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Fabio Mattos, Philip Garcia, Raymond Leuthold,
and Tony Hahn

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The Feasibility of a Boxed Beef Futures Contract: Hedging Wholesale Beef Cuts

Fabio Mattos

Philip Garcia

Raymond Leuthold

Tony Hahn *

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* The authors are graduate research assistant (fmattos@uiuc.edu), professor, professor emeritus,
and former graduate research assistant in the Department of Agricultural and Consumer
Economics, University of Illinois at Urbana-Champaign.

The Feasibility of a Boxed Beef Futures Contract: Hedging Wholesale Beef Cuts

The purpose of this paper is to investigate the feasibility of a new futures contract for hedging wholesale transactions in the beef industry based on the USDA boxed beef cutout index (BBCO). The results suggest the live cattle futures contract is not an adequate tool to manage the price risk of wholesale meat transactions in the beef industry. However, a futures contract based on the BBCO index might provide considerably more opportunities for the hedging of wholesale meat cut prices. A pattern of improved hedging effectiveness at more distant horizons also appears to emerge for the individual cuts of meat using the conditional hedge procedures. These results may be of particular interest to members of the meat industry with longer planning horizons, and more diversified transactions.

Keywords: hedge ratio, hedging effectiveness, boxed-beef cutout, wholesale beef prices

INTRODUCTION

The beef industry in the United States has evolved into a multi-million dollar industry characterized by automated processing facilities that can operate twenty-four hours a day. This evolution has created a much more vertically integrated and efficient industry, and changed selling practices so that retailers and wholesalers negotiate prices on a “boxed beef” rather than a carcass sales.

Processing facilities add extra value to the beef by separating it into primals, sub-primals and individual cuts of meat, that are sold to retailers and wholesalers in boxes and are ready to be prepared or placed in the meat case. Although there are many advantages to this new method, a very important risk management issue has been overlooked during this process. That is, the beef industry now delivers a completely different wholesale product than it did when the live cattle futures contract was introduced as a tool to manage price risk. Changes in packing and sales have led to the use of the beef cutout value as the industry standard for pricing a beef carcass and meat cuts. As cutout values can change independently of the live cattle futures prices, many of the participants in the beef industry have been left without an adequate price risk management mechanism.

The evolution of the meat industry and its effects on risk management can be observed in previous research. Studies based on data from 1970 to 1980 [Miller (1980), Miller and Luke (1982), and Hayenga and DiPietre (1982)] suggested that the live cattle futures contract could be an effective risk management tool for the meat industry. However, research in the late 80's [Gamble (1984), and Albanos (1985)] began to question the adequacy of the live cattle futures contract for managing price risk. More recent studies by Hayenga, Jiang and Lence (1996), and Schroeder and Yang (2001) further demonstrated that the live cattle futures contract has not been an adequate risk management tool. In general, low correlation between futures and meat cut prices, and related high basis risk has made effective risk transfer highly problematic.

The purpose of this study is to analyze the feasibility of a potentially new futures contract for the beef industry. The USDA has created and publishes a boxed beef price index (BBCO index), which is a weighted averaged price of all the reported sales of all meat cuts. This index has been proposed as the basis for a cash-settled boxed beef futures contract by members of the industry. We examine the potential hedging effectiveness of this index in the management of the price risks for several individual meat cuts. Using weekly data from 1985 through 1999, we employ standard optimal hedging regression techniques to generate simulated hedge ratios for 1, 6 and 12-week horizons for each cut. The horizons correspond to the selling practices of many market participants in the retail meat and food service industries. For purposes of comparison, we generate optimal hedge ratios and measures of hedging effectiveness for each meat cut and horizon using the live cattle futures contract. These results and comparisons should allow us to identify the potential gains in the proposed boxed beef contract against the existing live cattle contract.

Schroeder and Yang (2001) also examined indirectly the usefulness of the boxed beef price as a hedging tool considering 1-week hedging horizons during the January 1996 through June 2001 period. Our study amplifies on their research by investigating different hedging horizons that are consistent with industry practices and by using a longer time period. Further, we consider the hedging effectiveness of a composite product which may provide more valuable information on the usefulness of a potential contract for larger firms in the industry that market and purchase many beef cuts.

