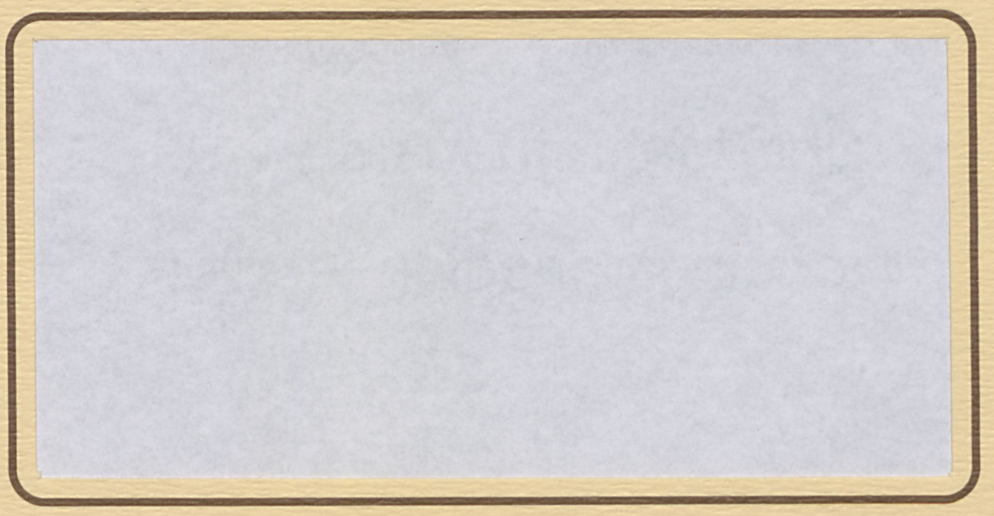
RURAL ECONOMY



STAFF PAPER

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Hedging Canadian Feedlot Cattle Revisited

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Abstract

Canadian cattle finishers who wish to hedge their production must use the U.S. futures markets. Prior research has suggested that Canadian cattle investors cannot successfully hedge using the Chicago Mercantile Exchange (CME) to manage risk due to variable basis assumed to be caused in part by variable exchange rates.

This article reevaluates the use of the CME by Canadian cattle investors feeding heavy feeder steers to slaughter. The study evaluates basis variability, the effect of exchange rates on basis variability and hedging effectiveness. It is shown that Alberta basis is less variable in the latter 1980s than the latter 1970s, Alberta basis is not more variable than the basis at Omaha, variance minimizing hedge ratios are similar between Alberta and Omaha, and changes in exchange rates have little relationship with changes in Alberta basis. These results suggest that the CME has a role in risk management in Canadian cattle feeding.

An historical cattle feeding simulation in Alberta during 1980 to 1989 using heavy feeder steers shows that hedging reduces risk by up to 43%. Exchange rate risk is very low and contributes less than 7% to risk. Basis makes up slightly more than 50% of risk. These results indicate that the CME can be used to manage risk for the cattle investor in Alberta although basis risk is still significant.

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Cattle finishers face a variety of risks including uncertainty in slaughter price, production and government policy. Risk amendment alternatives available to these producers include participation in government programs such as the National Tripartite Stabilization Program (NTSP) and market based alternatives such as forward pricing and the use of futures markets.

There is no Canadian futures market for live cattle. Therefore Canadian cattle investors have to use commodity markets in the United States for private risk management. The Canadian investor using the United States market is an offshore hedger facing possible differences in price movements between the two markets and exchange rate risk. Previous research on Canadian investors using United States cattle futures markets has reported conflicting results on the effectiveness of this futures market for managing risk (Caldwell et al. (1982), Gaston and Martin (1984), Carter and Loyns (1985) and Freeze et al. (1990)). Some of these studies concluded that basis risk and exchange rate risk were important deterrents to hedging. This paper reevaluates the use of commodity futures markets in the United States for managing price risk for Canadian investors owning feedlot cattle fed and sold in Canada. The research reported here suggests that the Chicago Mercantile Exchange (CME) can be used for risk management in Canada, that basis risk while significant does not preclude hedging to reduce price risk and that exchange rate risk is very small.

The article first reviews the literature on using the CME live cattle futures contract for hedging Canadian feedlot cattle. Next the historical basis risk faced by hedgers in Canada and the U.S. is evaluated to determine if there are major differences in risk faced by Alberta investors versus Omaha cattle investors. Included in this analysis is an evaluation of the historical exchange rate variability between Canada and United States and the hedging effectiveness ratio for Canadian and U.S. cattle investors using the CME live cattle contract. An historical cattle feeding simulation for Alberta cattle investors is described and used to further measure the risk level and exchange rate risk from using the CME for hedging over the period 1980 to 1989. This is followed by a discussion which attempts to reconcile the results of this study with earlier research efforts.

