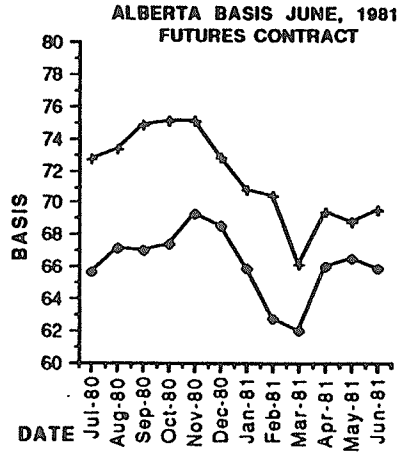
Basis = Futures price (+) minus Cash price (-)

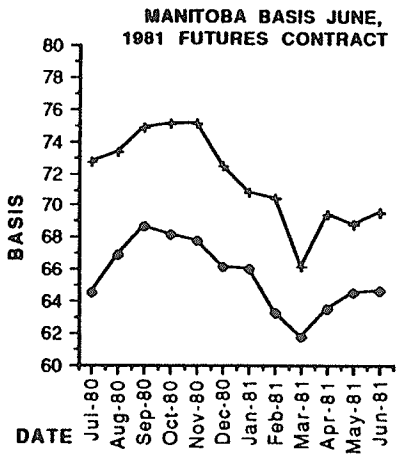
Basis Movement over Life of Contract

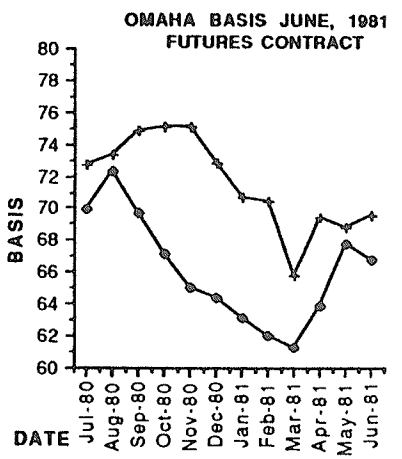


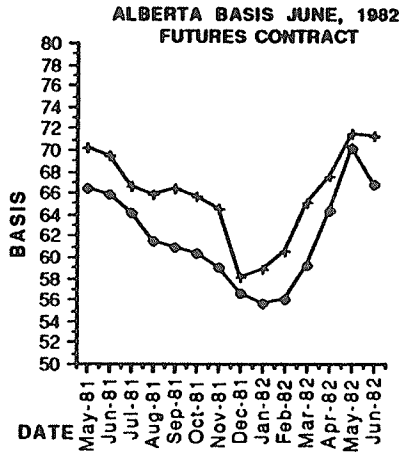
Basis = Futures price (+) minus Cash price (=)

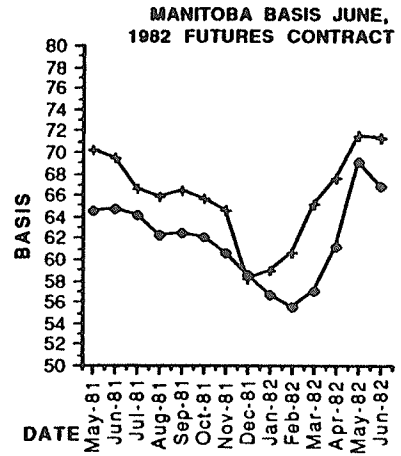
Basis Movement over Life of Contract

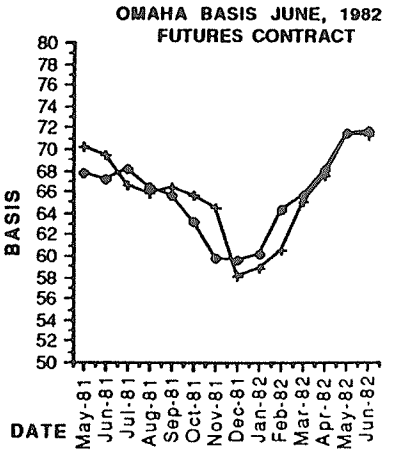






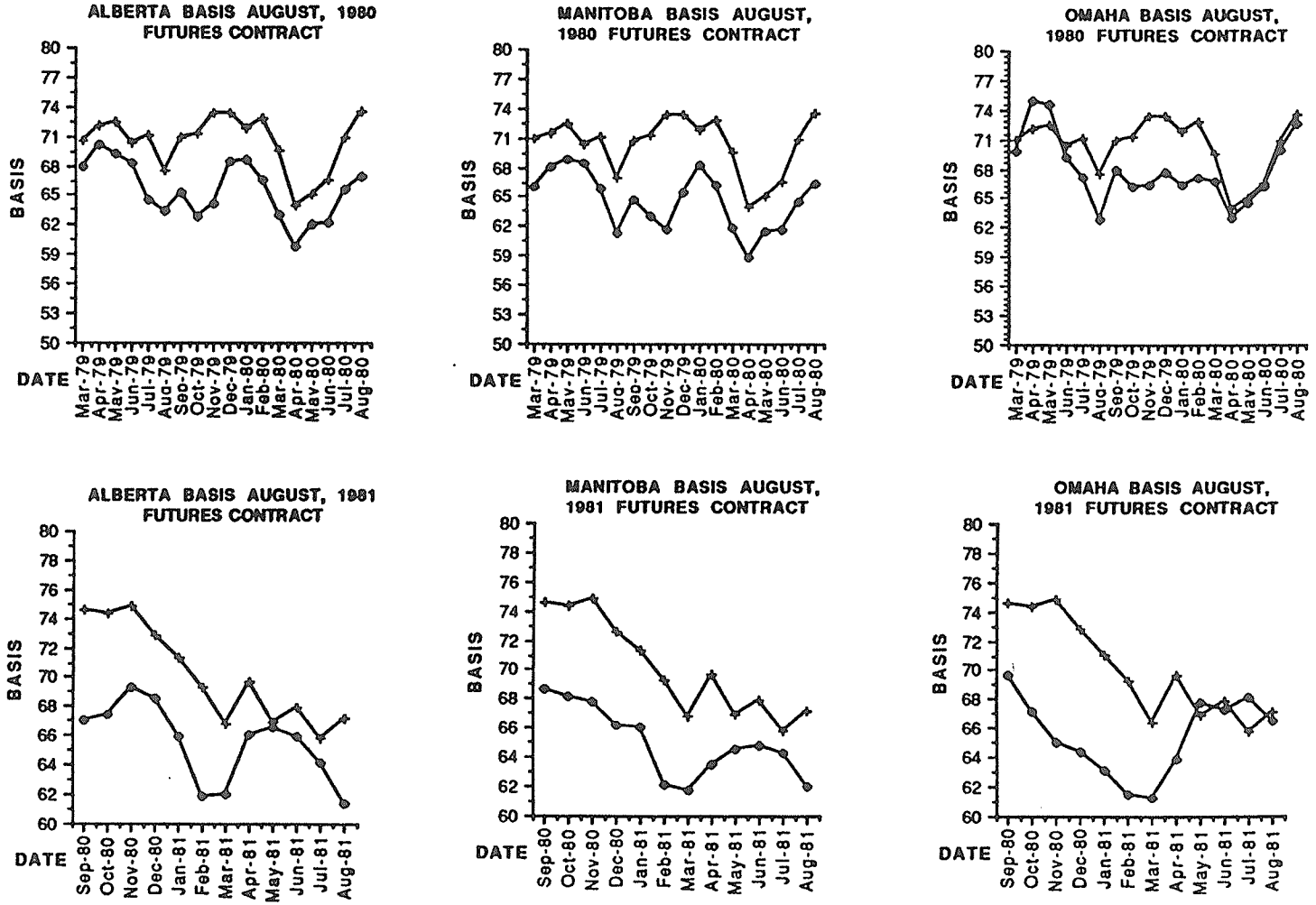






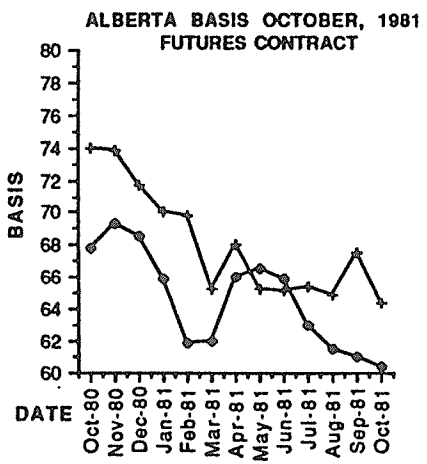
Basis = Futures price (+) minus Cash price (◆)

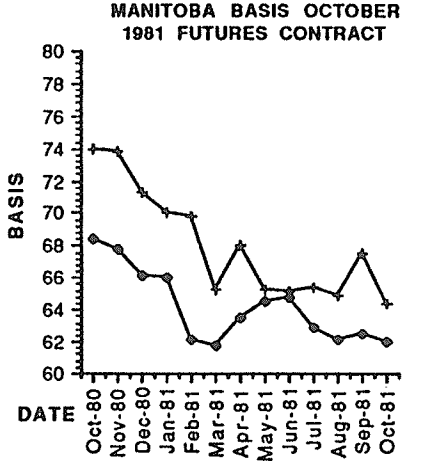
Basis Movement over Life of Contract

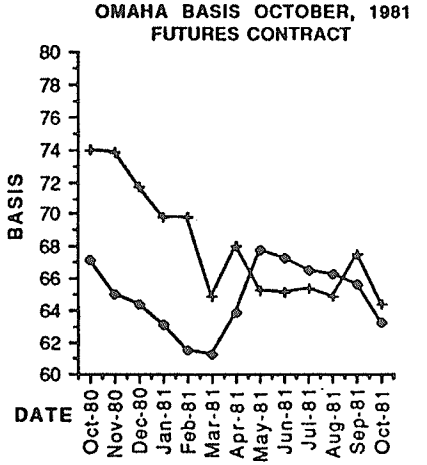


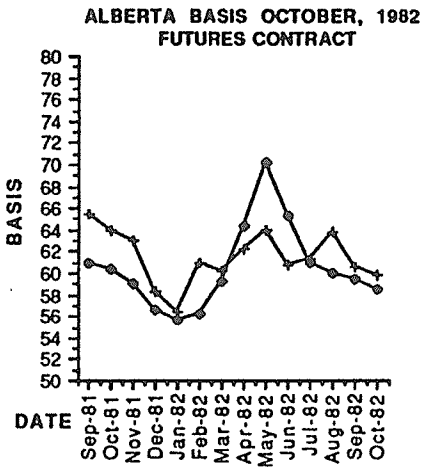
Basis = Futures price (+) minus Cash price (=)