The analysis should allow us to assess the viability of a new futures contract based on boxed beef prices. Favorable results would mean a more adequate risk management tool for wholesale buyers, grocery stores and major food service procurement companies to effectively hedge the price risk of the individual cuts of meat that they buy. Further, an effective boxed beef contract in conjunction with the current live cattle contract may permit packers to manage the risks in their processing margin.

HEDGING PROCEDURES

Hedging studies have been performed using a variety of procedures, and data transformations. In this paper, we focus on developing minimum risk optimal hedge ratios and hedging effectiveness measures using unconditional and conditional variances and the logarithmic differences in prices, i.e., the rate of returns. The unconditional hedge ratios and their hedging effectiveness measures are generated using a straightforward regression framework that regresses cash returns on the returns of futures prices or the returns in the boxed beef price series (BBCO). We use the procedures developed by Myers and Thompson (1989) to generate the conditional hedge ratios and a hedging effectiveness measure. Logarithmic differences in the prices were employed to reduce the potential effects of apparent changing price volatility in the sample, and to make comparisons between the live cattle futures and the BBCO more representative. The BBCO is continuous price series while the level of live cattle prices reflected in futures may possess discontinuities due to contract expiration and roll over to the next contract. The risk associated with the rollover effect may be an important factor in determining attractiveness of a hedging instrument particularly when buying and selling prices of the

different contracts vary substantially. However, because the BBCO series is not influenced by contract expiration, we use differences in price series so that more appropriate comparisons can be made.

Specifically, to estimate the unconditional hedging measures we use the following regression,

$$R_t^c = \mathbf{a} + \mathbf{b} R_t^f + \mathbf{e}_t \quad (1)$$

where R_t^c is the return on cash prices, R_t^f is the return on futures instrument (either the live cattle futures prices or the BBCO), and \mathbf{e}_t is the error term. The optimal hedge ratio is given by:

$$B_t = \frac{Cov(R_t^c, R_t^f)}{Var(R_t^f)} \quad (2)$$

where B_t is the optimal hedge ratio, and $Cov(R_t^c, R_t^f)$ is the covariance of the returns of cash and futures prices, and $Var(R_t^f)$ is the variance of the returns of futures prices. The hedging effectiveness can be calculated through the comparison of the risk from the unhedged position to the risk from a hedged position,

$$E_t = 1 - \frac{Var(R_t^h)}{Var(R_t^u)} \quad (3)$$

where E_t is the hedging effectiveness, $Var(R_t^h)$ is the variance of return from a hedged position, and $Var(R_t^u)$ is the variance of return from an unhedged position.

To estimate the conditional hedge measures, we follow Myers and Thompson in selecting lagged prices, here expressed as lagged returns of the BBCO index, live cattle futures, and the cash prices of the individual meat cuts, as the relevant conditioning information. When hedging with the BBCO index, the following equation is estimated,

$$R_t^c = \mathbf{a} + \mathbf{b} R_t^B + \sum_{i=1}^n \mathbf{g}_i R_{t-i}^c + \sum_{i=1}^n \mathbf{d}_i R_{t-i}^f + \sum_{i=1}^n \mathbf{f}_i R_{t-i}^B + \mathbf{e}_t \quad (4)$$

where R_t^c is the return on cash prices of the cut being hedged during period t, R_t^B is the return on the BBCO index during period t, R_{t-i}^c is the lag return on cash prices of the cut being hedged, R_{t-i}^B is the lag return on the BBCO index, R_{t-i}^f is the lag return on live cattle futures, and \mathbf{e}_t is the error term. A similar equation is used when hedging with live cattle futures. The only difference is that the variable R_t^B is replaced by R_t^f , which is the return on live cattle futures during period t. In both cases, the hedge ratios are given by the coefficient \mathbf{b} , which is the coefficient related to the explanatory variable during period t (either R_t^B or R_t^f in this model).