Previous Studies

The problems of hedging slaughter cattle have been investigated for both Canadian and United States investors (Caldwell et al. (1982), Gaston and Martin (1984), Carter and Loyns (1985), Freeze et al. (1990) and Leuthold and Tomek (1980)). Leuthold and Tomek (1980) provided a review of United States livestock hedging literature that suggested routine hedging reduced risk and reduced mean returns to such an extent that the strategy is unattractive to most cattle investors. More recent Canadian studies provide conflicting results. Carter and Loyns (1985) compared alternative hedging strategies for slaughter cattle using actual data from over 100,000 head of custom fed cattle in Western Canada from 1972 to 1981. Simulated hedging was added to the actual cattle data to evaluate risk where risk was measured as historical standard deviations in net profits per lot of cattle fed. Carter and Loyns concluded that a routine hedge and hold strategy reduced average profit and increased risk for heifers. This same strategy reduced average profit and reduced risk slightly for steers. The impact of exchange rate on risk with hedging was determined to be significant, although their test ignored possible interactions between the Canadian and United States cattle markets during the period of the hedge. These results, in their opinion, raised doubts about the usefulness of the United States live cattle futures market for Canadian feeders. Caldwell et al. (1982) reported that a routine hedge and hold strategy on slaughter cattle was risk increasing over not hedging for the time period 1975 to 1978. Caldwell et al. (1982) also used historical standard deviation as their risk measure. Freeze et al. (1990) using a target MOTAD linear programming model reported that in the cattle feeding year 1986-1987 cattle investors could increse income and reduce risk by hedging the Canadian dollar and live cattle.

The Canadian cattle hedging problem is an example of offshore commodity hedging. Thompson and Bond (1987) explored offshore commodity hedging with floating exchange rates. They stated that the difference between a U.S. hedger and an offshore hedger will depend on the extent to which exchange rate interactions affect perceived basis variance.

Variable basis and exchange rates were the reasons given for the lack of success in using the CME live cattle contract to routinely hedge Canadian cattle (Carter and Loyns (1985), Caldwell et al. (1982) and Gaston and Martin (1984)). These studies implied that

United States cattle feeders face less variable basis than Canadian cattle investors and therefore United States investors can better use the CME for hedging. None of these studies investigated if basis risk (or perceived basis risk) varied between Canada and the United States. Only Carter and Loyns attempted to measure exchange rate risk for the Canadian cattle investor hedging cattle.

The above discussion points to a need for further investigation of basis risk and exchange rate risk and its components for both Canadian and U.S. feeders. Similar levels of basis risk for producers in both countries and low exchange rate risk for the Canadian investor would indicate a need to reevaluate the question of Canadian hedging of live cattle.

Data Sources

This study simulates a cattle finishing operation in Alberta over the period 1976 to 1989. Production and marketing decisions are assumed to be conducted on a monthly basis. Average prices for the third week of each month were collected on 800+ lb good quality Edmonton feeder steers, all A grades of Alberta direct to packer live slaughter steers, and 1000 to 1100 lb choice Omaha slaughter steers. Closing CME live cattle futures prices and Canada/U.S. exchange rates were collected for the Wednesday of the third week of each month. The data source for all cattle prices and exchange rates was Alberta Agriculture. The United States general price deflater (U.S. President) and the Canadian consumer price index (Bank of Canada) were collected and used to adjust all prices for inflation.

Analysis And Results

Some simple statistics on the relationship between the Alberta market and the United States market are first presented along with comparisons of basis and exchange rate variability to show that the CME has a role in Canadian cattle investment. This is followed by a comparison of basis risk between Alberta and Omaha to assess whether the Alberta investor faces significantly more basis risk than the Omaha cattle investor when hedging. Variance minimizing hedge ratios are compared between Alberta and Omaha to

compare the risk reduction from using the CME live cattle futures contract. Finally, the Alberta cattle feeding simulation model and the results of the simulation with and without hedging are presented. Exchange rate risk and basis risk are measured using this model.

Theoretical models have identified that hedging effectiveness is determined by the covariance between the relevant cash and futures prices (Kamara (1982)). As a preliminary indicator of the potential use of the CME by Canadian cattle feeders, the correlation between Alberta cash prices and CME futures prices is calculated. Correlations of real Alberta slaughter steer prices and CME live cattle futures prices are 0.91 for the period 1980 to 1989. The correlation rises to 0.96 when the CME price is adjusted to Canadian dollars using the prevailing spot exchange rate. Figure 1, a graph of nominal Alberta cash steer price and Omaha cash steer prices (not adjusted for exchange rates), also suggests a relatively close relationship between the Alberta and United States markets. The close relationship between Alberta and Unites States prices supports the concept of a North American market for slaughter cattle.

