Evaluating the Hedging Potential of the Lean Hog Futures Contract

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ABSTRACT

The lean hog futures contract is replacing the live hog futures contract at the Chicago Mercantile Exchange beginning with the February 1997 contract. The lean hog futures will be cash settled based on a broad-based lean hog price index, eliminating terminal markets from the price discovery process. Using this index over a twenty-month period as a proxy for the lean hog futures price, this paper compares the hedging effectiveness of the live hog futures contract to the hedging potential of the lean hog futures contract for cash live hogs as well as four cash meat cuts. Frozen pork bellies futures are also examined for the cash meats. Both long-term and short-term hedges are simulated, using the minimum-variance approach, which utilizes only unconditional information, and the Myers-Thompson approach that incorporates conditional information. The results show that the lean hog futures should perform better than either the live hog or the frozen pork bellies futures as a hedging instrument for Omaha cash hogs and cash loins. The strongest evidence of this is for the short-term hedging of cash hogs. For the other three meats, no futures contract demonstrated a clear hedging advantage.

INTRODUCTION

For more than a quarter of a century, the live hog futures contract has served as a very important risk management tool offered by the Chicago Mercantile Exchange (CME) for participants in the hog industry. However, the December 1996 contract is the final live hog futures contract. Beginning with the February 1997 contract, which began trading in November 1995, a lean hog futures contract is replacing the live hog contract as the primary risk management tool offered by the CME for the hog industry.

There were several factors involved in the decision to revise the hog futures contract. However, all relevant factors have one common source--structural changes highlighted by the rapid growth of horizontal and vertical coordination throughout the industry. These structural changes have altered the marketing strategies for hog producers, as hogs are increasingly being marketed directly to packing plants, bypassing terminal and auction markets.

This fundamental shift has sparked three major concerns dealing with the reliability of the live hog futures contract. First, the live hog settlement procedure has come under fire. Final settlement requires physical delivery of slaughter hogs to one of seven terminal markets. Over the past twenty years, however, there has been a substantial and steady decrease in terminal market volume as a percentage of all hogs marketed in the United States. Second, the trading volume of the live hog futures and options has been extremely volatile since 1990. Both futures and options volume decreased dramatically from 1990 to 1993, then increased slightly in 1994 and more substantially in 1995, although the 1995 futures volume remains substantially lower than the 1990 volume. This unpredictable pattern raises concern regarding the utilization of the live hog futures and options. Third, the hog industry has generally moved away from the pricing of hogs on a live basis. Rather, the industry has developed carcass-based pricing systems in which the price paid for hogs is a function of lean meat content and not gross live weight. The lean hog futures contract is an attempt to more accurately represent the hog industry in this respect.

While the impact of structural changes on marketing practices throughout the industry is fairly clear, it is less clear whether altering the hog contract will increase hedging effectiveness. On one hand, thinner terminal markets could be limiting the contract's effectiveness as a price discovery and risk management tool. Therefore, a replacement that provides a more accurate representation of cash price should increase hedging effectiveness. On the other hand, the changing structure of the industry itself may have reduced the need for futures contracts while alternative means of managing price risk (such as forward contracts between producers and packers) have become more viable. If this is true, lower contract volumes may not be an indication of decreasing contract performance, suggesting that the lean hog futures may not be able to improve hedging effectiveness.

The lean hog futures contract will be cash settled based on a lean hog cash index developed by the CME, eliminating the terminal markets from the settlement process. The value of this cash index has been calculated since May 1994. The index itself is the two-day weighted average (weighted by the number of head) of individual price indexes from the Western Corn Belt, the Eastern Corn Belt, and the Mid-South region, as reported by the USDA. These three regions account for over 90% of the nation's inventory of market hogs (CME, 1995). Table 1 highlights the major differences between the two contracts.

It should be noted that while both contracts have 40,000 pound trading units, the lean hog contract represents lean (carcass-based) hogs. Thus, one live hog contract is slightly less than three-quarters as large as one lean hog contract.

The purpose of this paper is to evaluate the potential performance of the lean hog contract as a replacement for the live hog contract. In doing so, the lean hog cash index will serve as a representation of the lean hog futures contract. These index prices will be used along with cash live hog prices and four cash meat prices (hams, loins, pork bellies, and trimmings) to obtain potential optimal hedge ratios and potential hedging effectiveness measures for the new futures contract. These results will then be compared with similar analysis using live hog futures contract prices in place of lean hog index prices. This evaluation and comparison will demonstrate how the changes in the hog futures contract may change hedging procedures for buyers and sellers of pork and pork products. This evaluation is a necessary step in determining whether the lean hog contract can perform as an improved source of price discovery and risk management for the hog industry.