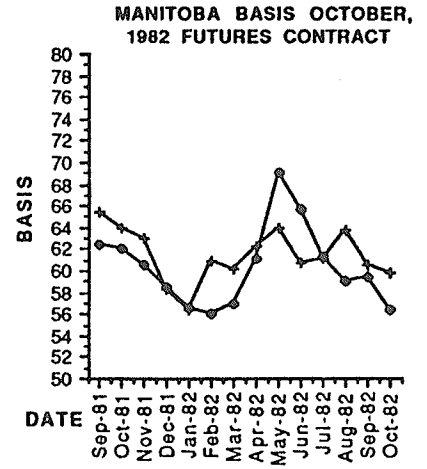
Basis Movement over Life of Contract

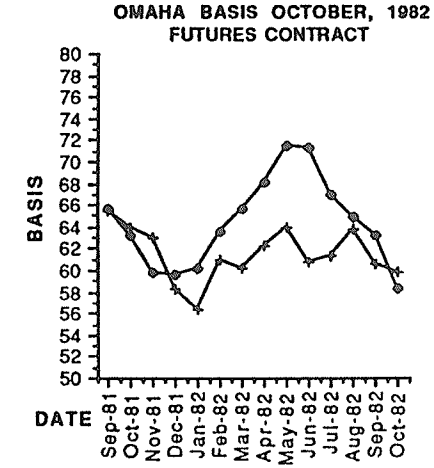






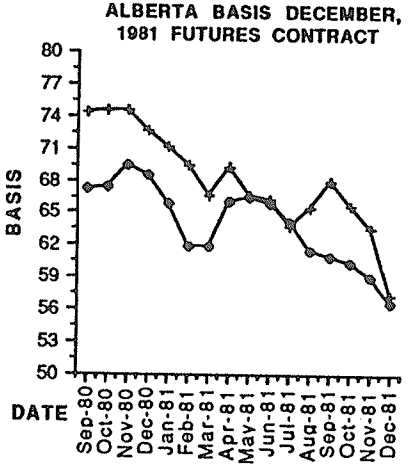


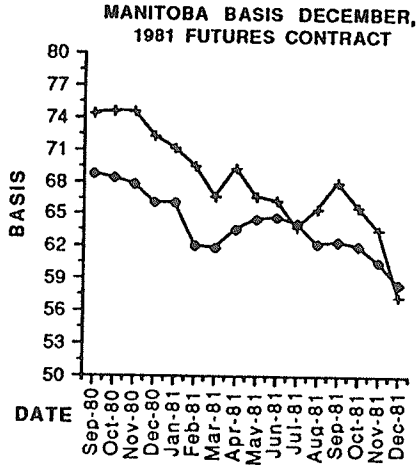


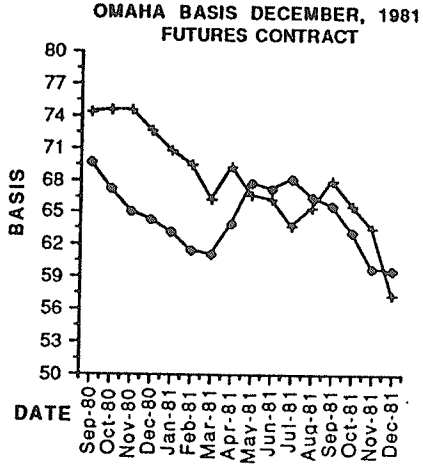


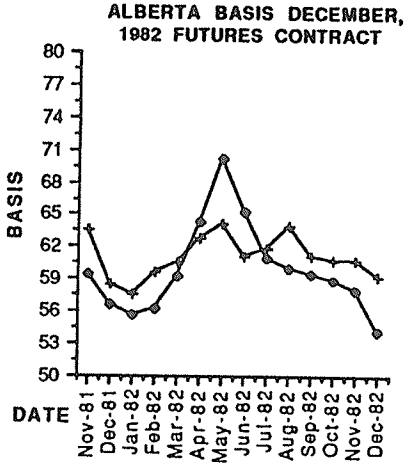
Basis = Futures price (+) minus Cash price (-)

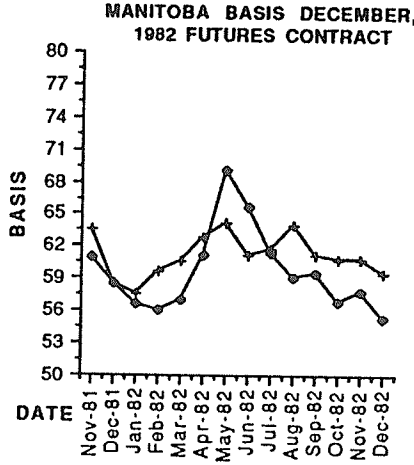
Basis Movement over Life of Contract

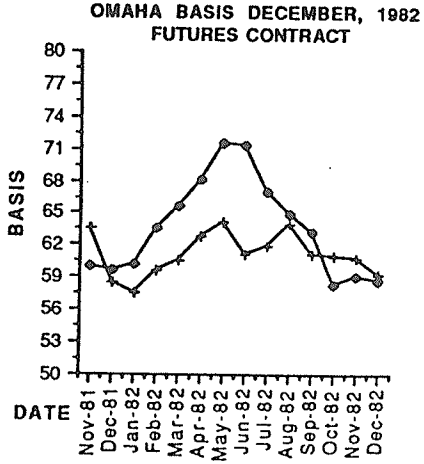






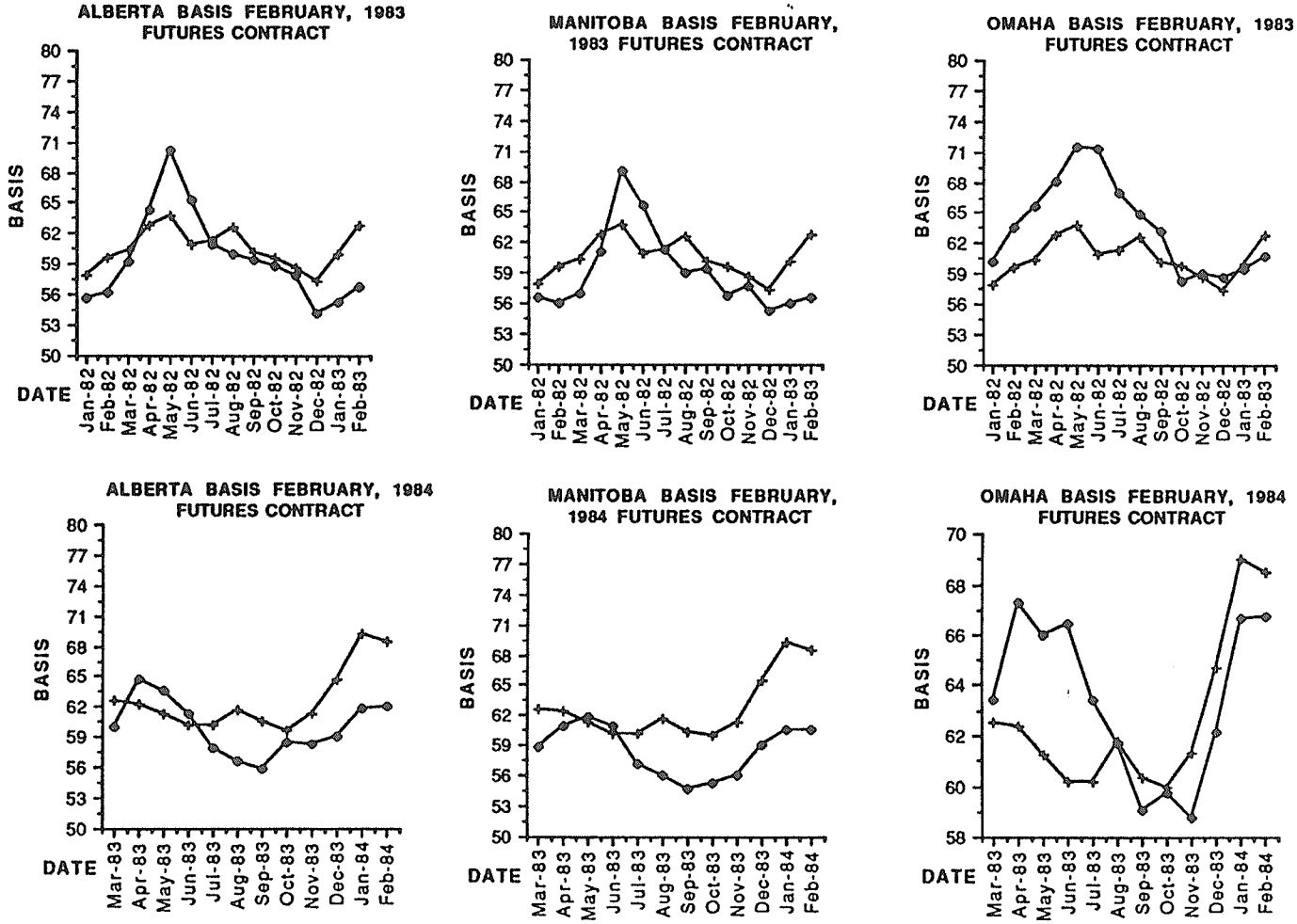






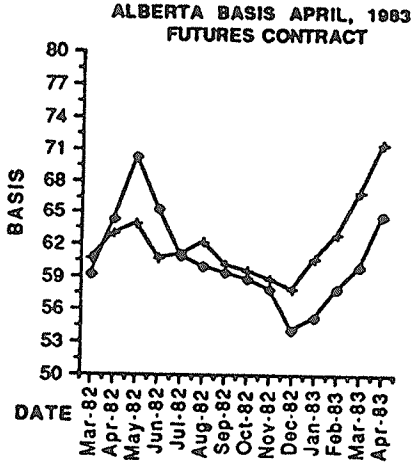
Basis = Futures price (+) minus Cash price (=)

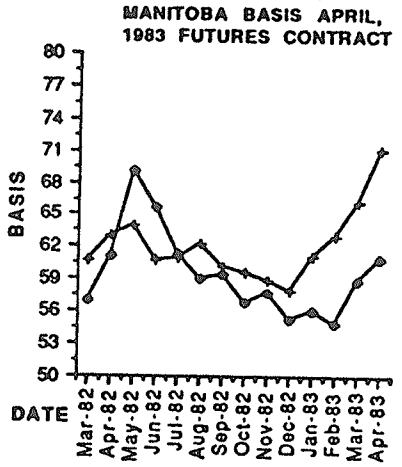
Basis Movement over Life of Contract

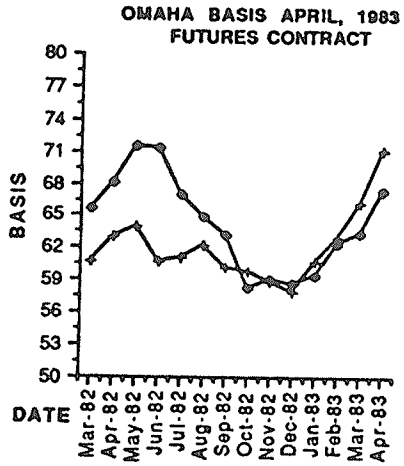


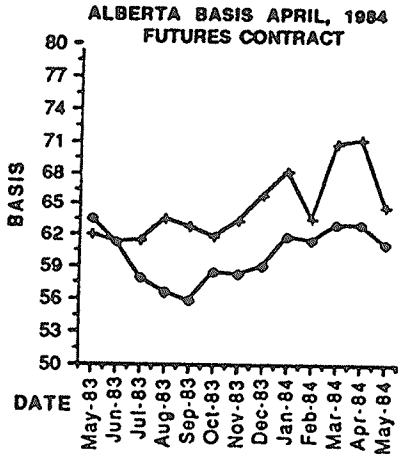
Basis = Futures price (+) minus Cash price (=)