A review of simple statistics suggests the CME has a possible role in managing risk in cattle feeding in Western Canada. These results are further supported by an analysis of basis variability in Alberta and Omaha. Earlier studies indicated basis variability was a deterrent to Canadian hedging. Previous studies are dated and basis may have changed due to closer links between the United States and Canadian cattle markets. Western Canadian basis may have been less variable in the 1980s than in the 1970s due to increased live cattle slaughter exports to the United States. Live cattle slaughter exports from Alberta to the United States were 569 head in 1979 and 182,978 head in 1989 (Alberta Agriculture). A graph of nearby Alberta basis in Figure 2 also suggests that basis is less variable in the late 1980s than in the late 1970s. Table 1 shows the means and standard deviations of the Alberta nearby basis. A standard F test of whether Alberta basis is less variable in the period 1985 to 1989 than 1976 to 1980, conducted at the 5% level of significance, shows the Alberta basis is significantly less variable in the later time period.

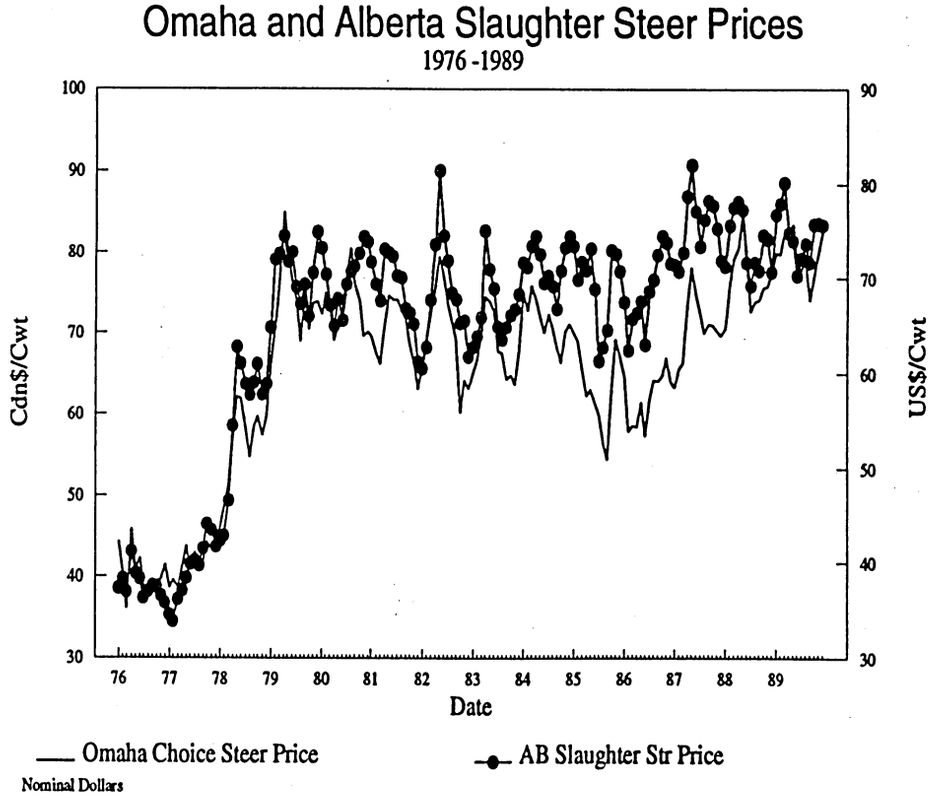

Figure 1

Alberta basis variability is also compared to Omaha basis variability to answer the question: Are Alberta cattle investors at a disadvantage in using the CME for risk management? It has been an implicit assumption of some Canadian studies that United States cattle investors are better able to use the futures market for hedging. The Omaha basis