The hedging effectiveness in this model is measured by the percentage reduction in the conditional variance of cash returns when hedging occurs. In the absence of the hedge, the conditional variance of the cash returns is given by $Var(cash) = MSE = \frac{SSE}{T - K}$ where SSE is the sum of squared residuals, T is the number of observations and K is the number of independent variables plus the constant. It is generated by estimating the conditioning equation $R_t^c = \mathbf{a} + \sum_{i=1}^n \mathbf{g}_i R_{t-i}^c + \sum_{i=1}^n \mathbf{d}_i R_{t-i}^f + \sum_{i=1}^n \mathbf{f}_i R_{t-i}^B + \mathbf{e}_t$. In the presence of the hedge, the conditional variance of the cash returns is generated by estimating the MSE from the original conditional hedge equation.

DATA

The boxed beef values

The Boxed Beef Cutout (BBCO) value is an estimate of the value of a beef carcass based on current national wholesale prices being paid for sub-primal cuts. It “provides an overall cutout or performance indicator for the fabricated beef cuts industry”, since “its formulation replicates the actual processes used by the industry when calculating their own overall cutouts”¹.

Four different cutout values are calculated to represent the majority of the grades of the cuts. These four different values include Choice and Select indices for a 600-750 pound carcass (referred to as *Choice light* and *Select light*), and Choice and Select indices for a 750-900 carcass (referred to as *Choice heavy* and *Select heavy*).

To calculate the cutout value, current fabricated boxed beef cut prices and industry cut yields are used to calculate sub-primal values which are then combined into primal values. The primal values are multiplied by their yield from the carcass and the resultant values are combined into the final carcass cutout value. By utilizing this system, cuts that are produced and sold in larger volumes will have more impact on the overall cutout value.

The BBCO index and the cash prices for individual cuts were obtained from the USDA’s national boxed beef cuts report, and are weekly averages for the period January 5, 1985 to December 25, 1999. The BBCO index is used to represent a cutout futures contract². Values for both the Choice light and the Choice heavy indices were examined, but since the findings were very similar only the results using the Choice light index are reported.

The six cuts chosen for the analysis are among the most heavily traded cuts (Table 1), and range from expensive steaks to less expensive cuts. Additionally, we develop hedging measures for an “equal-weighted portfolio” of the six cuts which was generated by simply

¹ Livestock Mandatory Price Reporting System: Report to the Secretary of Agriculture, Appendix 6, page 1.

² Preliminary analysis showed a high degree of correlation between the Choice and Select series. Due to the smaller number of observations in our Select series, we chose to work with the Choice series.

averaging their prices. This should provide us with an idea of usefulness of the hedging instruments for larger hedgers that work with more diversified purchases and sales.

Table 1. Meat Cuts

Cut of Beef	Sector	Main use
Boneless ribeye	Food service	Prime Rib
Boneless strips	Food service	Strip Steaks
Grinds	Food service / Retail	Ground Beef
Insides	Food service	Round Roast
Short Loin	Retail	T-Bone Steak
Top Butt	Food service / Retail	Sirloin Steak

Planning and Hedging Horizons

Different components of the meat industry may be concerned with different hedging horizons. The hedging horizons analyzed were chosen to reflect hedging strategies of two types of buyers: retail meat buyers, and the food service. Purchases and sales for the retail, or grocery, sector of boxed beef sales involve less certainty about which cuts to order. A grocery meat case depends on its weekly special sale items to generate sales. While the specials are usually the same cut for particular weeks of the year, there is a great deal of flexibility in the planning of the advertised item. In general, the planning horizon for the retail sector is usually only a few weeks in the future.

The food service sector (restaurants, cruise ships, hotels, schools, prisons, government buildings, and other institutional facilities) faces the possibility of exceeding specified budgets if the cost of meat should increase unexpectedly. These facilities have the ability to plan their own menus weeks and even months in advance, and purchase only a few cuts of meat. In light of these planning horizons, we examine three different hedging horizons: 1 week, 6 weeks, and 12 weeks.