Two major assumptions are made for this study. First, the lean hog futures price is expected to closely resemble the lean hog index price. Because lean hog futures prices have only recently become available and the first futures contract (February 1997) is some time before settlement, using actual lean hog futures data would not be informative. The lean hog futures will likely reflect the lean hog index most closely for nearby contracts drawing closer to final settlement. Therefore, the short-term hedge ratios and hedging effectiveness measures should provide the most accurate information when dealing with the lean hog index.

Second, this study will use Omaha live hogs to represent the cash hog price. However, as the hog industry continues to shift towards carcass-based pricing systems, terminal cash markets may soon vanish, or at least continue to lose volume. Thus, the Omaha live hog price may not provide an accurate representation of the cash market that hedgers will be facing in the future.

REVIEW OF LITERATURE

The Minimum-Variance Hedge Ratio

Several sources exist describing regression techniques to determine the optimal hedge ratio and the corresponding hedging effectiveness for various commodities. Benninga, et al. (1984) derived the minimum-variance hedge ratio from an ordinary least squares (OLS) regression with cash price levels (or price changes) as the dependent variable and futures price levels (or price changes) as the explanatory variable. The minimum-variance hedge ratio is simply the slope coefficient of the OLS regression, or equivalently:

Covariance (Cash, Futures) / Variance (Futures).

This ratio was developed as the optimal hedge ratio for any unbiased futures market. If the futures market is unbiased, the only advantage to hedging is to reduce risks associated with deviations from the expected income. By using the minimum-variance hedge ratio, a producer will eliminate the maximum amount of uncertainty that can possibly be eliminated by hedging. Therefore, if the futures market is unbiased, the minimum-variance hedge ratio will always be the optimal hedge ratio for any risk averse producer regardless of the degree of risk aversion.

While the authors described optimal hedge ratios determined by price levels or price changes, others (such as Brown, 1985) have used percentage changes in their determination of the optimal hedge ratio. Other studies have allowed for the possibility of biased futures markets (Peck, 1975; Kahl, 1983; Witt, et al., 1987; Thompson and Bond, 1987). In each case, the minimum-variance hedge ratio is adjusted according to expected futures and cash prices, and the resulting basis level.

The Myers-Thompson Approach

In 1989, Myers and Thompson contended that the minimum-variance hedge ratio was not appropriate for optimal hedge ratio estimation in many circumstances. This is because the slope from the minimum-variance regression is a ratio of the unconditional covariance between the dependent and explanatory variable to the unconditional variance of the explanatory variable. The authors point out that the conditional variance and covariance values should be considered rather than just the unconditional values. Thus, the minimum-variance techniques are quite restrictive in assuming that the cash price at any given time is simply a function of the futures price at the same time.

Myers and Thompson developed a generalized OLS model using corn, wheat, and soybean examples, separately, in which a cash price was a function of its own futures price as well as lagged values of spot and futures prices. Specifically:

$$CP_t = a_0 + b_1 {*} FP_t + b_2(L)CP_{t-1} + b_3(L)FP_{t-1} + E_t$$

where: $b_2(L)$ and $b_3(L)$ are polynomials in the lag operator L;
L is defined by $Ly_t = y_{t-1}$ and represents the number of lagged variables included in the regression;
CP_t = Spot price;
FP_t = Futures price.

It should be noted that price changes can be substituted for price levels in the above representation. Further, the authors point out that applied models should incorporate all sources of information that have an impact on the determination of the cash price. Their examples showed that the simple regression models using price changes provided estimates very close to those obtained with their generalized approach. However, models using price levels or returns were found to be inaccurate in their study.

Cross-Hedging

One of the purposes of this study is to determine whether the cash hog index can serve as an effective risk management tool for large buyers and sellers of wholesale pork products. Hayenga and DiPietre (1982) studied a very similar situation in analyzing the hedging possibilities of wholesale pork products with the live hog futures contract from 1970 to 1979. Their results showed a very high correlation between pork product prices and live hog futures prices. However, their methodology differed significantly from the methods that will be employed in this study. First, they used average price levels rather than price changes over a specific lagged period. Second, their model reduced ten years of daily data to a sample size of ten for each regression, placing a great deal of emphasis on each individual observation. Third, they used a simple minimum-variance regression technique that may not be appropriate for reasons similar to those suggested by Myers and Thompson (1989). Hayenga, et al. (1994) further examined cross-hedging beef and pork products using both unconditional and conditional approaches. They concluded that meat handlers should consider using more sophisticated cross-hedging models in order to provide better results.