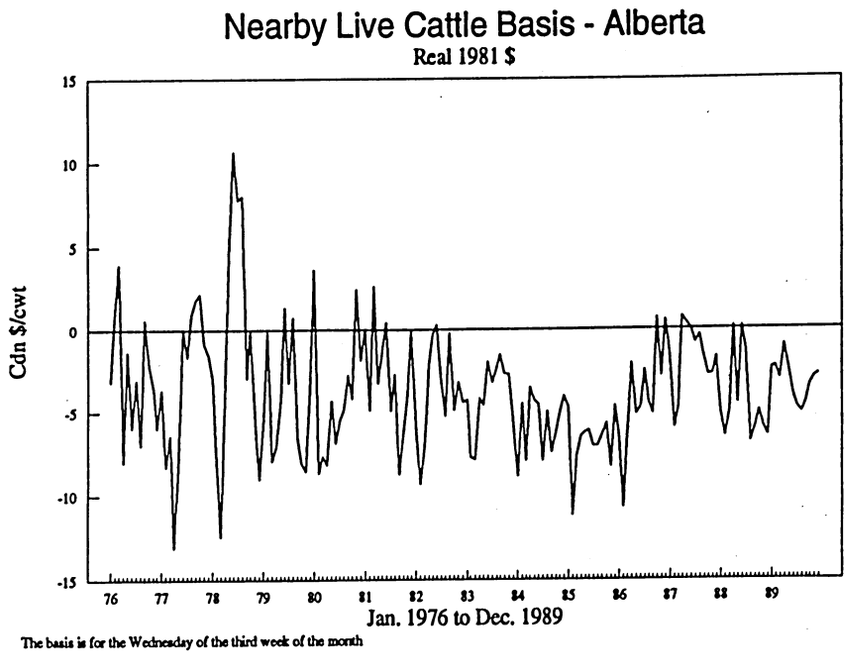

Figure 2

means and standard deviations are in Table 1. The Omaha basis standard deviation in Canadian dollars, 4.07, or U.S. dollars, 3.53[1], is not appreciably smaller than the Alberta basis standard deviation, 4.18, for the latter part of the 1980s.

A standard F test to compare the basis variances between the two markets is not appropriate since the Alberta basis and the Omaha basis are not independent. Since it is the unpredictable portion of basis that is relevant to the cattle investor, a test comparing

1 For most of this period the value of one U.S. dollar was greater than the value of one Canadian dollar.

forecast MSE (Ashley et al. (1980)) with two similar basis forecast models for Alberta and Omaha concluded that the mean square error of the basis for Omaha is not smaller than the basis for Alberta[2].

Table 1
Alberta and Omaha Nearby Live Cattle Basis

Alberta Nearby Basis in real Canadian 1989 Dollars[A]

Time Period	Mean	Sample Std. Dev.
1976-89	-5.73	5.59
1976-1980	-4.78	7.45*
1980-1989	-6.25	4.35
1985-1989	-6.20	4.18*

Omaha Nearby Basis in U.S. 1989 Dollars

Time Period	Mean	Sample Std. Dev.
1976-89	-1.25	3.76
1976-1980	-1.86	4.28
1980-1989	-1.03	3.38
1985-1989	-1.26	3.53

Omaha Nearby Basis Converted to 1989 Canadian Dollars

Time Period	Mean	Sample Std. Dev.
1976-89	-1.30	3.94
1976-1980	-1.76	4.12
1980-1989	-1.17	3.80
1985-1989	-1.46	4.07

A. Adjusted with all item consumer price index. The *'s indicate that the standard deviations are different from each other at the 5% level of significance using a standard F test on the variances. The other overlapping time periods for Alberta were not tested for differences.

2 The forecast used in both cases is a simple mean of historical basis calculated at time t (in real dollars and the Alberta basis converted to U.S. dollars using the spot exchange rate) and used to forecast ahead 3 months to month t+3. The root MSE for the Alberta basis forecast is 4.53 in 1989 Canadian dollars or 3.59 in 1989 U.S dollars. The root MSE for Omaha basis is 4.32 in 1989 U.S. dollars. Results from the Ashley test were confirmed using a Pitman test(Snedecor and Cochran (1980)).

Another way to consider the risk faced by feeders is through a comparison of movements in important variables over the length of a normal feeding period for heavy feeder cattle. Means and standard deviations for the three month change in exchange rates, basis and Alberta slaughter steer prices for 1980 to 1989 are in Table 2. The change in basis is smaller than the change in price levels which suggests a legitimate role for hedging. Changes in the variability of exchange rates, basis and slaughter prices were tested by comparing the variances of these variables over different time periods. Table 2 contains standard deviations for the periods 1976 to 1980 and 1985 to 1989. Standard F test results show that variances for three month changes in exchange rates, Alberta basis and Alberta cash steer slaughter prices are significantly lower during the 1985-89 period than 1976-80. The correlation between the three month change in basis and the change in exchange rates is 0.02 for 1980 to 1989. Exchange rate changes do not seem to affect the change in basis. Similarly the correlation between the three month change in Alberta cash steer prices and exchange rates is -0.21 for 1980 to 1989. Both correlations suggest exchange rate changes are not a significant factor in hedging or in price forecasting risk.