Live cattle futures prices

The futures prices were obtained from live cattle futures contract traded in the Chicago Mercantile Exchange (CME). Contract months are February, April, June, August, October and December, and midweek closing prices were used from the nearby futures contract that corresponded to the length of the hedging horizon. That is, the specific contract selected permits the hedger to maintain the position without having to roll over to a new contract. For example, if the buyer with a 6-week hedging horizon placed a hedge on September 4, 1985, the date to lift the hedge would be October 16, 1985. Given that many hedgers do not trade contracts in the expiration month, the December contract is used to place the hedge. Following this procedure, the hedger avoids potential risk in rolling the hedge forward at the expiration of the October contract. In addition, using this procedure and working with differenced price data makes the analysis of the hedging measures between the BBCO index (a continuous series), and the live cattle futures prices more comparable.

RESULTS

Graphs of the returns for representative cuts, the BBCO index, and the live cattle futures prices are presented in Figures 1 and 2. Several points should be made. First, the analysis was performed using non-overlapping data so that the number of observations for the 12-week horizon is less than the 1-week horizon. At the more distant horizons, the characteristics of the series could possibly change depending on the starting date of the first hedge. To examine this possibility we generated returns series beginning with alternative starting points, but found only minor differences in the results reported below.

Second, all the returns series are stationary but there did seem to be some evidence of heteroscedasticity. The heteroscedasticity appears to be less pronounced in the return series for the longer-horizon hedges. Following Myers (1991), Baille and Myers (1991), and Garcia, Roh, Leuthold (1995), we estimated simplified GARCH models for selected cuts that allow for time-varying hedge ratios. Consistent with previous research, we found little difference in the hedging performance. Because we did encounter some difficulty with convergence, we report the conditional hedge results based on the Myers and Thompson procedure. To further check the sensitivity of these results, we separated the data into three time periods with five years of observations in each period and performed the analysis. We found modest but not systematic differences in the hedge ratios and hedging effectiveness measures, but no differences in the qualitative implications we report below. Finally, the lags in the variables in the conditional equations were determined using the Schwartz Bayesian Criterion. In most cases, the selected models contained no more than two lags.

Hedge Ratios

The estimated hedge ratios using the unconditional and conditional procedures are presented in Tables 2 and 3. For all six cuts and the equal-weighted (EW) portfolio, hedge ratios are greater when hedging with the BBCO index than with the live cattle futures (LCF). Except in a few cases, all the hedge ratios using the BBCO index are above 1, while hedge ratios using live cattle futures are below 0.5. The estimated hedge ratios for each cut at each hedging horizon seem in general to be rather insensitive to whether the conditional or unconditional procedure is used. Only in a few cases, where the hedge is placed at the 12-week horizon using the live cattle futures, do the conditional and unconditional hedge ratios differ greatly. In these situations, the unconditional hedge ratios decline dramatically and even take on negative values. Examination of the individual meat cut hedge ratios at each time horizon demonstrates little evidence of higher hedge ratios being associated consistently with specific meat cuts. Further, there appears to be no evidence that hedge ratios are increasing or decreasing systematically as the hedging horizon changes.

Table 2. Unconditional Hedge Ratios

	1-week horizon		6-week horizon		12-week horizon	
	BBCO	LCF	BBCO	LCF	BBCO	LCF
Grinds	1.2494	0.3049	0.6920	0.4547	0.7630	0.5462
Insides	1.3796	0.4611	1.2615	0.6642	1.3298	0.5435
Ribeye	1.1428	0.2836	1.2457	0.3233	1.0270	0.0774
Short Loin	1.3343	0.2447	1.4947	0.3866	1.1622	-0.0801
Strips	1.1581	0.2779	1.3418	0.4248	1.1717	0.0401
Top Butt	1.4713	0.3784	1.2548	0.4973	1.0851	-0.1538
EW Portfolio	1.2893	0.3251	1.2151	0.4585	1.0898	0.1622

Table 3. Conditional Hedge Ratios

	1-week horizon		6-week horizon		12-week horizon	
	BBCO	LCF	BBCO	LCF	BBCO	LCF
Grinds	1.1551	0.3005	0.6955	0.4953	0.8102	0.5885
Insides	1.3553	0.4476	1.2050	0.5673	1.1888	0.5044
Ribeye	1.0546	0.3109	1.2375	0.2899	0.9556	0.1957
Short Loin	1.2695	0.2918	1.5724	0.3782	1.1683	0.4728
Strips	1.1326	0.3304	1.3659	0.4161	1.1590	0.3713
Top Butt	1.3824	0.4180	1.3274	0.5882	1.0689	0.4627
EW Portfolio	1.2419	0.3511	1.2507	0.4416	1.1220	0.4572