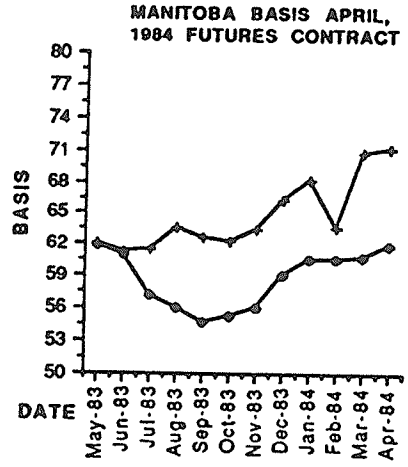
Basis Movement over Life of Contract

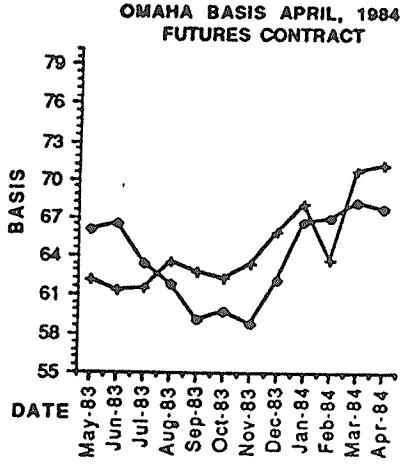






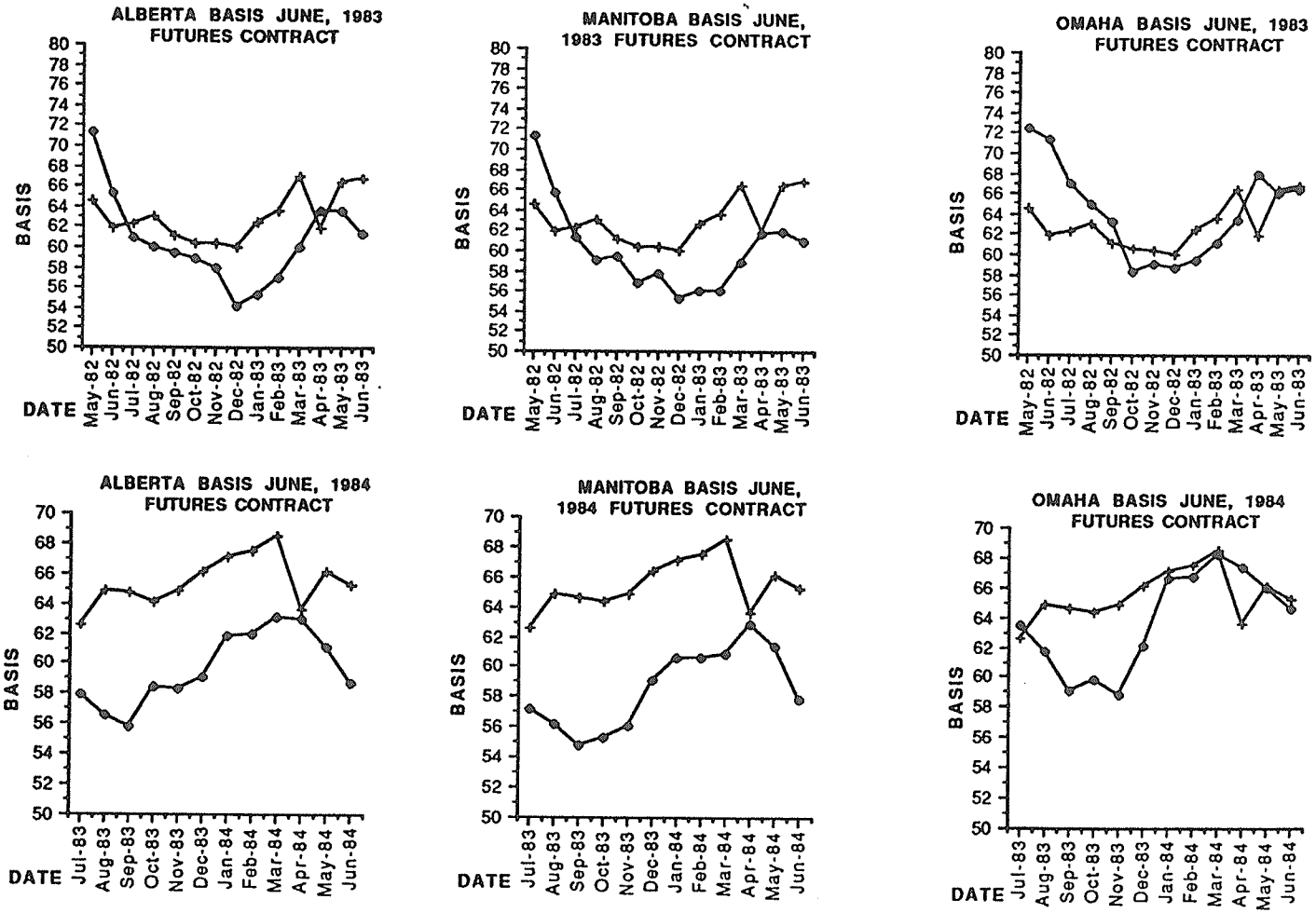






Basis = Futures price (+) minus Cash price (-)

Basis Movement over Life of Contract



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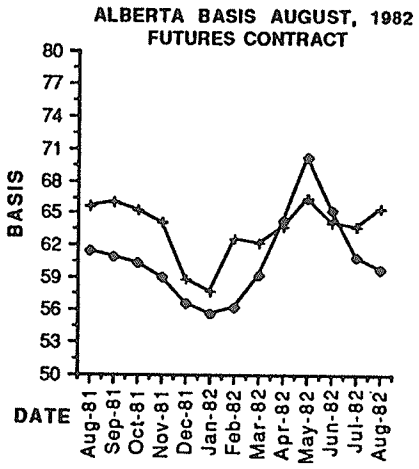
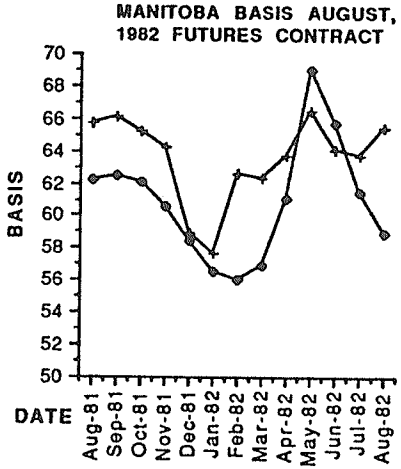
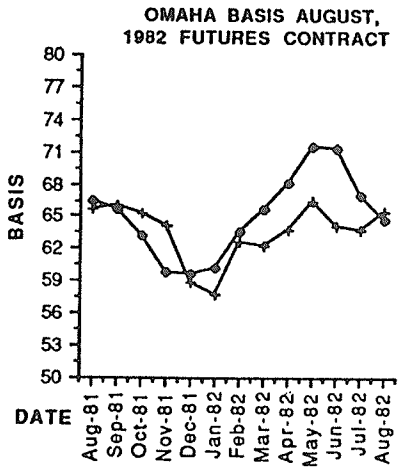
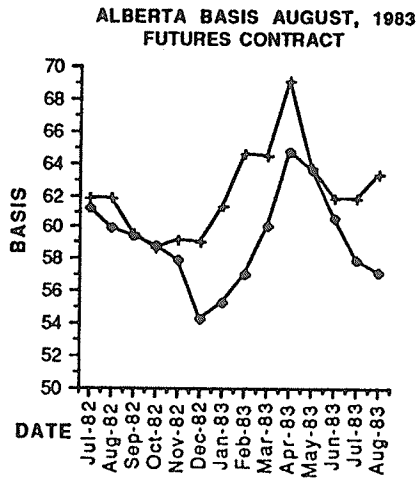
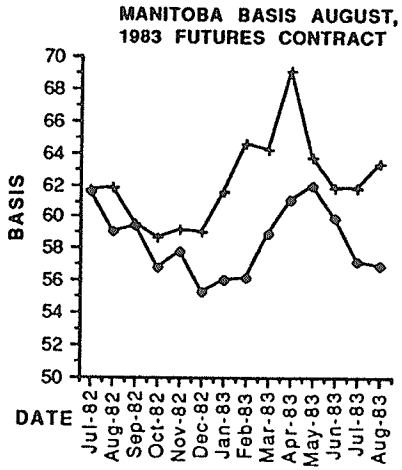
Basis Movement over Life of Contract

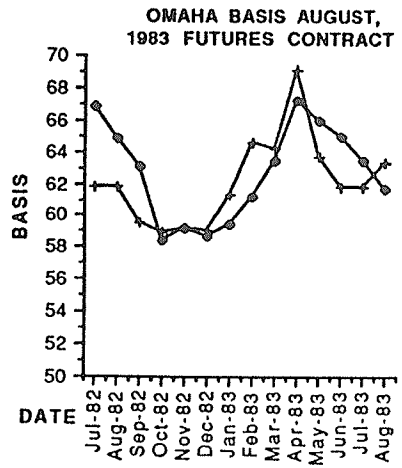






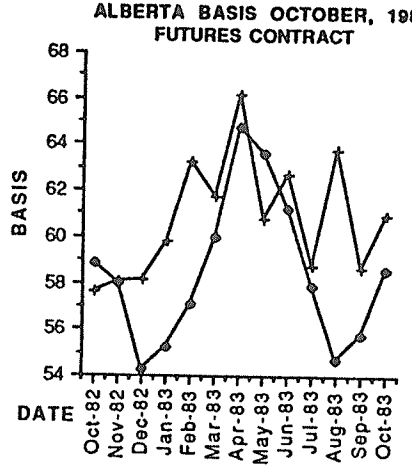


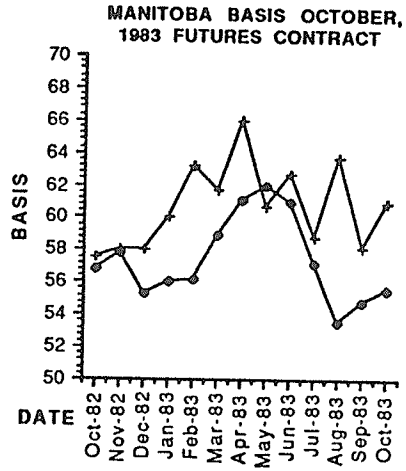


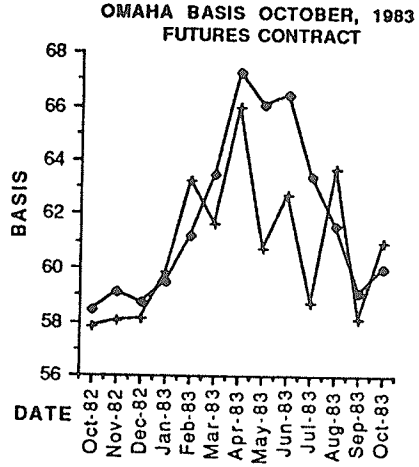


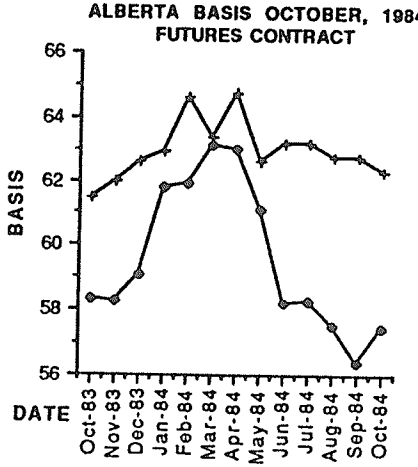
Basis = Futures price (+) minus Cash price (=)

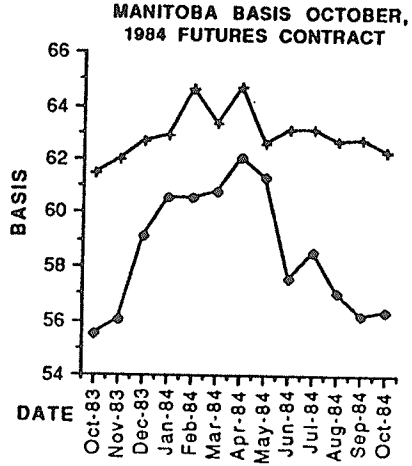
Basis Movement over Life of Contract

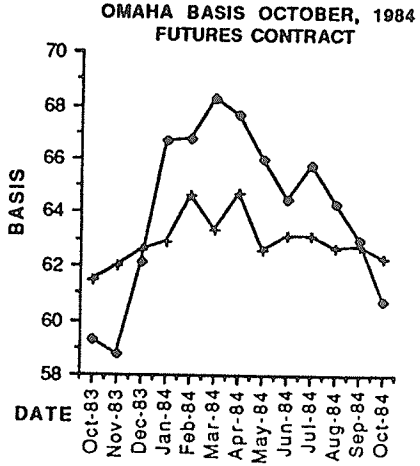






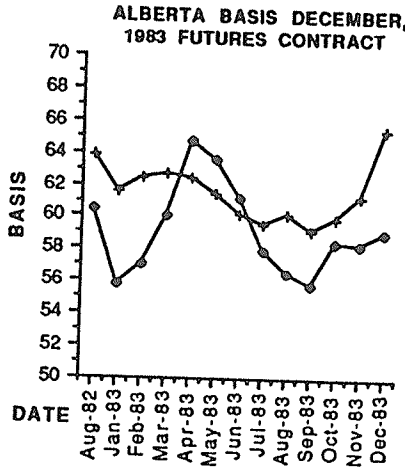


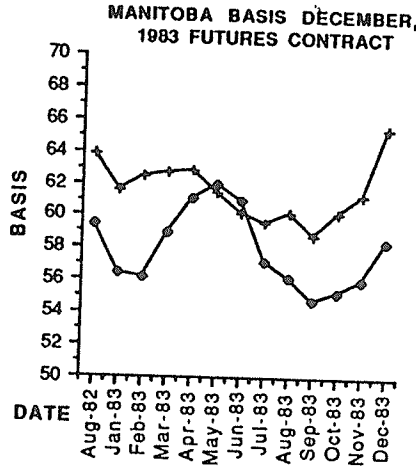


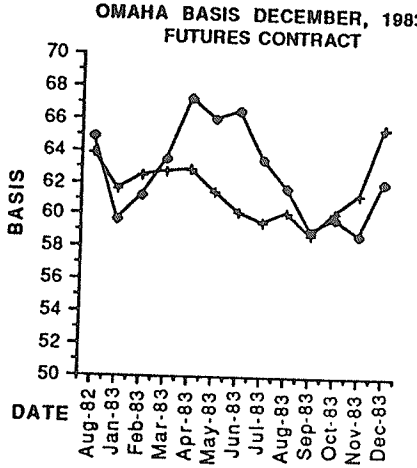


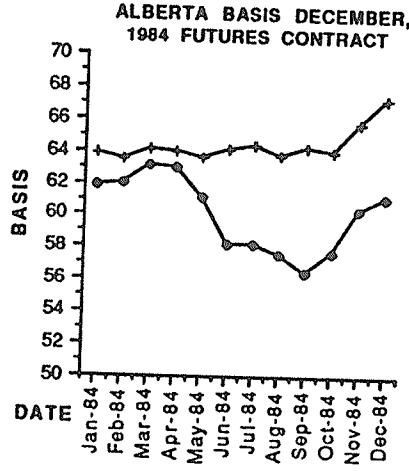
Basis = Futures price (+) minus Cash price (=)