Comparison of the Alberta investor versus the Omaha investor involves the variance minimizing hedge ratio calculation from the returns on a portfolio of cattle and cattle futures. With unbiased futures markets the variance minimizing hedge ratio is often referred to as the optimal hedge. Different risks in the two markets should imply different levels of variance minimizing hedging and hedging effectiveness. There are many references on the optimal hedge and the best model formulation including Rolfo (1980), Kahl (1983), Peck (1975), Stein (1961), Johnson (1960), Heifner (1972), Bond and Thompson (1985), Cecchetti et al. (1988), Anderson and Danthine (1981), Bond and Thompson (1986), Peterson and Leuthold (1987), Berck (1981), Kenyon and Clay (1987), Newbery and Stiglitz (1981) and Robison and Barry (1987). Care must be exercised when comparing the hedging effectiveness from different sets of data (Lindahl (1989)). Heifner (1972) determined upper limits of hedge ratios for cattle feeders in the U.S. that ranged from 0.56 to 0.88 and concluded that about 1/3 to 1/2 of the price risk in his study area could be eliminated by optimal hedging. Carter and Loyns (1985) calculated hedge ratios for the Canadian cattle feeder using OLS regressions of cash price changes and futures price changes. Their result for steers was a hedge ratio of 0.62 with a hedging effectiveness measure of 0.12.

Table 2
Three Month Movements in Exchange Rate, Basis and Cash Steer Slaughter Price

Time	Exchange Rate	AB Basis	AB Steer Price
1980-1989 Mean[A]	-0.02	-0.14	1.47
Sample Std. Dev.	1.55	5.85	8.86
1976-1980 Mean	0.85	0.15	-1.95
Sample Std. Dev.	1.96*[B]	11.17*	12.81*
1985-1989 Mean	-0.49	-0.15	0.80
Sample Std. Dev.	1.45*	4.64*	7.39*

A. These are the means of the changes in exchange rates, basis and cash price. For example the exchange rate 3 month difference is $X_t - X_{t+3}$ where the X is the spot exchange rate at month t and month t + 3. This exchange rate is U.S. dollars to buy 100 Canadian dollars. Alberta basis and Alberta slaughter steer price are in real 1989 Canadian dollars per hundredweight.
B. *'s indicate these standard deviations are significantly different from each other at the 5% level of significance using a standard F test.

The price difference model with OLS used by Carter and Loyns (1985) is used to calculate hedge ratios for the Alberta and Omaha cattle investor. The prices used are the Alberta change in cash prices, Omaha change in prices and the CME futures live cattle price changes. The price difference method using actual prices allows for comparisons between the Alberta and the Omaha cattle investor without having to specify a cattle feeding and price forecast model for Omaha. All numbers are converted to real dollars before calculating the hedge ratios. Equation (1) describes the optimal hedge model for Alberta as

$$(CP_t - CP_{t+3}) = \alpha + (FP_{j,t} \times X_t - FP_{j,t+3} \times X_{t+3})\gamma + \mu \qquad (1)$$

Where CP_t is the Alberta cash slaughter steer price in month t, α is a constant, $FP_{j,t}$ is the CME live cattle futures price for contract j in month t, X_t is the spot exchange rate in month t, γ is the hedge ratio and μ is assumed to have zero mean and homoskedastic variance with no serial correlation. The R-Squared value of equation (1) is a measure of

hedging effectiveness. This model is calculated for 3 month price differences using OLS. The hedge ratios are reported for the entire period ending in 1989. The variance minimizing hedge ratios and hedging effectiveness measures in Table 3 suggest that hedging reduces price risk by about 41% for Alberta and that there is little difference in hedging risk between the two locations.

Table 3
Variance Minimizing Hedge Ratios
Alberta And Omaha[A]

Alberta Hedge Ratio	Hedging Effectiveness Alberta R-Squared	Omaha Hedge Ratio	Hedging Effectiveness Omaha R-Squared
0.70	0.41	0.69	0.45

A. The estimation period used data from 1976 to 1989. The OLS estimating equations exhibited significant first order autocorrelation. Correcting for the autocorrelation using a Maximum Likelihood (ML) estimation procedure changed the Alberta results to 0.59 for the hedge ratio and 0.60 for the hedge effectiveness. Similar results for Omaha were 0.60 for the hedge ratio and 0.66 for hedge effectiveness. For both Alberta and Omaha the hedge ratios are significantly different from 0 and from 1 when tested in the ML adjusted model.

These results on basis, exchange rates and variance minimizing hedges imply that the risk faced by a Canadian cattle investor using the CME live cattle futures market for hedging is not greater than that of a United States investor. Secondly basis risk and exchange rate risk do not appear to be factors that should prevent the use of hedging to manage cattle feeding risk in Canada during the 1980s. These conclusions are tested in an historical cattle feeding simulation model which is described next.