Hedging Effectiveness

The hedging effectiveness measures for the unconditional and conditional procedures are presented in Figure 3. For all cuts of meat cuts and the portfolio, the hedging effectiveness is considerably higher using the BBCO as a hedging instrument compared to the LCF. For example, at the 1-week horizon, the hedging effectiveness using the LCF struggles to reach 5%, while the hedging effectiveness using the BBCO averages about 30% for the individual cuts, and about 60% for the portfolio. Similar to the hedge ratios, the results of the hedging effectiveness measures seem to be rather insensitive to the procedure used except in the case of the unconditional hedges placed at the 12-week horizon. Here, the hedging effectiveness values using the LCF are practically nonexistent for certain cuts which correspond closely to the small and negative hedge ratios reported earlier.

Using the BBCO as the hedging instrument, clear differences can be identified in hedging effectiveness. Higher values of hedging effectiveness are associated with the portfolio, insides, and short loins across horizons. Regardless of the horizon examined, the hedging effectiveness for the portfolio is above 55% and reaches 75% at the 12-week horizon. Using the conditional measures and the BBCO index, a general pattern also emerges suggesting higher hedging effectiveness for all cuts at more distant horizons.

SUMMARY AND IMPLICATIONS

The purpose of this study was to investigate the feasibility of a new futures contract for hedging wholesale transactions in the beef industry based on the USDA boxed beef cutout index (BBCO). Using unconditional and conditional hedging procedures, we estimate hedging ratios and hedging effectiveness measures for selected meat cuts and an equally-weighted portfolio of the meat cuts at 1-, 6-, and 12-week horizons using the BBCO index as a hedging instrument. We also performed the same analysis using the live cattle futures contract, the price risk hedging instrument currently available to the meat industry.

Consistent with more recent research (Albanos, 1985; Hayenga, Jiang and Lence, 1996), the results of the analysis suggest the live cattle futures contract is not an adequate tool to manage the price risk of wholesale meat transactions in the beef industry. However, a futures contract based on the BBCO index might provide considerably more opportunities for the hedging of wholesale meat cut prices. Similar findings were reported by Schroeder and Yang (2001) whose primary interest was the development of spread contract, but identified the value of the BBCO index in hedging meat cuts. Here, using the BBCO as a hedging instrument, the hedging effectiveness differed rather consistently by specific meat cuts. For instance, the portfolio, insides, and short loins generated the highest hedging effectiveness measures regardless of the horizon. Further, the hedging effectiveness of the equal-weighted portfolio is considerably higher than the hedging effectiveness of any individual cut, ranging from 55% to 75% at the most distant horizons. A pattern of improved hedging effectiveness at more distant horizons also appears to emerge for the individual cuts of meat using the conditional hedge procedures. These results may be particularly valuable for members of the meat industry with longer planning horizons, particularly if their transactions are more diversified.

Clearly, some care must be used in interpreting our findings. While they do provide an indication of the relative attractiveness of a BBCO contract for hedging wholesale meat transactions, they are based on the notion that the USDA cutout value would reflect the behavior of a new contract. Such an assumption abstracts from the critical issues of contract design, and the difficulty of developing and maintaining liquidity particularly at more distant horizons. It is also important to remember that a contract based on the cutout value may not necessarily be attractive to all members of the industry. Those particularly interested would be those firms with more diversified sales, or perhaps meat packers interested in managing risks in their processing margin.

Finally, while not the main focus of our analysis, we find that in general our empirical results were rather insensitive to the hedging procedures used. Only at the most distant horizons where the number of observations declines rapidly did we find discrepancies between the implications from using conditional or unconditional procedures. Where the results change, the conditional procedures seem to provide findings more consistent with the patterns that emerged from the data. Overall, these findings corroborate earlier research that reported very little difference in hedging performance between conditional and unconditional procedures. They suggest the need for analysts to develop more precise hedging techniques, but they also suggest that industry analysts can use the reasonably straightforward procedures employed to assess the effectiveness of their hedging strategies without significant reductions in accuracy.