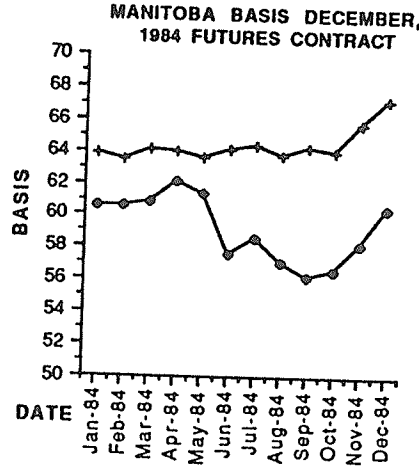
Basis Movement over Life of Contract

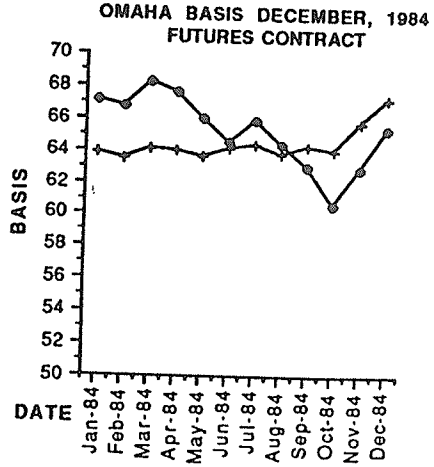






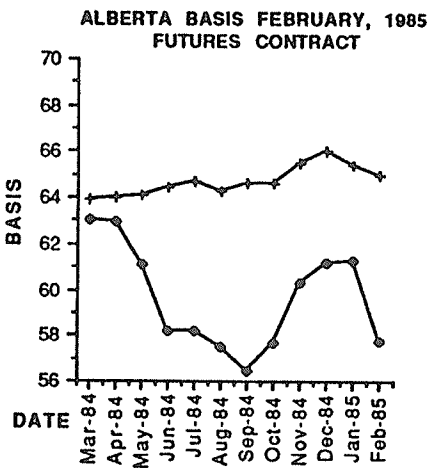


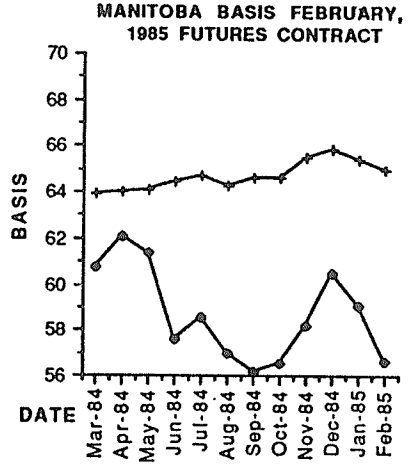


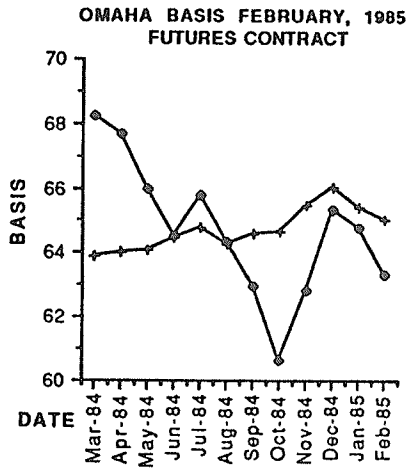


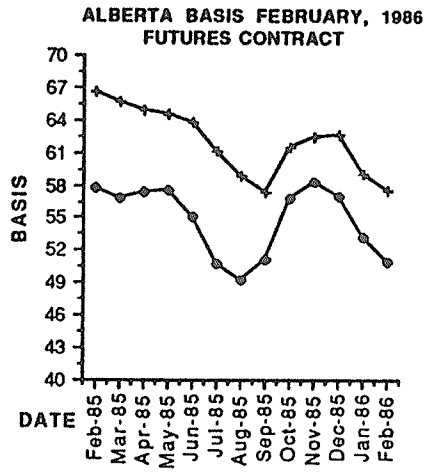
Basis = Futures price (+) minus Cash price (=)

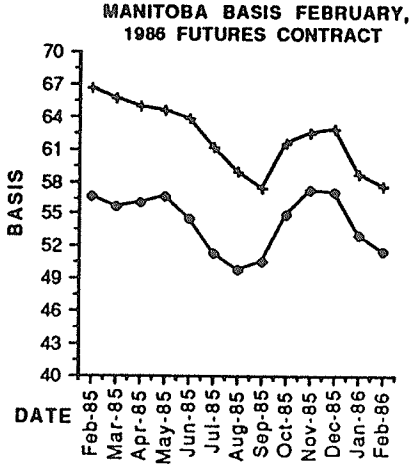
Basis Movement over Life of Contract

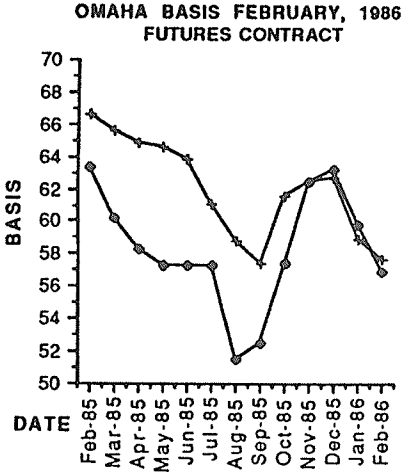






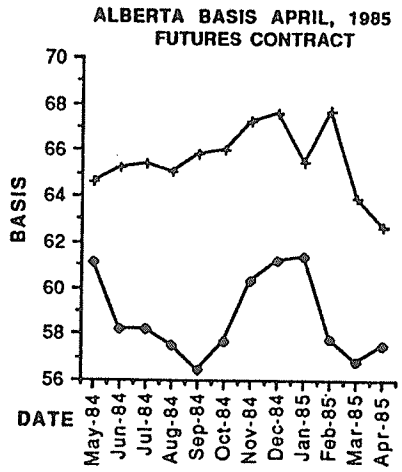


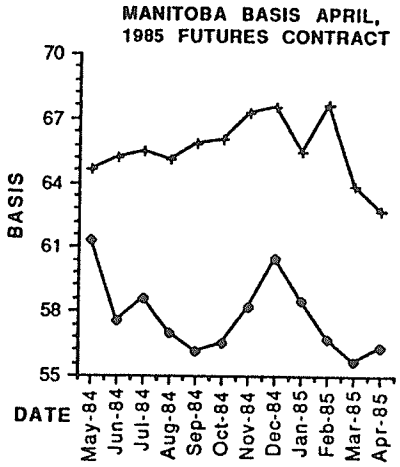


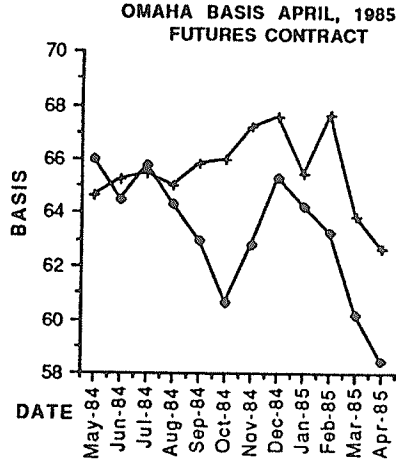


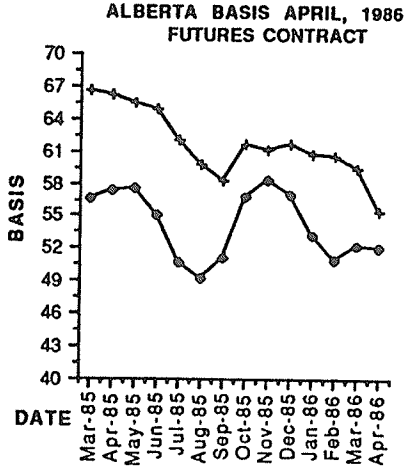
Basis = Futures price (+) minus Cash price (-)

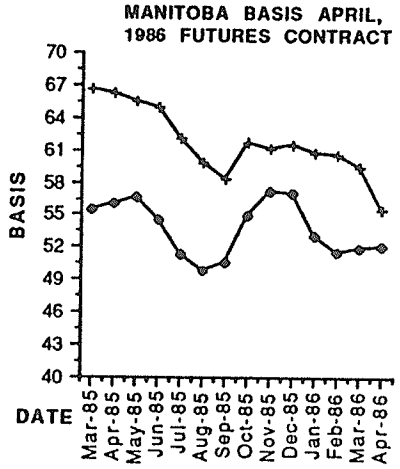
Basis Movement over Life of Contract

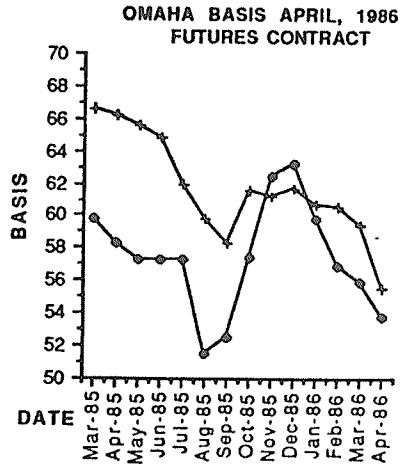






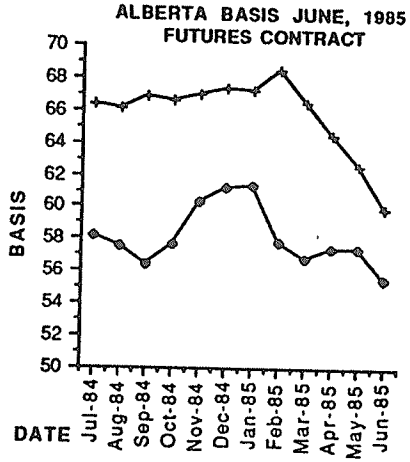


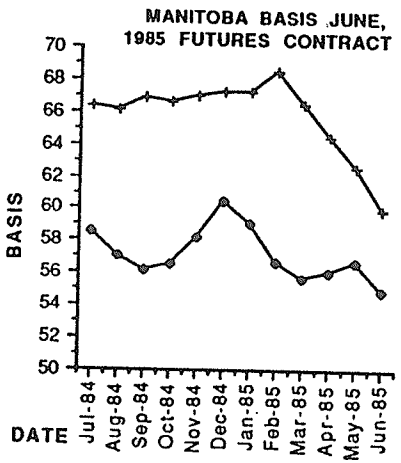


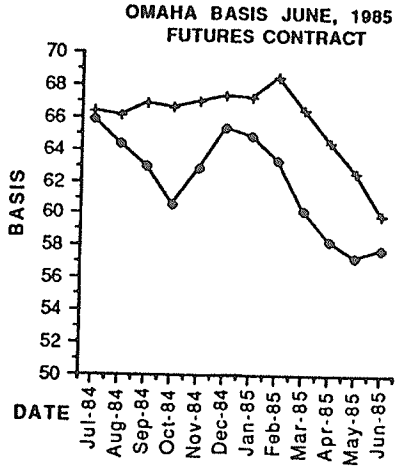


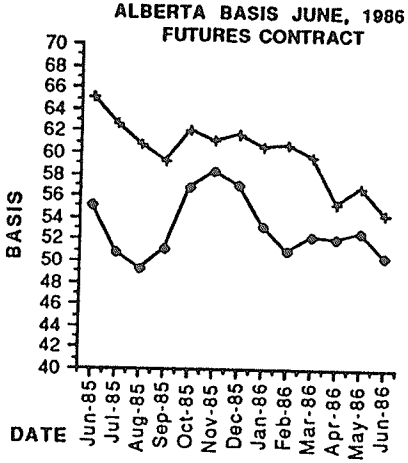
Basis = Futures price (+) minus Cash price (=)