The base historical simulation has a cattle investor purchase 100 heavy feeder steers each month at Edmonton, Alberta and place them in a custom feedlot near Calgary, Alberta. The first feeder steers in the main part of the simulation are purchased in October 1979 for sale in January 1980. The last lot of feeders are purchased in September 1989 for sale in December 1989. All feeder purchases and sales occur on Wednesday of the third week of the month. All feeding costs are assumed paid at the beginning of the

feeding period. Production risk is not included based on the research results of Coles (1989). The only risk is slaughter price risk. This study follows the lead of Peck (1975) and measures risk as deviations from forecasts using Mean Square Error (MSE). The cattle are fed three months in a custom feedlot to a slaughter weight of 1157 lbs.

Net profits and forecast net profits are calculated in Canadian dollars on each lot of cattle fed. The net profits on each lot of cattle without hedging and with hedging are calculated respectively as

$$NP_{t+3} = (CP_{t+3} \times Q_{t+3} - TC_t) \tag{2}$$

$$NP_{t+3} = (CP_{t+3} \times Q_{t+3} - TC_t) + Q_{t+3} \times (FP_{j,t} - FP_{j,t+3}) \times X_{t+3} \tag{2a}$$

where NP_{t+3} is net profit per lot sold in month $t+3$, CP_{t+3} is Alberta slaughter steer cash price, Q_{t+3} is quantity of beef sold, TC_t is total production cost (including hedge brokerage fee if applicable) paid in month t, FP_j is the CME live cattle futures contract price with maturity month j, j is the nearest contract month available after month t+3 and X_{t+3} is the spot exchange rate converting U.S dollars to Canadian dollars. The hedge component in equation (2a), $Q_{t+3} \times (FP_{j,t} - FP_{j,t+3}) \times X_{t+3}$, follows the offshore commodity hedge calculation of Benninga et al. (1985) and Thompson and Bond (1987) and differs from the calculation of Carter and Loyns (1985)[3]. To simplify calculations margin costs are assumed negligible and the futures contract is assumed infinitely divisible to exactly match expected production.

Only data that is available at the time of the decision to feed cattle is used to forecast net profits for MSE. This ex ante approach is used to simulate as closely as possible the actual information set faced by a cattle investor at the time an investment decision is made. The forecasted net profits with hedging are calculated on each lot of cattle at the time of feeder purchase as

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3 Carter and Loyns (1985) specify the hedge calculation in their study as $(FP_{j,t} \times X_t - FP_{j,t+3} \times X_{t+3})$ which implicitly assumes a 100% margin requirement in their model. Typically hedgers only require 5% margin and based on experience with the model in this study the Carter and Loyns specification leads to biases (increased hedge profits) when calculating the hedge.

$$\tilde{NP}_{t+3} = (\tilde{CP}_{t+3} \times Q_{t+3} - TC_t) + Q_{t+3} \times (FP_{j,t} - \tilde{FP}_{j,t+3}) \times \tilde{X}_{t+3} \quad (3)$$

where "~" represents forecasts. If the futures market is unbiased and FP_t is used to forecast FP_{t+3}, (3) reduces to

$$\tilde{NP}_{t+3} = (\tilde{CP}_{t+3} \times Q_{t+3} - TC_t) \quad (3a)$$

Equation (3a) is the forecast with no hedging or with hedging when the futures market is unbiased. A test for futures market bias in the context of this model is provided later and it suggests that the CME live cattle futures contract is unbiased. Equation (3a) is used to forecast in this model.

The historical data from January 1976 to October 1979 are used to develop the first set of price and net profit forecasts in equation 3. The forecasts are updated each month using the most recent information available at the time of the simulated cattle purchase. The CME futures live cattle contract adjusted for forecast basis and forecast exchange rate proved to be the best Alberta slaughter steer price forecaster during the time period of this study.[4] The three month ahead Alberta slaughter steer price forecast model used was

$$\tilde{CP}_{t+3} = FP_{j,t} \times X_t + \tilde{B}_{t+3} \quad (4)$$

where $\tilde{B}$ is forecast Alberta live cattle nearby basis developed from an ARIMA(1,1,1)[5] forecasting model updated each month with new information. The futures price $FP_{j,t}$ is assumed to be an unbiased forecast of the expected futures price, $E(\tilde{FP}_{j,t+3})$, where E is the expectations operator. Based on the results of Boothe and Longworth (1986), Wolff (1988) and Chrystal and Thornton (1988) the current spot exchange rate, X_t, is used as the forecast of the expected exchange rate, $E(\tilde{X}_{t+3})$. The actual Alberta nearby basis numbers used in Table 1 are calculated from

$$CP_{t+3} = FP_{j,t+3} \times X_{t+3} + B_{t+3} \quad (5)$$

The mean square error risk measure of net profits (with no hedging) is defined as

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4 Nine different Alberta slaughter steer price forecasters were evaluated using Mean Square Error. The selection of the best price forecast model was based on data for the entire time period 1976 to 1989.