Thompson, et al. (1993) gave further background on cross-hedging commodities, focusing on the relationships between cash canola prices and soybean, soybean oil, and soybean meal futures prices. Using price changes over different lagged time periods, the authors provided a detailed analysis of the minimum-variance hedge ratio and also provided a hedging effectiveness measure indicating the proportion of cash price variance that can be eliminated through hedging at the minimum-variance rate. Hedging effectiveness can be measured by using the R^2 coefficient when using OLS regression techniques.

Thompson, et al. also examined the importance of lag length specification when dealing with price changes. First, the length of the lag was shown to represent the time period that a hedge is typically held. Next, it was determined that a tradeoff occurred as the lag length was increased. With short lags, there were more observations, but the hedging effectiveness was generally much lower. Alternatively, with longer lags, the hedging effectiveness tended to increase (implying that a higher percentage of price variability could be eliminated by increasing the length of the hedge), but the sample size obviously decreased. The results and implications of these findings suggest that a similar relationship could be found within the hog industry.

MODELS, PROCEDURES, AND DATA

Models and Procedures

Augmented Dickey-Fuller tests were first performed on the weekly time series of each variable. These tests showed that each of the time series exhibits evidence of being nonstationary in price levels but stationary in price differences (unit roots). It has been widely shown that the presence of a unit root means that analysis should be done in price changes rather than in price levels in order to provide efficient estimates. Thus, price changes over different time lags will be evaluated throughout this paper.

Two approaches will be used in this paper. First, a simple regression model similar to the work of Benninga, et al. (1984) giving minimum-variance hedge ratios will be evaluated. The conditional approach suggested by Myers and Thompson (1989) will provide the framework for the second type of analysis. Specifically, each cash price will be a function of its own futures price and lagged values of cash and futures prices. The Myers-Thompson framework allows for additional explanatory variables, but no other variables will be incorporated for this paper.

Thus, each minimum-variance hedge ratio will be determined by the slope coefficient and the hedging effectiveness will be measured by the R^2 coefficient from an OLS regression of cash price changes on futures price changes. Further, as discussed by Thompson, et al., the length of the time lags to be used is an important consideration. One, two, four, eight, thirteen, and twenty-six week lags will be used for estimation. This will provide approximations for one-week, two-week, one-month, two-month, three-month, and six-month hedges.

For the Myers-Thompson analysis, the hedge ratio will be determined by the coefficient on the non-lagged futures price and the hedging effectiveness will be measured by the adjusted R^2 coefficient, which adjusts according to the number of explanatory variables included in the model. Analysis will focus on one-week and four-week price changes. Further, the number of cash and futures price lags to be included in each regression will be determined by the final prediction error (FPE), described in Bessler and Binkley (1980). Each cash time series for each of the hedge lengths will be tested to minimize the FPE. Then, rather than only using the optimal number of lags, a range of lags will be tested, ranging from a small number of lagged variables to a number large enough to capture the highest optimal lag, subject to the condition that the number of lagged variables can be no larger than 20% of the original sample size. This restricts the sample size from becoming too small or not representative of the entire time series.

These two alternative methods will be used to find potential optimal hedge ratios and the related hedging effectiveness values for cash live hogs and cash meats, using the lean hog index as a proxy for the lean hog futures. These results will then be compared to similar analysis using the applicable live hog contracts. Thus, using the live hog results as a benchmark, it can be determined (with limitations) if the lean hog futures will be more or less effective than the live hog futures in terms of hedging cash hogs and each of the four cash meats. Further, frozen pork bellies futures will also be used as a hedging instrument for each of the cash meats, allowing for comparison between the hog futures and frozen pork bellies futures.

Finally, it should be noted that neither approach makes any assumptions concerning the nature of the hedger's operation. This analysis will provide hedge ratios and hedging effectiveness measures that can be applied to both long- and short-hedging operations.