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Figure 1. Returns at the 1-week horizon

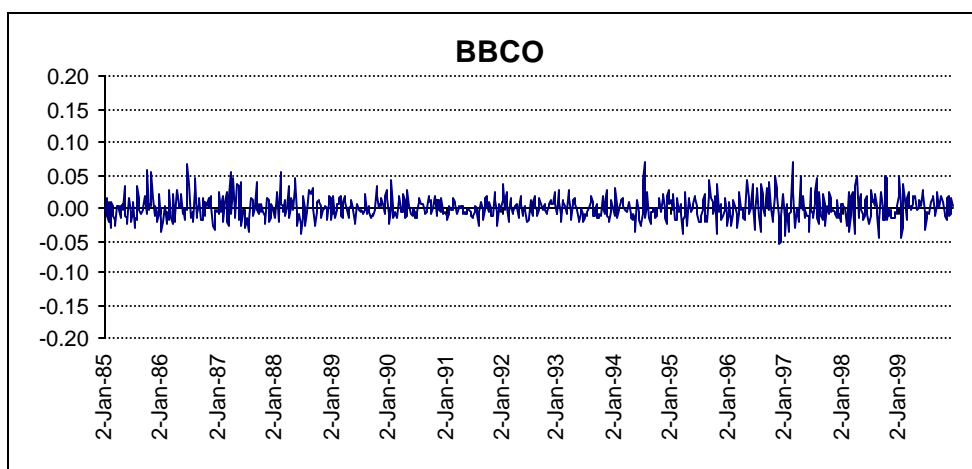
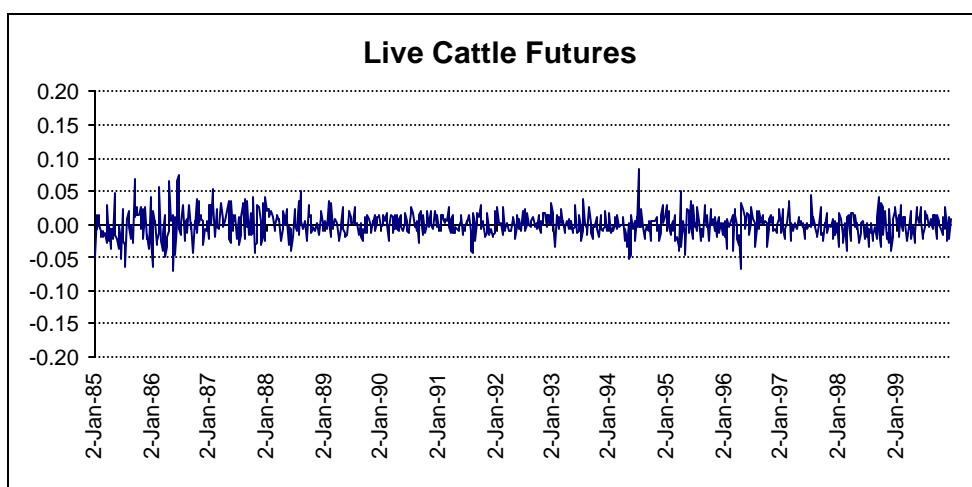
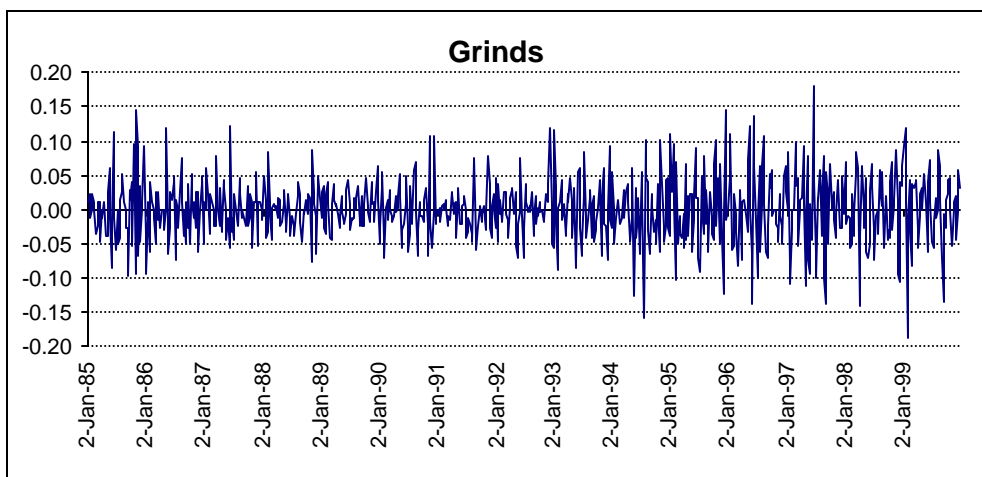