5 ARIMA(1,1,1) model of Alberta basis was identified using usual Box-Jenkins techniques in RATS (VAR Econometrics).

$$MSE = \frac{\sum_{t=1}^{T} (NP_t - \tilde{NP}_t)^2}{T-1} \tag{6}$$

where T is the total number of periods. Equation (6) can be expanded to show the different sources of risk measured by MSE and this will help in understanding the MSE results reported later. First, substitute equation (5) into equation (2) and substitute equation (4) into equation (3a). Then substitute these expanded versions of equations (2) and (3a), into (6) to get

$$MSE = \frac{\sum_{t=1}^{T} [(FP_{j,t+3} \times X_{t+3} - FP_{j,t} \times X_t) + (B_{t+3} - \tilde{B}_{t+3})]^2 \times Q_{t+3}^2}{T-1} \tag{7}$$

The MSE risk measure of net profits, equation (7), is composed of price risk, the change in FP_t to $FP_{j,t+3}$, exchange rate risk, the change in X_t to X_{t+3} and basis risk, the change in $\tilde{B}_{t+3}$ to B_{t+3}.

The MSE with a hedge and hold strategy changes the risk components and it is derived by substituting equation (5) into (2a), equation (4) into (3a) and then substituting the expanded versions of (2a) and (3a), into (6) to get

$$MSE = \frac{\sum_{t=1}^{T} [FP_{j,t} \times (X_{t+3} - X_t) + (B_{t+3} - \tilde{B}_{t+3})]^2 \times Q_{t+3}^2}{T-1} \tag{7a}$$

With a hedge and hold strategy in equation (7a) there is only exchange rate risk and basis risk. Price risk is eliminated. These risks in equations (7) and (7a) are measured separately in this simple model. The derivations of MSE above assume an unbiased futures market. The futures market was first tested for bias before using the simulation model to estimate MSE and this test is reported next.

The routine hedge is evaluated for the net profit or loss (excluding brokers fees or margin costs) using the hedge component in equation (2a), $(FP_{j,t} - FP_{j,t+3}) \times X_{t+3}$. This evaluates the bias in the live cattle futures market since the mean of hedge profits should be 0 if $FP_{j,t}$ is an unbiased forecast of $FP_{j,t+3}$. Live cattle contracts are sold at the same time the feeder steers are purchased and purchased back on the date the cattle are sold. The results for the Alberta hedge profit in $/cwt for the 3 month hedge are in Table 4.

Table 4
Hedge Profit For Alberta Investor
January 1980 to December 1989[A]

Hedge Length	Mean $/cwt	Sample Std. Dev.	t Statistic[B]
90 day	-0.88	7.75	1.24

A. Means and standard deviations are reported in December 1989 Canadian dollars. The approximate brokerage costs of $0.19/cwt in the same 1989 dollars are not included. The hedge data exhibited positive first order autocorrelation. Correction for the autocorrelation does not change the conclusion that the mean is not significantly different from zero.
B. T statistic is the standard test for the difference of the mean from 0.

Results of the t test on hedge profits suggests that the mean of three month holding period hedge profits (Table 4) over the period 1980 to 1989 is not significantly different from zero. From this we conclude that the futures market is not biased over the period considered and that over the long term an investor would forecast that hedge profits equal 0. The conclusion of an unbiased market supports the use of forecast equation (3a) in the simulation model.

The simulation model outlined above is used to evaluate hedging effectiveness and decompose the MSE of cattle feeding profits from 1980 to 1989. The cattle feeding simulation compares a 100% hedge and hold risk management strategy (equation (2a)) to no hedging (equation (2)). The net profit per lot, the standard deviation of net profit per lot, and the root MSE of net profit are calculated using the model and are reported in Table 5. The hedge and hold strategy reduces risk by 43% (9483.75-5440.32/9483.75). This is significant at the 5% level using the test of Ashley et al. (1980). The use of standard deviations as a risk measure underestimates the impact of hedging and it shows only a 17% drop in standard deviation[6]. The use of standard deviations as the main risk measure may account for the conclusions in some studies that hedging does not reduce risk.

6 This is similar to the result reported by Carter and Loyns (1985) for steers where hedging showed a 14% drop in standard deviation over no hedging for the period 1972 to 1981.