Data

The lean hog index that will determine final settlement of the lean hog futures contract has been calculated by the CME since May 1994. The Omaha cash price will serve as the cash hog price for this analysis. The data for the four cash meats (hams, loins, bellies, and trimmings) comes from the National Carlot Meat Report, published by the USDA. Futures prices will be determined by the closing price of the applicable nearby contract (not the contract during its delivery month) at the time the hedge is to be lifted. This prevents any hedge from being 'open' in the delivery month, thus keeping all data consistent. Further, when rolling from one contract to the next, price changes will be calculated using the same contract rather than calculating price changes between contracts. Weekly data for every Wednesday from May 4, 1994 to December 27, 1995 are used, providing twenty months of data. The analysis is done on price changes of lengths one-week and longer.

RESULTS

The minimum-variance results will be presented first, followed by the Myers-Thompson results. After all of the results have been presented, evaluation will follow.

Minimum-Variance Results

Hedge ratios and hedging effectiveness values were first calculated using the minimum-variance approach for each combination of the six alternative lag lengths, the three futures contracts, and the five cash prices, with the exception that cash hogs were not tested using frozen pork bellies futures. For lag lengths of eight-weeks and shorter, hedges were placed on a Wednesday and lifted after the given time lag had occurred. However, because the observations do not overlap, this procedure allowed for alternative starting dates in which the first hedge could be placed for all lags between two- and eight-weeks. For example, when using the two-week lag for any of the cash/futures combinations, the first observation could be calculated as the third week's price minus the first week's price, the second observation the fifth week's price minus the third week's price, and so on. The other alternative is for the first observation to be the fourth week's price minus the second week's price. Thus, there were two separate regressions for the two-week lag, four for the four-week lag, and eight for the eight-week lag. The simple average of the two, four, or eight separate parameter estimates, respectively, will be reported in this paper.

However, to eliminate the problem of decreasing numbers of observations with increasing lag lengths for the longer thirteen- and twenty-six-week lag lengths, hedges were placed every Wednesday (as long as enough time remained to offset the hedge before the end of the time series). Thus they used overlapping data. Although preliminary tests revealed that this approach yielded significant autocorrelation, preliminary results employing overlapping data for two-, four-, and eight-week lags were qualitatively similar to those with non-overlapping data[1]. Further, the method employing non-overlapping data would provide only five to six observations for the thirteen-week lag and only two to three observations for the twenty-six week lag, making reasonable analysis improbable. Thus, cautionary acceptance of these results based on overlapping data is warranted.

The minimum-variance results are presented in Tables 2 and 3. Table 2 shows the average hedging effectiveness measures (R^2 values) for each combination employed. Table 3 shows the average hedge ratios from the same set of regressions. In each table,

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[1] Because of the similarities, these results are not presented in this paper.

the results for the thirteen- and twenty-six week lags were calculated using overlapping data and may be inefficient. These results are denoted by an asterisk.

Myers-Thompson Results

For the Myers-Thompson regressions, only time lags of one- and four-weeks were evaluated. Longer time lags were not explored because of the large number of observations lost due to lagged values of the cash and futures price changes being included in the regression equations. Thus, no overlapping data were used in any of these regressions. Like the minimum-variance approach, the Myers-Thompson approach using four-week price changes had four alternative starting dates in which the first hedge could be placed, and the simple average of the four results is reported for each combination.

The final prediction error (FPE) discussed earlier was used to determine the optimal number of lagged cash and futures price changes to be included. Although the test only determines the number of lagged cash variables that should be included, cash and futures variables were added simultaneously. The results showed that the optimal number of lagged variables to be included varied from one (hams) to fourteen (loins) for the one-week price change. To provide analysis over the entire range of optimal lag structures, four alternative numbers of lags (one, four, nine, and fourteen) are evaluated. For the four-week price change, the optimal number of lags varied from one (hams) to six (Omaha hogs). However, to prevent the number of lagged variables from exceeding 20% of the total number of observations, three alternative numbers of lags (one, two, and four) are evaluated.

Tables 4 and 5 show results of the Myers-Thompson analysis for the alternative number of lagged variables. Table 4 shows the average hedging effectiveness measures (adjusted R^2 values). These coefficients are reported because the number of explanatory variables increased as the number of lagged variables increased. Table 5 shows the average hedge ratios from the same set of regressions.

Minimum-Variance Hedging Effectiveness

Table 2 can be used to analyze the minimum-variance hedging effectiveness values. Comparison of the R^2 values from the minimum-variance regressions with the same variables but different lag lengths shows that the hedging effectiveness generally increased as the lag length was increased. This is consistent with Thompson, et al. (1993), and suggests that a higher percentage of the price variability can be eliminated as the hedge length increases.