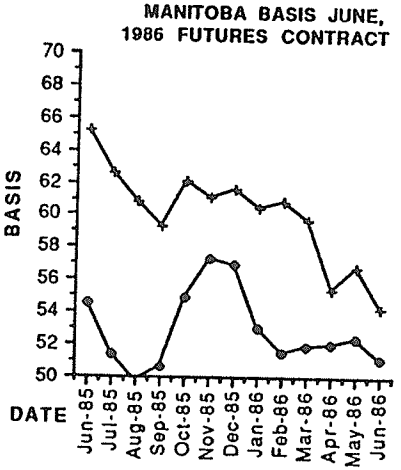
Basis Movement over Life of Contract

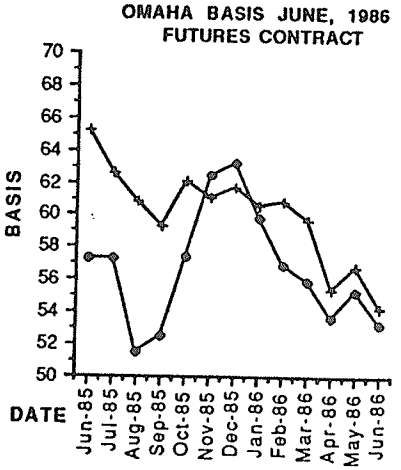






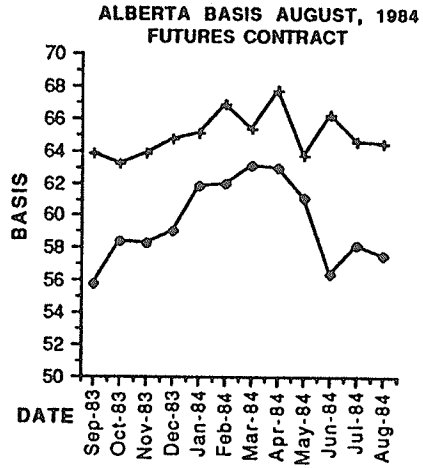


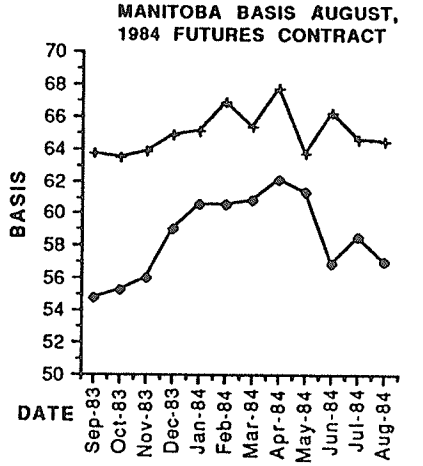


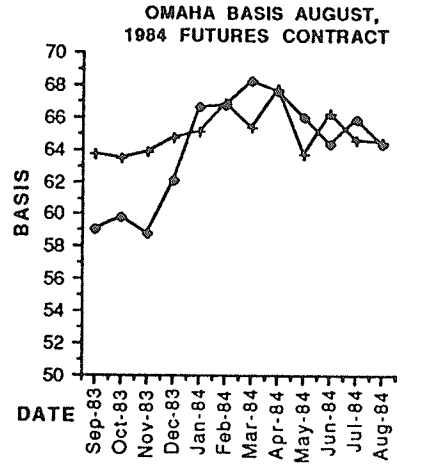


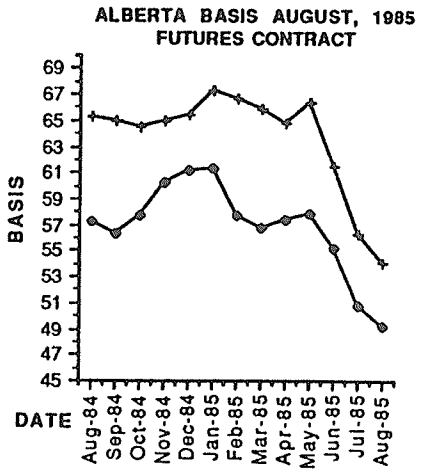
Basis = Futures price (+) minus Cash price (-)

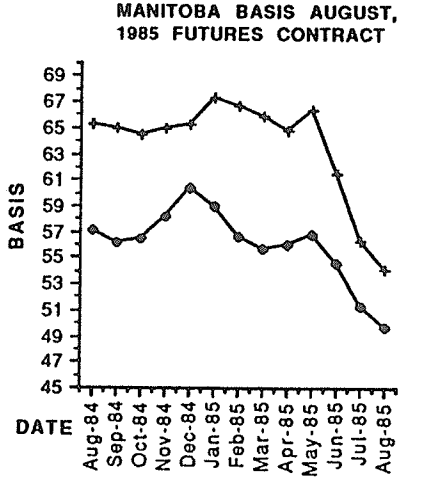
Basis Movement over Life of Contract

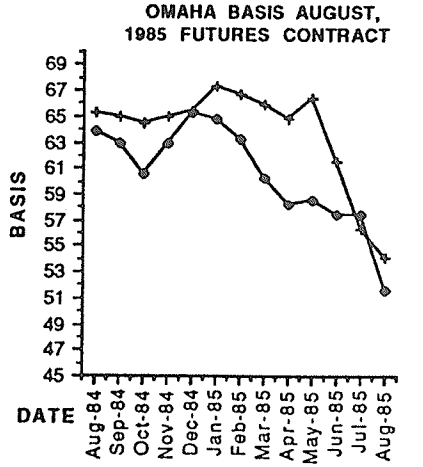






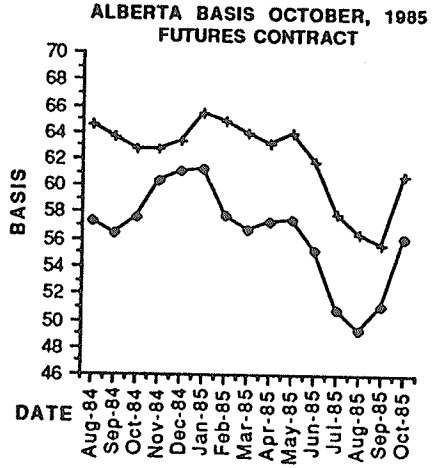


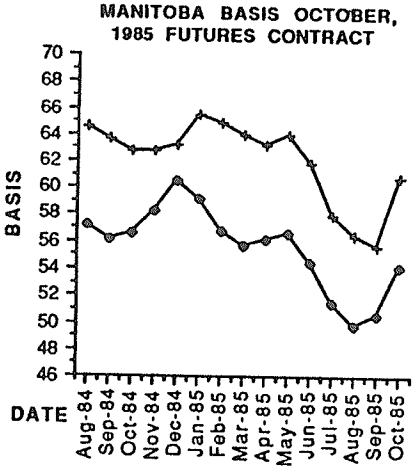


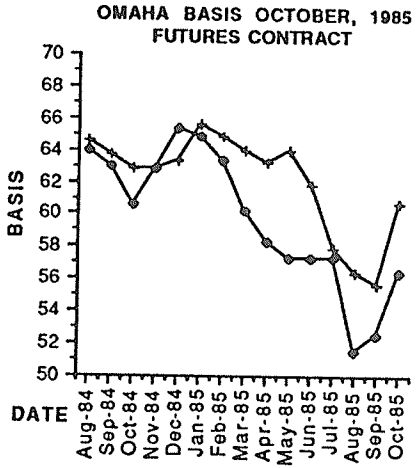


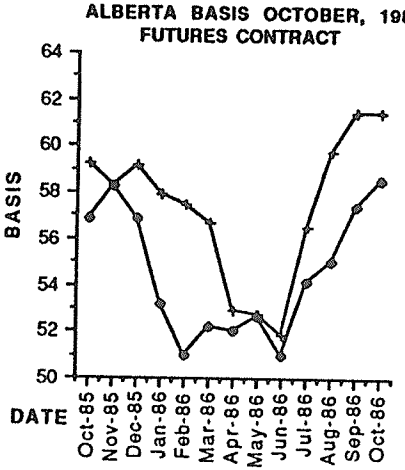
Basis = Futures price (+) minus Cash price (=)

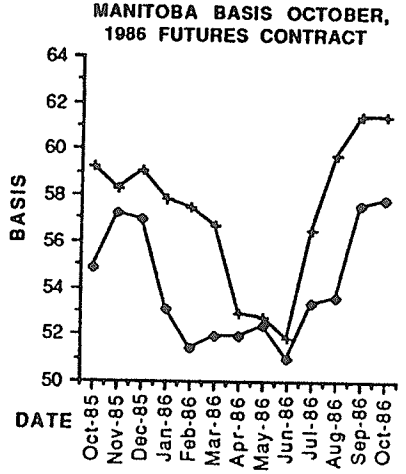
Basis Movement over Life of Contract

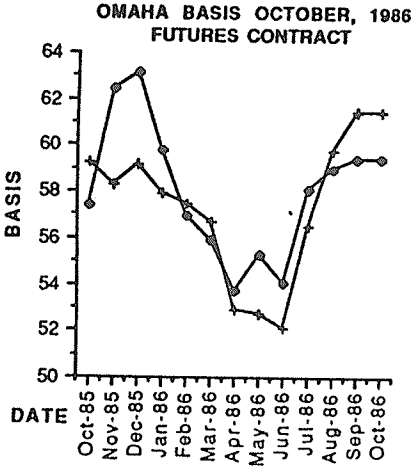






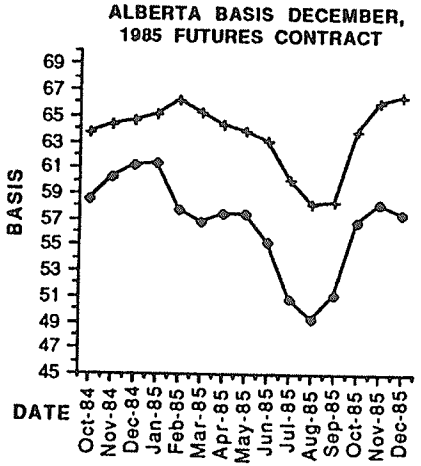


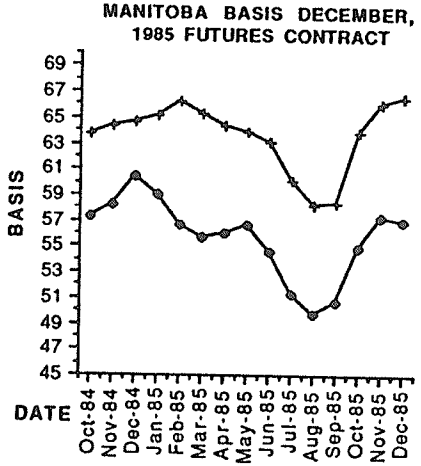


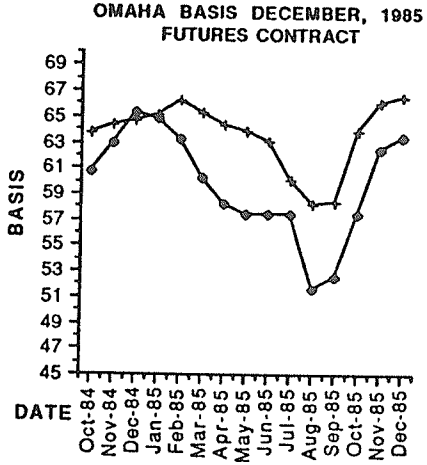


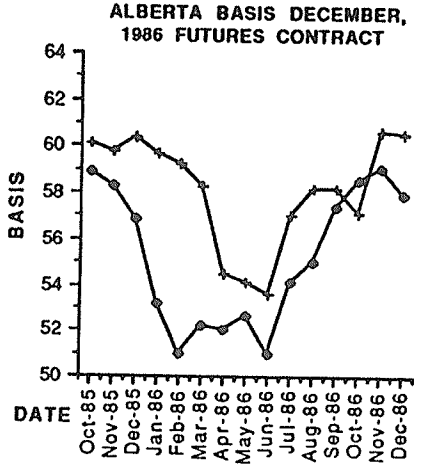
Basis = Futures price (+) minus Cash price (◊)