Table 5
Net Profits And MSE of Net Profits Per Lot[A]

Using Forecast Exchange Rate (Equations (7) and (7a) for MSE Calculations)

	Mean Dec. 1989 $	Std. Dev.	Root MSE
No Hedging 1980-89	-956.90	8622.69	9483.75a[B]
Hedge and Hold 1980-89	-2154.03	7175.64	5440.32a

Perfect Exchange Rate Forecasts (Equations (8) and (8a) for MSE Calculations)

	Root MSE
No Hedging (Price and Basis Risk)	9460.77b
Hedge and Hold (Basis Risk Only)	5097.55b

A. Does not include the NTSP program. If the NTSP program is included the mean of net profits per lot changes to -197.62 with no hedging and -1394.75 with hedging. The standard deviations with NTSP are similar to the standard deviations reported here. Caution should be used when comparing the mean of net profits in this model to the industry since small changes in feeding efficiency or costs would significantly change these means.
B. MSE with the same letter a or b indicates significantly different from each other at the 5% level using MSE test of Ashley et al. (1980).

Exchange rate risk and basis risk are measured by incorporating a perfect exchange rate forecast in the simulation model which removes exchange rate risk as a factor. Within the simulation model we replace the forecast exchange rate used in slaughter price forecast equation (4), X_t , with the actual exchange rate, X_{t+3}, that occurs. The comparison of the models with the forecast exchange rate and the perfect exchange rate forecast is a measure of exchange rate risk. The perfect exchange rate forecast changes the MSE with no hedging, equation (7), to

$$MSE = \frac{\sum_{t=1}^{T} [(FP_{j,t+3} - FP_{j,t}) \times X_{t+3} + (B_{t+3} - \tilde{B}_{t+3})]^2 \times Q_{t+3}^2}{T-1} \quad (8)$$

The risk remaining in equation (8) is price risk and basis risk. The perfect exchange rate forecast changes the MSE with hedging, equation (7a) to

$$MSE = \frac{\sum_{t=1}^{T} [B_{t+3} - \tilde{B}_{t+3}]^2 \times Q_{t+3}^2}{T-1} \quad (8a)$$

The risk remaining in equation (8a) is basis risk. The root MSEs from equations (8) and (8a) with perfect exchange rate forecasts are reported in Table 5.

MSE drops marginally from 9483.75 to 9460.77 when exchange rate risk is removed. This is a 0.2% drop is total risk (9483.75-9460.77/9483.75) when not hedging and it is not significant at the 5% level. Exchange rate has almost no impact on the price forecast and risk when not hedging. The removal of exchange rate risk with hedging drops risk from 5440.32 to 5097.55 and this is not significant at the 5% level. Exchange rate risk is minimal when hedging over a three month time period. The root MSE, 5097.55 with hedging and a perfect exchange rate forecast (equation (8a), is a measure of total basis risk faced by an Alberta hedger. Basis risk is 54% (5097.55/9483.75) of total risk. Basis is a measure of the independent price movement of the Alberta market versus the U.S. futures market (in Canadian dollars) in this model. Basis risk is still substantial but this does not seem to preclude the use of hedging to reduce overall price risk.

Summary And Conclusions

This study reevaluates the use of commodity futures markets in the United States for managing risk for Canadian investors owning feedlot cattle fed and sold in Canada. Prior research in the 1970s concluded that basis risk and exchange rate risk were important deterrents to hedging. Our results show that basis risk and exchange rate risk are lower in the late 1980s than in the late 1970s and this may in part account for the different results in our study. The results of this study indicate that Alberta cattle investors can use the CME live cattle futures contract for managing risk. Exchange rate risk between Canada and the United States is not an important risk factor. Alberta basis risk does not appear to be any greater than basis risk at Omaha during the late 1980s. Vari-

ance minimizing hedge ratios and measures of hedging effectiveness are quite similar between Alberta and Omaha. Basis risk may not be a major factor preventing the use of this futures market for hedging in the 1980s although basis risk makes up over 50 % of the risk in the model used here. Basis risk is a major factor preventing further reductions in risk when hedging and as such deserves more research.

Results from the historical simulation indicate that a hedge and hold strategy may reduce risk significantly for Alberta cattle investors. The average cost of full hedging is less than $12.00 per head (without interest on margin costs). This average hedge cost can be compared to a Canadian government program designed to stabilize cattle feeder income, the National Tripartite Stabilization Program (NTSP), that in 1989 had total combined individual and government premiums of $24.30 per head.

Our results contradict the conclusions of other studies on the use of the CME live cattle contract by Canadian cattle investors. Part of this difference may be related to the time period covered by this study as compared to other studies and the methodology used to calculate the hedge and to measure risk. These results suggest that if Canadian investors in heavy feeder cattle are not hedging using the CME live cattle contract it is likely for reasons other than basis risk (or basis risk different from that of United States investors) and exchange rate risk.

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