The more important comparison, however, is that between the hedging effectiveness values of models with the same lag lengths and dependent variables, but different futures contracts. It can be seen from Table 2 that hams had very low hedging effectiveness values for nearly every time lag and futures contract. Loins, on the other hand, showed relatively strong hedging possibilities with the lean hog index, giving hedging effectiveness coefficients that were more than twice as high as the live hog futures for every lag length. The frozen pork bellies futures showed virtually no hedging potential for cash loins. For cash pork bellies, the pork bellies futures performed the best for every lag length. However, the live hog futures and the lean hog index surprisingly produced hedging effectiveness values that were not substantially lower than those for the frozen pork bellies contract. The difference between the hedging effectiveness of the three contracts on cash trimmings was modest throughout, although the lean hog index outperformed the others for time lags of eight-weeks and longer. However, this may be misleading because price changes in the lean hog index may not be an accurate prediction of price changes in more distant lean hog futures contracts.

The best fitting regressions, by far, were those in which Omaha cash hogs were regressed on the lean hog index. The lean hog index strongly outperformed the live hog futures for all of these regressions. Here, the assumption that the lean hog futures contracts will fluctuate similarly to the lean hog index becomes important. The nearby lean hog futures will likely change at a similar rate as the lean hog index. However, more distant futures contracts should be determined by supply and demand forecasts for the settlement date rather than by the current index price. However, at the very least, this evidence suggests that the settlement mechanism for the lean hog futures contract is a very good representation of one of this nation's major live hog cash markets. Further, because the lean hog index outperformed the live hog futures so strongly for the short lags, it is difficult to imagine that the lean hog futures contract will not offer a higher hedging effectiveness measure than the live hog futures does, particularly in the short-term.

Myers-Thompson Hedging Effectiveness

Table 4 shows the hedging effectiveness results from the Myers-Thompson regressions. Like the minimum-variance results, the Myers-Thompson results indicate that hams have no hedging possibilities with any of the three futures contracts. Loins were again found to be most effectively hedged using the lean hog index, showing that the lean hog futures should be a better hedging tool for cash loins than either of the other two contracts. The frozen pork bellies futures again produced the highest hedging effectiveness values for cash pork bellies, followed closely by the other two contracts. The results were very close and inconclusive for all three contracts as a hedging instrument for trimmings. Finally, the hedging effectiveness values for cash hogs were again much higher when the lean hog index was used rather than the live hog futures. As with the minimum-variance results, the magnitude of the Myers-Thompson results may be misleading. However, because both of the time lags examined are relatively short, it can be predicted with a reasonable amount of confidence that the lean hog futures should be able to outperform the live hog futures as a hedging tool for cash hogs when hedges will be held for relatively short periods of time.

It should be kept in mind that the R^2 values from the minimum-variance regressions should not be directly compared to the adjusted R^2 values from the Myers-Thompson regressions. However, it is still clear that the hedging effectiveness measures give generally similar results for each of the cash prices, regardless of the approach taken. This suggests that one of two situations likely exists. One is that other explanatory variables should be included in the Myers-Thompson analysis. These variables, if they exist, could lead to more efficient conditional estimates for the Myers-Thompson optimal hedge ratios. The other possibility is that the markets are successfully incorporating the conditional information available. If this is the case, additional explanatory variables will not help in determining the optimal hedge ratio. Therefore, assuming there are not any variables that have been withheld from the conditional approach, the minimum-variance approach using price changes appears to be quite adequate for this type of application.

Hedge Ratio Analysis

Before analyzing the hedge ratios, it should be noted that the hedge ratios themselves should not be used to determine whether or not the lean hog contract will provide a better contract for hedgers than the live hog contract. Hedging effectiveness measures from the previous section should be used for that purpose. Thus, the value of direct comparison of the hedge ratios between the two alternative contracts is minimal, and will not be done in this study.