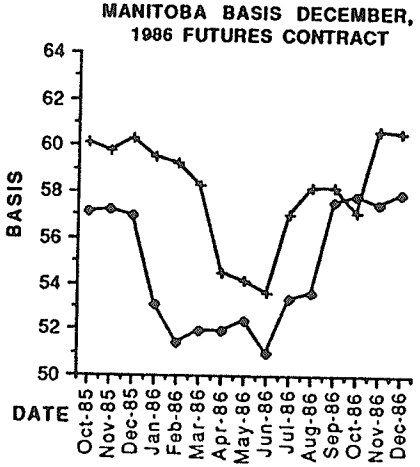
Basis Movement over Life of Contract

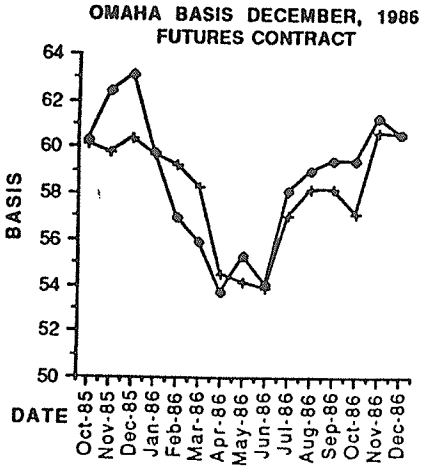






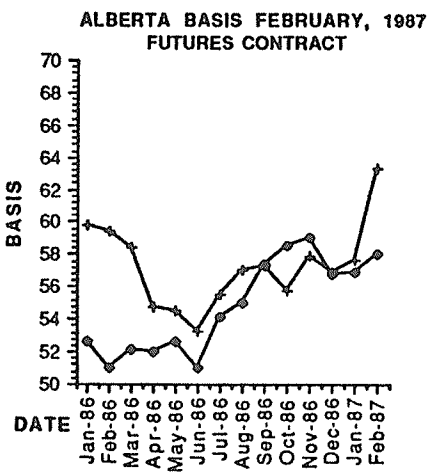


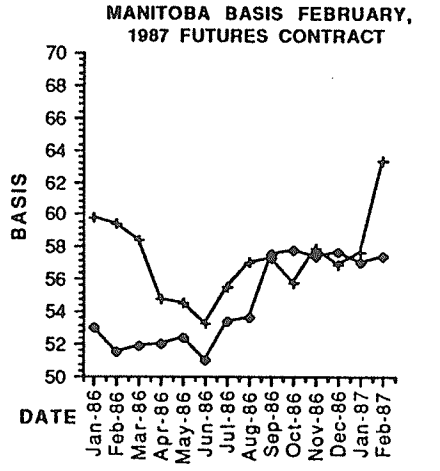


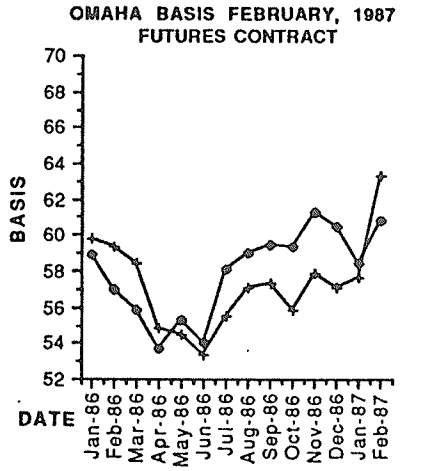


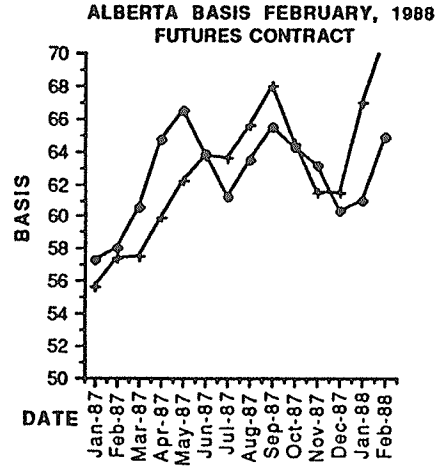
Basis = Futures price (+) minus Cash price (=)

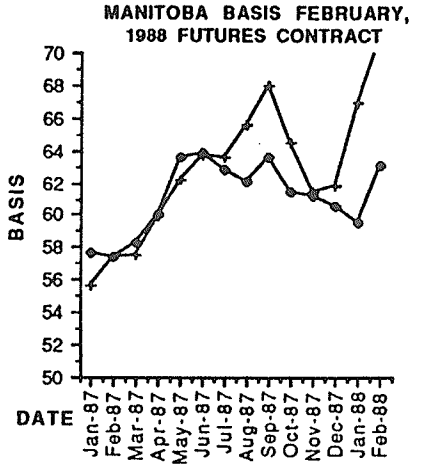
Basis Movement over Life of Contract

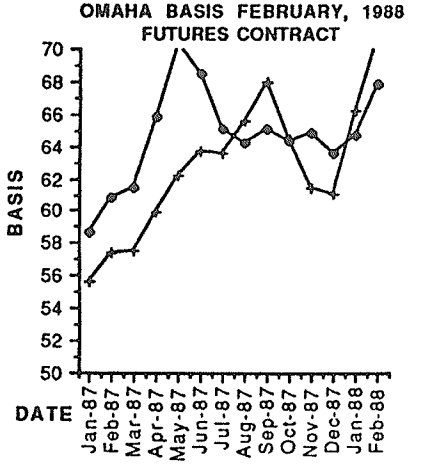






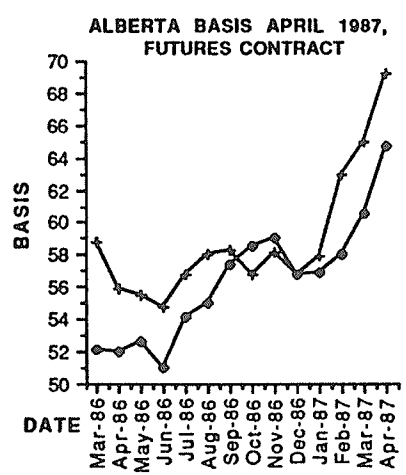


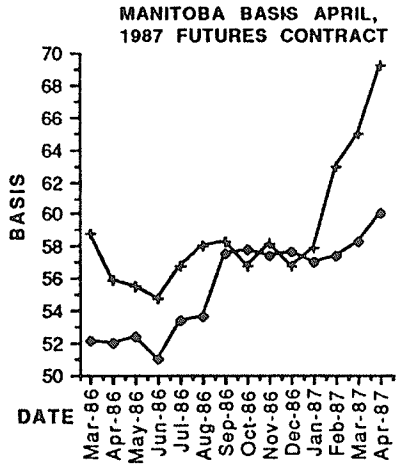


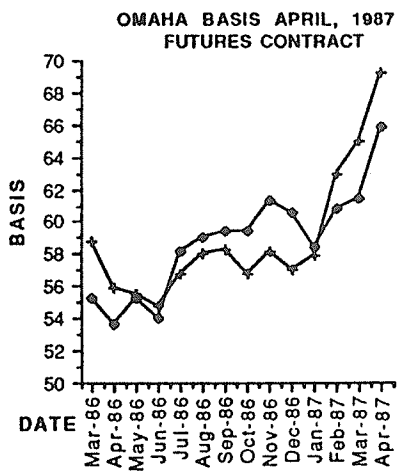


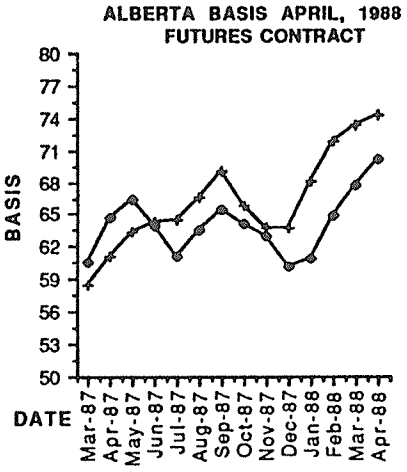
Basis = Futures price (+) minus Cash price (◊)

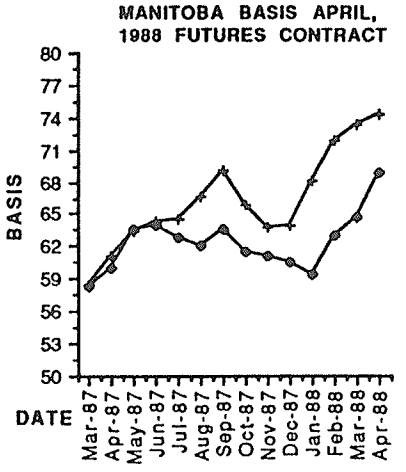
Basis Movement over Life of Contract

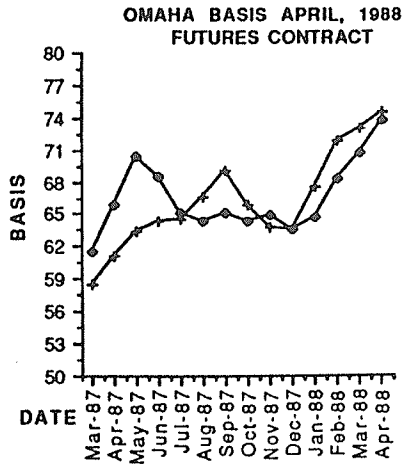






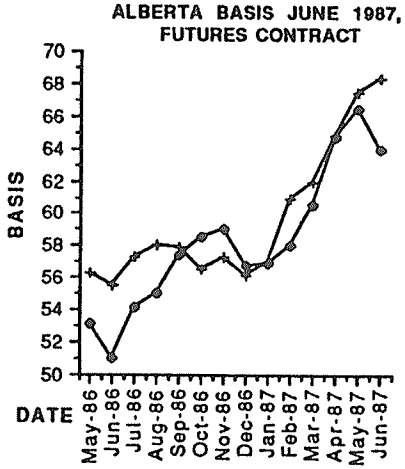


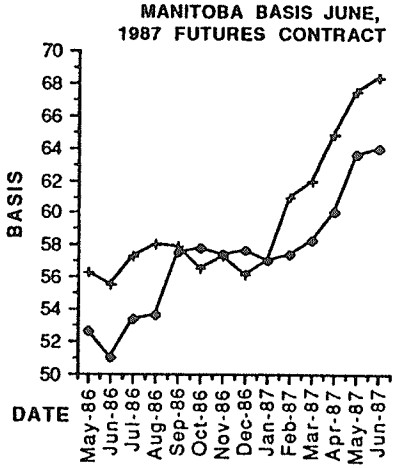


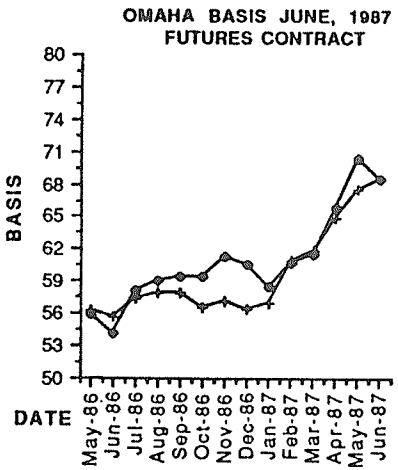


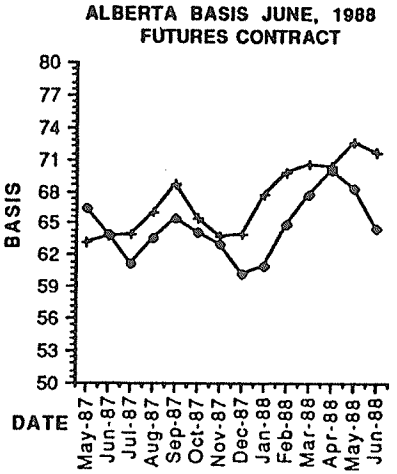
Basis = Futures price (+) minus Cash price (-)