Rather, the minimum-variance hedge ratios will first be analyzed over different lag lengths, using the results from Table 3. The hedge ratios generally increased as the hedge length increased, although this was not always the case. While two-thirds of the hedge ratios for hams were negative, these results should not be given much emphasis because of the extremely low hedging effectiveness values discussed earlier. For most of the other cash variables, however, the hedge ratios generally trended upwards as the length of the hedge increased. The steadiness of the hedge ratios when hedging cash pork bellies on frozen pork bellies futures should be noted. Thus, while frozen pork bellies futures produced hedging effectiveness values that were only marginally higher than those from the other two contracts, the steady hedge ratios provide some evidence that frozen pork bellies futures do provide cash pork bellies hedging advantages. Further, the hedge ratios were quite steady for Omaha cash hogs on the lean hog index. However, the lean hog index may not serve as a good approximation of distant lean hog futures contracts. Thus, these steady hedge ratios may be misleading for the longer time lags, and an increasing hedge ratio with respect to length of lag may be more likely to occur.

Second, the Myers-Thompson hedge ratios will be compared over differing numbers of lagged cash and futures variables, using the results from Table 5. Again, the hams results should be given only minor consideration due to the lack of hedging potential. For loins, the hedge ratios remained fairly steady as additional lagged values were added, with the exception of fourteen lags using the one-week time lag. Most cases involving cash pork bellies produced fairly steady hedge ratios, particularly when using frozen pork bellies futures as the hedging instrument. For trimmings, the hedge ratios involving the two hog contracts varied marginally as lagged values were added, but tended to increase when using the pork bellies futures. Finally, although some variation was present as lagged values were added to the regressions involving Omaha cash hogs, the hedge ratios were relatively steady.

Third, the hedge ratios from the minimum-variance regressions will be briefly compared to those from the Myers-Thompson regressions in which the same cash and futures price changes were used. With the exception of the four-week price changes involving cash trimmings, the two approaches led to comparable results. However, the Myers-Thompson results for the four-week changes involving cash trimmings were lower for live hog futures, dramatically lower for the lean hog index, and substantially higher for frozen pork bellies futures. Because this is the only strong exception, these results suggest that either the simpler minimum-variance approach is usually sufficient, or that there are possibly other variables that should be included in the Myers-Thompson analysis.

IMPLICATIONS AND SUMMARY

Implications

Because the objective of this paper is to compare the potential hedging performance of the lean hog futures to the recent performance of the live hog futures, the comparison of hedging effectiveness values resulting from the use of these alternative contracts should be given emphasis. The fact that the lean hog index performed nearly as well or better than the live hog futures for each of the meat products is encouraging for the future of the new hog futures contract. More encouraging, however, is the impressive performance of the lean hog index with the Omaha cash hogs. Although these results may be misleading in terms of magnitude, particularly for the longer time lags, the results are very promising for short-term hedging using the nearby lean hog futures contract. Overall, the lean hog contract does appear to be an improvement over the live hog contract. Although the long-term hedging possibilities are difficult to accurately predict, the lean hog index value will certainly have a reasonably strong relationship with the distant lean hog futures prices.

For hog producers, the dramatically higher hedging effectiveness coefficients should provide confidence that the lean hog settlement procedure is an accurate representation of the cash market, and hedges held for short periods should be effective in reducing price risk. In fact, even hedges that will be held for longer periods should provide hog producers confidence that the hedge can be lifted at a price that accurately represents the cash price. Thus, the futures price can likely be 'locked' in advance with only a minimal amount of basis uncertainty, given the cash settlement provision.

For meat packers and others involved in the handling of large quantities of meat products, the hedging advantages of the lean hog contract are less dramatic. Only cash loins show a large potential advantage to using the lean hog futures rather than the live hog futures. The lean hog futures should provide opportunities similar to those available with the live hog futures in terms of hedging cash pork bellies. Significant opportunities to hedge pork trimmings will likely not exist with the lean hog futures contract, and hams showed no hedging opportunity whatsoever. However, the live hog futures does not provide significant hedging opportunities for these two meats either. Thus, there will likely be distinct hedging advantages to the lean hog futures contract with respect to cash hogs and loins while no major disadvantages of the contract have been uncovered in this study.

Finally, there are interesting implications regarding the frozen pork bellies futures contract. The fact that the hedging effectiveness coefficients of cash pork bellies using the lean hog index and the live hog futures were nearly as high as those using the frozen pork bellies futures suggests that the pork bellies futures could potentially be undermined by either of the two hog contracts. However, frozen pork bellies futures produced steadier hedge ratios than either of the hog contracts. This stability will support continued use of the frozen pork bellies futures contract. Further, the cost of carry of pork bellies is incorporated in frozen pork bellies futures but not in live hog or lean hog futures. This may help to explain the steady hedge ratios, and may also provide reason to keep the frozen pork bellies futures contract alive.

Summary

Structural changes have changed the marketing procedures for hogs over the past several years, and further changes will likely continue to alter marketing practices in the future. These structural changes have raised concerns about the live hog futures contract and its settlement procedure. In an attempt to deal with these changes, the lean hog futures contract is replacing the live hog futures contract beginning with the February 1997 contract. The new contract will be cash settled based on the lean hog index, eliminating the ever-thinning terminal markets from the price discovery process.

This study has compared optimal hedge ratios and the resulting hedging effectiveness for cash live hogs and cash meats, using three alternative futures contracts. The optimal hedge ratios and hedging effectiveness measures have been compared over different lag lengths and across the two different methodological approaches. Several implications can be made based on these results. First, the lean hog futures should offer significant short-term hedging advantages over the live hog contract, particularly for the hedging of cash hogs. Second, the frozen pork bellies futures contract offers slightly better hedging opportunities for cash pork bellies than either of the two hog futures contracts. Third, the similarities between the minimum-variance results and the Myers-Thompson results suggest that either the cash and futures markets incorporate available information well, or that other variables should be included in the conditional Myers-Thompson analysis. Fourth, the lean hog futures will likely perform better than the live hog futures for the purposes of hedging cash hogs and loins, and about as well as the live hog futures for the hedging of cash pork bellies. However, neither contract showed significant hedging opportunities for pork trimmings, and hams showed absolutely no hedging possibilities from any of the models used in this study.

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Table 1. Comparison of Live Hog and Lean Hog Contract Specifications

Specification	Live Hog Contract	Lean Hog Contract
Trading Unit	40,000 pounds of U.S. No. 1, 2, 3 grade barrows and gilts	40,000 pounds of lean value (carcass-based) hogs
Description	230 - 260 pounds per head average live weight	Carcass between 51 - 52% lean with .80 to .99 inches of backfat at the last rib or equivalent
Final Settlement	Delivery accepted any business day of the contract month, with certain exceptions	Cash settled based on the lean hog cash index price
Delivery Points	East St. Louis, Omaha, Peoria, St. Joseph, St. Paul, Sioux City, and Sioux Falls	There shall be no delivery in settlement of this contract

Source: CME, 1993; CME, 1995.

Table 2. Average Hedging Effectiveness, Minimum-Variance Regressions

CASH VAR. Futures Var.	HEDGE LENGTH 1 week	2 weeks	4 weeks	8 weeks	13 weeks	26 weeks
HAMS:						
Live Fut.	.0016	.0265	.0585	.0729	.0064*	.0001*
Lean Index	.0014	.0281	.0392	.0938	.0019*	.0143*
FPB Fut.	.0044	.0133	.0130	.1605	.1224*	.1263*
LOINS:						
Live Fut.	.0568	.0807	.2370	.2951	.3162*	.3263*
Lean Index	.2169	.3834	.6366	.7139	.6840*	.7264*
FPB Fut.	.0026	.0183	.0448	.0206	.0032*	.0434*
BELLIES:						
Live Fut.	.1566	.2478	.2777	.4500	.5434*	.6743*
Lean Index	.1882	.2313	.3084	.4479	.5353*	.5956*
FPB Fut.	.2833	.3068	.3997	.4970	.5909*	.7122*
TRIMMINGS:						
Live Fut.	.0635	.1055	.1955	.3673	.3437*	.3803*
Lean Index	.0396	.0746	.1530	.4522	.4395*	.4795*
FPB Fut.	.0835	.0696	.1322	.3143	.3039*	.3371*
OMAHA CASH HOGS:						
Live Fut.	.1095	.3095	.4640	.5754	.5505*	.6503*
Lean Index	.7480	.8796	.9541	.9821	.9821*	.9822*

Note: * represents results from regressions that used overlapping data.