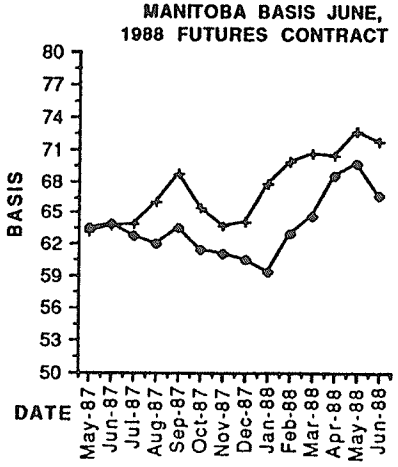
Basis Movement over Life of Contract

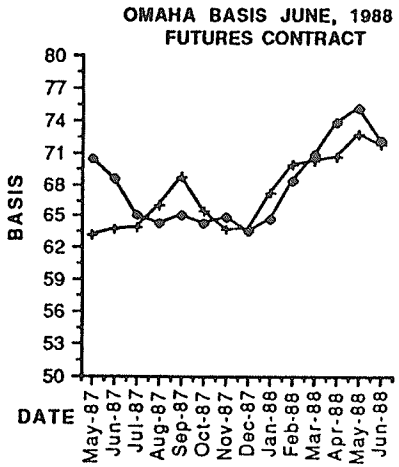






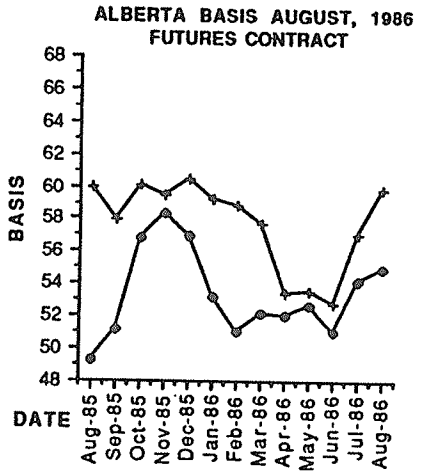


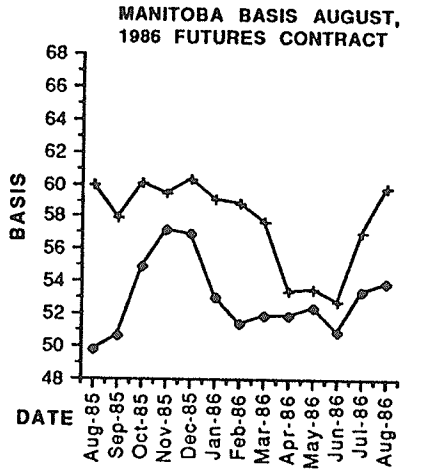


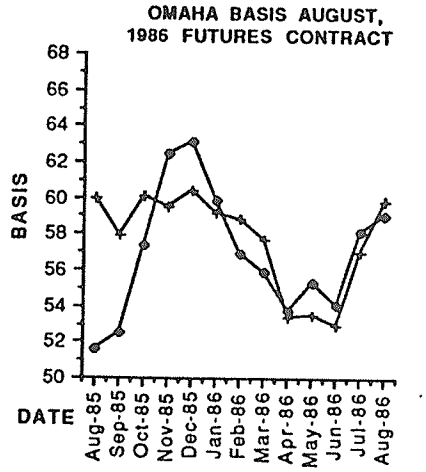


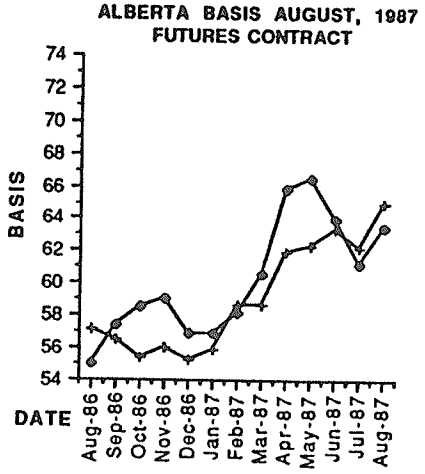
Basis = Futures price (+) minus Cash price (-)

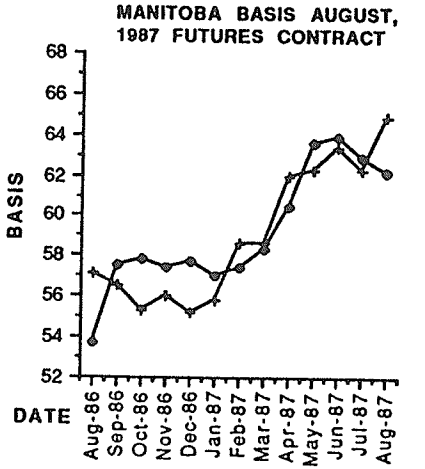
Basis Movement over Life of Contract

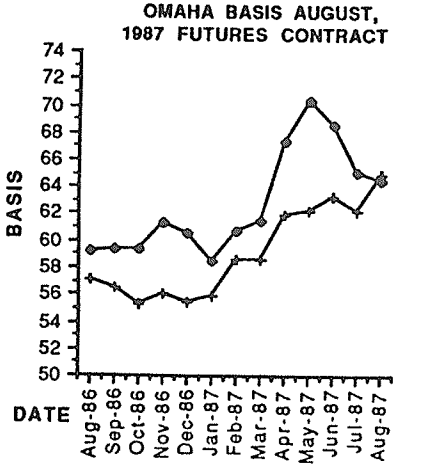






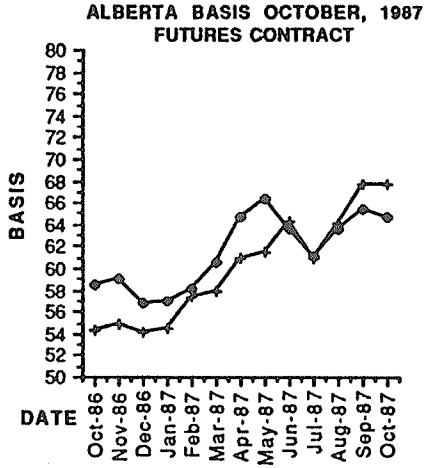


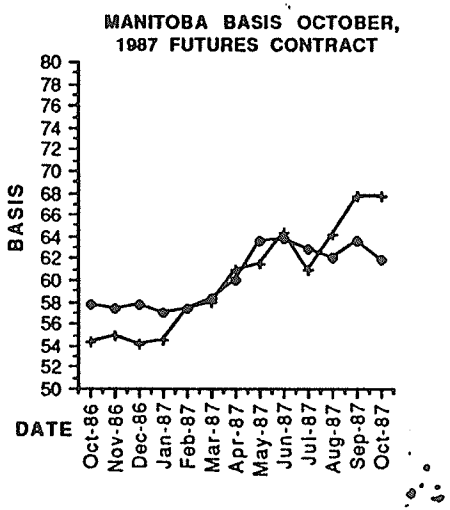


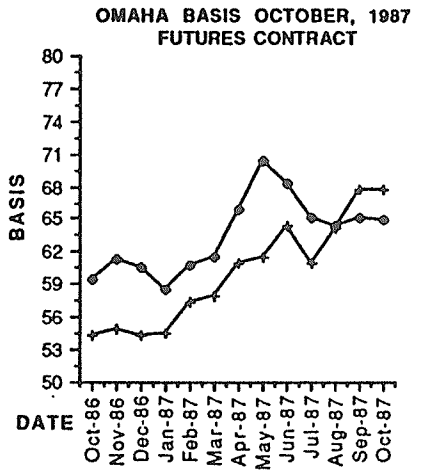


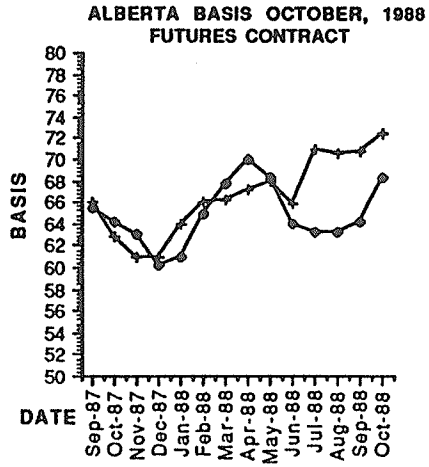
Basis = Futures price (+) minus Cash price (=)

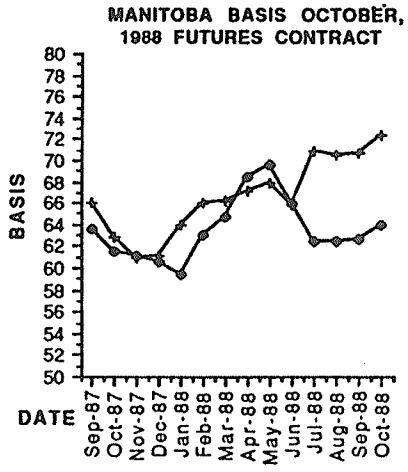
Basis Movement over Life of Contract

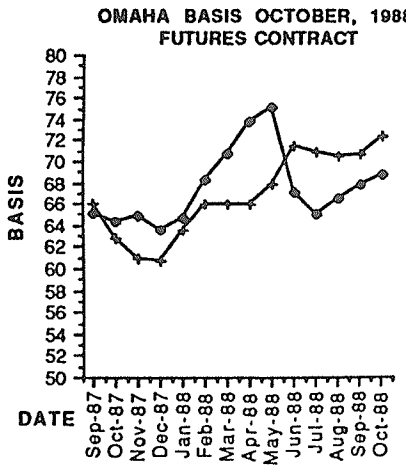






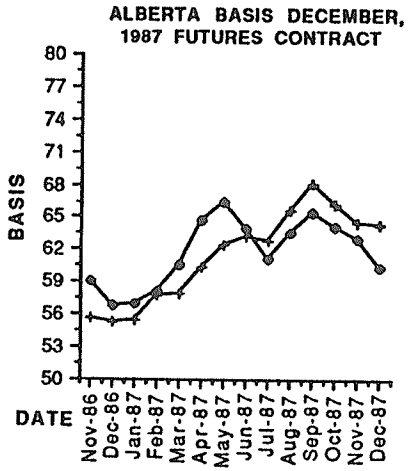


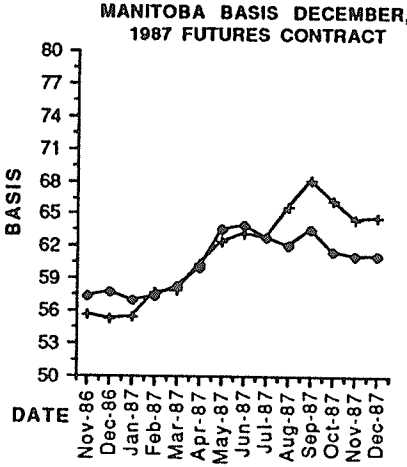


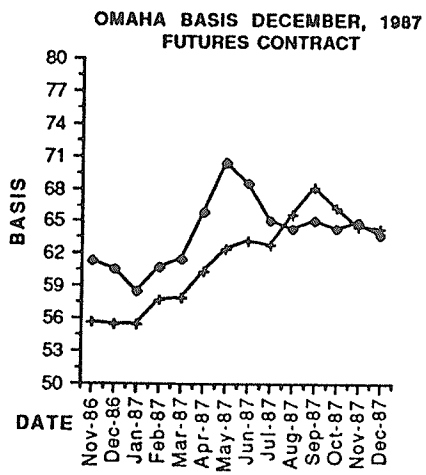


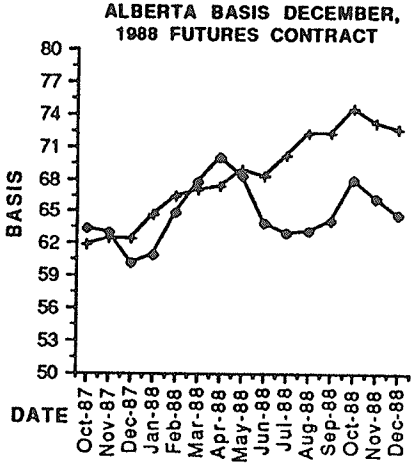
Basis = Futures price (+) minus Cash price (=)