Table 3. Average Hedge Ratios, Minimum-Variance Regressions

CASH VAR. Futures Var.	HEDGE LENGTH 1 week	2 weeks	4 weeks	8 weeks	13 weeks	26 weeks
HAMS:						
Live Fut.	-.1361	-.6021	-.8881	-.1299	.2457*	.0235*
Lean Index	-.0835	-.3275	-.1519	-.1110	-.0478*	-.1534*
FPB Fut.	-.1244	.0623	-.2352	.5170	.7124*	.7930*
LOINS:						
Live Fut.	.8373	1.1301	2.1970	2.5217	2.1256*	2.2603*
Lean Index	1.0768	1.4528	1.6780	1.5669	1.4781*	1.3648*
FPB Fut.	.0986	.3015	.5121	.2658	.1889*	.5793*
BELLIES:						
Live Fut.	1.3319	1.4510	1.4017	1.6263	1.9332*	1.9031*
Lean Index	.9608	.8421	.6968	.6460	.6773*	.7238*
FPB Fut.	.9841	.9329	1.0357	1.0490	1.3346*	1.3743*
TRIMMINGS:						
Live Fut.	.7308	.9724	1.2212	1.4438	1.4577*	1.4657*
Lean Index	.3797	.4619	.4945	.6278	.5818*	.6660*
FPB Fut.	.4602	.4434	.5634	.8701	.9074*	.9696*
OMAHA CASH HOGS:						
Live Fut.	.4260	.7892	1.1411	1.4126	1.5682*	1.4718*
Lean Index	.7327	.7800	.7574	.7336	.7393*	.7319*

Note: * represents results from regressions that used overlapping data.

Table 4. Average Hedging Effectiveness, Myers-Thompson Regressions

CASH VAR. / Futures Var.	1-WEEK HEDGE 1 lag	4 lags	9 lags	14 lags	4-WEEK HEDGE 1 lag	2 lags	4 lags
HAMS:							
Live Fut.	.0267	.0465	.0247	.0719	-.0352	-.0732	-.5237
Lean Index	.0167	.0520	.0467	.0161	.0636	.0878	-.2580
FPB Fut.	.0069	.0286	-.0483	.0726	.0513	.1294	-.0708
LOINS:							
Live Fut.	.1245	.1896	.2606	.3739	.1484	.1605	.2900
Lean Index	.2648	.3107	.3250	.4445	.6328	.6324	.5934
FPB Fut.	.0646	.0614	.0752	.3344	.1189	.0419	.2741
BELLIES:							
Live Fut.	.1882	.2757	.3159	.2716	.3418	.3228	.2278
Lean Index	.2276	.3002	.2919	.2537	.3233	.3033	.1741
FPB Fut.	.3057	.3624	.3979	.3377	.3294	.3857	.4894
TRIMMINGS:							
Live Fut.	.0316	.1665	.2318	.2164	.2710	.1960	.3121
Lean Index	.0069	.1010	.1548	.0859	.4114	.3464	.3836
FPB Fut.	.0744	.1683	.1041	.1111	.1669	.1555	.0969
OMAHA CASH HOGS:							
Live Fut.	.1216	.1506	.2214	.3369	.4090	.4090	.4811
Lean Index	.8147	.8339	.8783	.8985	.9666	.9762	.9656

Table 5. Average Hedge Ratios, Myers-Thompson Regressions

	1-WEEK HEDGE				4-WEEK HEDGE		
CASH VAR. Futures Var.	1 lag	4 lags	9 lags	14 lags	1 lag	2 lags	4 lags
HAMS:							
Live Fut.	-.0872	-.0860	.1712	.2204	-.9775	-.8664	-1.2530
Lean Index	.0617	.0800	.2114	.1972	-.5950	-.5488	-.5936
FPB Fut.	-.1221	-.0150	-.0095	-.0342	-.1865	-.1004	-.8109
LOINS:							
Live Fut.	.8449	.8226	.8286	.5912	2.3128	2.4756	2.1051
Lean Index	.8761	.8856	.8636	.7436	1.7621	1.7888	1.7411
FPB Fut.	.0678	-.0228	-.1062	.0153	.3319	.4358	.7596
BELLIES:							
Live Fut.	1.3667	1.1563	1.0290	1.1600	1.2236	1.3853	1.2140
Lean Index	1.0396	.8408	.7876	.8983	.5414	.5470	.5857
FPB Fut.	.9755	.9710	1.0446	.9682	1.0632	1.2759	1.2075
TRIMMINGS:							
Live Fut.	.7155	.7074	.5614	.6512	.9466	1.0083	1.0222
Lean Index	.3660	.3222	.3204	.2565	.2154	.2025	.1319
FPB Fut.	.4440	.5542	.5421	.7168	.7181	.9854	.9587
OMAHA CASH HOGS:							
Live Fut.	.4959	.5012	.5736	.7542	1.1728	1.1894	1.2644
Lean Index	.8311	.8071	.7770	.7613	.7598	.7541	.7341