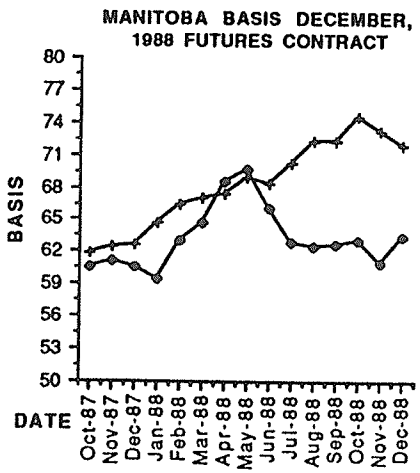
Basis Movement over Life of Contract

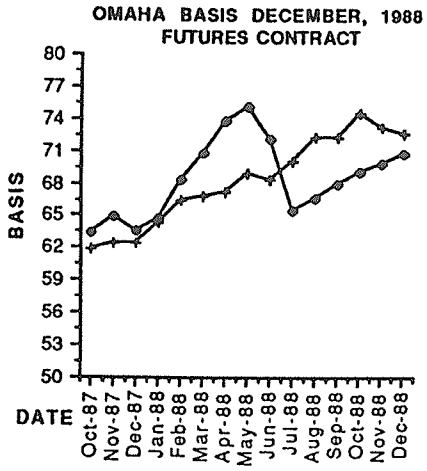






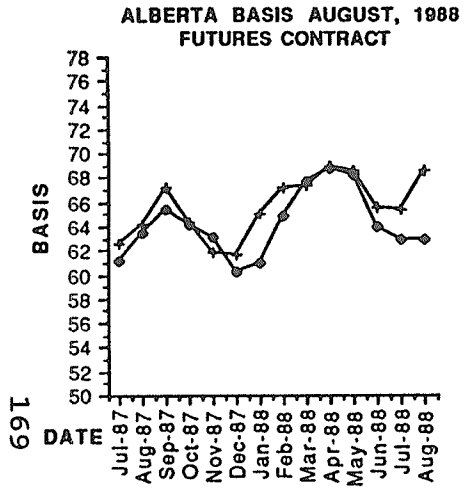


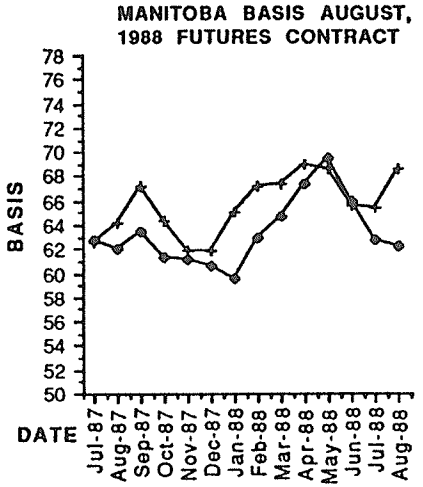


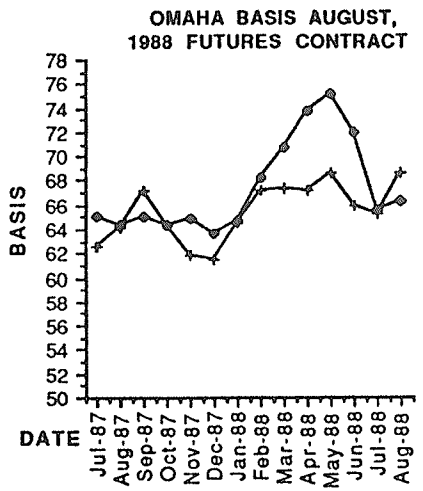


Basis = Futures price (+) minus Cash price (◊)

Basis Movement over Life of Contract







Basis = Futures price (+) minus Cash price (-)

Appendix C

SKEWNESS SIGNIFICANCE TEST

Snedecor and Cochran described the following test for significant skewness for small samples. While these authors do not divide the sample variance by (n-1) but used n instead, this study used SAS which calculates m_2 by dividing the sample variance by (n-1). Once skewness is calculated as described in Chapter III, the skewness coefficient is compared with the table below (as the sample size is between 25 and 200). If the skewness coefficient falls outside the percentage points columnar values, the coefficient is statistically significant at the 10 or 2 per cent level. The 10 per cent level is used in this study.

SKEWNESS TEST - (one-tailed test)

Size of Sample n	Percentage Points 5%	1%	Standard Deviation	Size of Sample n	Percentage Points 5%	1%	Standard Deviation
25	0.711	1.061	0.4354	100	0.389	0.567	0.2377
30	0.661	0.982	0.4052	125	0.350	0.508	0.2139
35	0.621	0.921	0.3804	150	0.321	0.464	0.1961
40	0.587	0.869	0.3596	175	0.298	0.430	0.1820
45	0.558	0.825	0.3418	200	0.280	0.403	0.1706
50	0.533	0.787	0.3264	250	0.251	0.360	0.1531
60	0.492	0.723	0.3009	300	0.230	0.329	0.1400
70	0.459	0.673	0.2806	350	0.213	0.305	0.1298
80	0.432	0.631	0.2638	400	0.200	0.285	0.1216
90	0.409	0.596	0.2498	450	0.188	0.269	0.1147
100	0.389	0.567	0.2377	500	0.179	0.255	0.1089

Since the distribution of skewness is symmetrical about zero, the percentages represent 10% and 2% two-tailed values.

Reproduced from Table A 20, Statistical Methods, Snedecor and Cochran

Appendix D

KURTOSIS SIGNIFICANCE TEST

Snedecor and Cochran describe the following test in analyzing the significance of kurtosis in a distribution. Once kurtosis is calculated as described in Chapter III, the value is compared to the corresponding value in the table below. For this study 75 observation levels are used. If the kurtosis coefficient falls outside the upper and lower percentage points in the table at the 5 or 1 per cent level, the sample is said to exhibit significant kurtosis. The test statistic used in this study corresponded to the 10% level.

TABLE FOR KURTOSIS TEST

(percentage points of the distribution)

Size of Sample	Percentage Points				Size of Sample	Percentage Points			
	Upper		Lower			Upper		Lower	
n	1%	5%	5%	1%	n	1%	5%	5%	1%
50	4.88	3.99	2.15	1.95	600	3.54	3.34	2.70	2.60
75	4.59	3.87	2.27	2.08	650	3.52	3.33	2.71	2.61
100	4.39	3.77	2.35	2.18	700	3.50	3.31	2.72	2.62
125	4.24	3.71	2.40	2.24	750	3.48	3.30	2.73	2.64
150	4.13	3.65	2.45	2.29	800	3.46	3.29	2.74	2.65
					850	3.45	3.28	2.74	2.66
200	3.98	3.57	2.51	2.37	900	3.43	3.28	2.75	2.66
250	3.87	3.52	2.55	2.42	950	3.42	3.27	2.76	2.67
300	3.79	3.47	2.59	2.46	1000	3.41	3.26	2.76	2.68
350	3.72	3.44	2.62	2.50					
400	3.67	3.41	2.64	2.52	1200	3.37	3.24	2.78	2.71
450	3.63	3.39	2.66	2.55	1400	3.34	3.22	2.80	2.72
500	3.60	3.37	2.67	2.57	1600	3.32	3.21	2.81	2.74
550	3.57	3.35	2.69	2.58	1800	3.30	3.20	2.82	2.76
600	3.54	3.34	2.70	2.60	2000	3.28	3.18	2.83	2.77

Reproduced from Table A 20 Statistical Methods, Snedecor and Cochran

Appendix E

SHAPIRO-WILK NORMALITY TEST

Shapiro and Wilk (1965) identify the following five steps in calculating the W test for normality.

1) Order the observations to obtain an ordered sample,

2) Compute

$$S^2=\sum_{1}^{n}(y_i-\bar{y})^2$$
$$=\sum_{1}^{n}(x_i-\bar{x})^2$$

3) If n is even, n=2k compute b

$$b=\sum_{i}^{k}a_{n-i+1}(y_{n-i+1}-y_i)$$

if n is odd, n=2k + 1,

$$b=a_n(y_n-y_1)+\ldots+a_{k+2}(y_{k+2}-y_k)$$

4) Compute $W = b^2/S^2$.

5) Compare with table value for 1, 2, 5, 10, 50, 90, 95 and 99% points of the distribution of W given in Table 6 (page 605, Shapiro-Wilk). The 5% point is used in this study. Low values of W denote a non normal distribution.

Appendix F

AUTOCORRELATION COEFFICIENT ESTIMATES

AUTOREGRESSIVE CORRELATION COEFFICIENTS FROM OLS PROCEDURE OF BIVARIATE MODEL OF CASH PRICE ON FUTURES PRICE BY MARKET AND CONTRACT

	Manitoba	Omaha	Alberta
Year	Rho coefficient	Rho coefficient	Rho coefficient
	February Futures Contract		
1977	-0.59	-0.25	-0.62
1978	-0.53	-0.54	-0.48
1979	-0.53	-0.53	-0.64
1981	-0.48	-0.47	-0.50
1982	-0.63	-0.70	-0.52
1983	-0.12	-0.01	-0.15
1984	-0.67	-0.66	-0.66
1985	-0.60	-0.48	-0.68
1986	-0.66	-0.65	-0.68
1987	-0.41	-0.37	-0.39
1988	-0.58	-0.53	-0.53
	April Futures Contract		
1977	-0.73	-0.13	-0.55
1978	-0.51	-0.60	-0.56
1979	-0.60	-0.69	-0.66
1980	-0.38	-0.51	-0.38
1981	-0.61	-0.70	-0.70
1982	-0.64	-0.62	-0.48
1983	-0.46	-0.46	-0.50
1984	-0.55	-0.47	-0.54
1985	-0.27	-0.24	-0.28
1986	-0.59	-0.59	-0.57
1987	-0.59	-0.62	-0.57
1988	-0.55	-0.62	-0.57
	June Futures Contract		
1977	-0.47	-0.31	-0.48
1978	-0.83	-0.67	-0.83
1979	-0.71	-0.78	-0.76
1980	-0.61	-0.67	-0.61
1981	-0.32	-0.68	-0.72
1982	-0.48	-0.45	-0.16
1983	-0.37	-0.29	-0.33
1984	-0.12	-0.06	-0.02
1985	-0.56	-0.38	-0.57
1986	-0.47	-0.49	-0.47
1987	-0.73	-0.62	-0.60
1988	-0.67	-0.60	-0.70

Autocorrelation coefficients.--continued

	August Futures Contract		
1977	-0.50	-0.20	-0.52
1978	-0.68	-0.31	-0.70
1979	-0.68	-0.73	-0.68
1980	-0.52	-0.62	-0.47
1981	-0.65	-0.66	-0.72
1982	-0.37	-0.42	-0.41
1983	-0.63	-0.52	-0.59
1984	0.26	0.39	0.02
1985	-0.54	-0.55	-0.52
1986	-0.63	-0.62	-0.63
1987	-0.50	-0.49	-0.60
1988	-0.37	-0.21	-0.33
	October Futures Contract		
1977	-0.62	-0.12	-0.59
1978	-0.57	-0.25	-0.60
1979	-0.51	-0.46	-0.47
1980	-0.52	-0.40	-0.49
1981	-0.59	-0.42	-0.59
1982	-0.26	-0.32	-0.30
1983	-0.20	0.25	-0.04
1984	0.33	0.70	0.14
1985	-0.53	-0.47	-0.58
1986	-0.65	-0.62	-0.65
1987	-0.77	-0.73	-0.68
1988	-0.42	-0.75	-0.47
	December Futures Contract		
1977	-0.56	-0.45	-0.51
1978	-0.44	-0.19	-0.47
1979	-0.34	-0.36	-0.30
1980	-0.52	-0.62	-0.66
1981	-0.63	-0.58	-0.62
1982	-0.12	-0.21	-0.07
1983	-0.40	-0.39	-0.41
1984	-0.24	-0.12	-0.29
1985	-0.57	-0.56	-0.56
1986	-0.54	-0.37	-0.54
1987	-0.85	-0.84	-0.85
1988	-0.50	-0.41	-0.62