Figure 2. Returns at the 12-week horizon

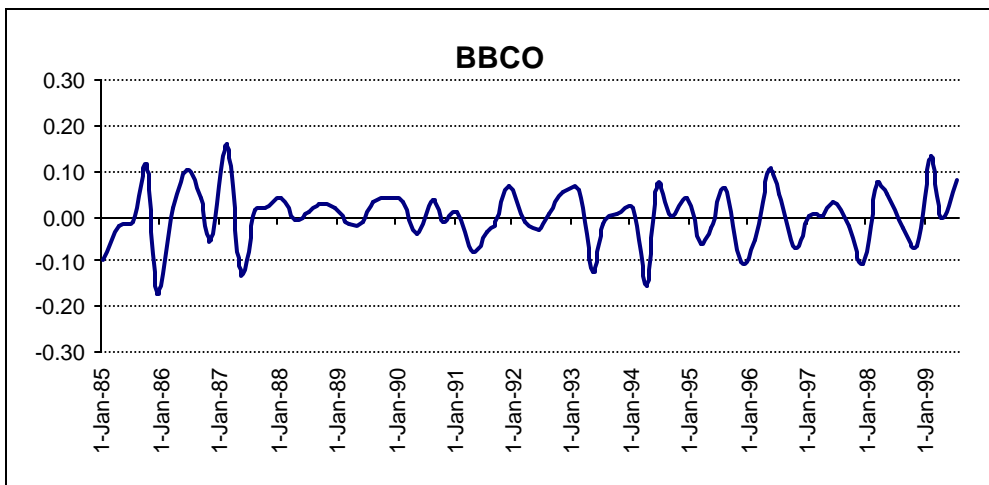
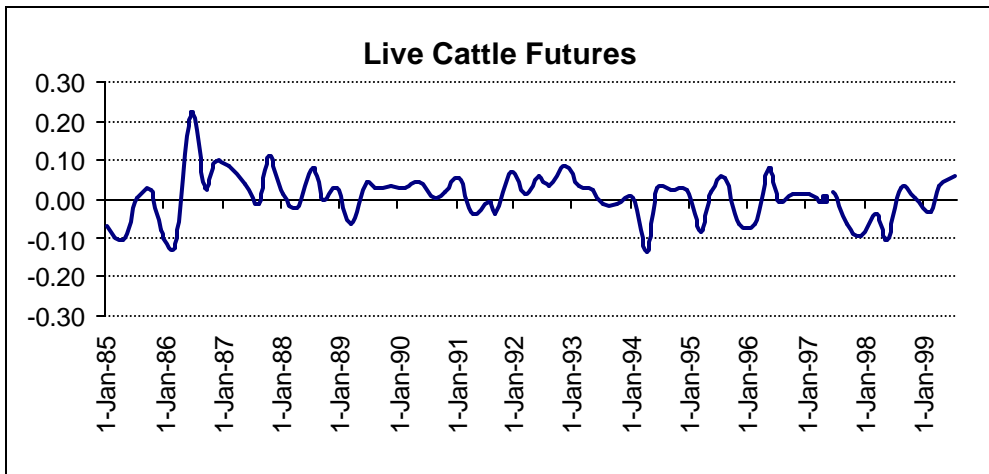
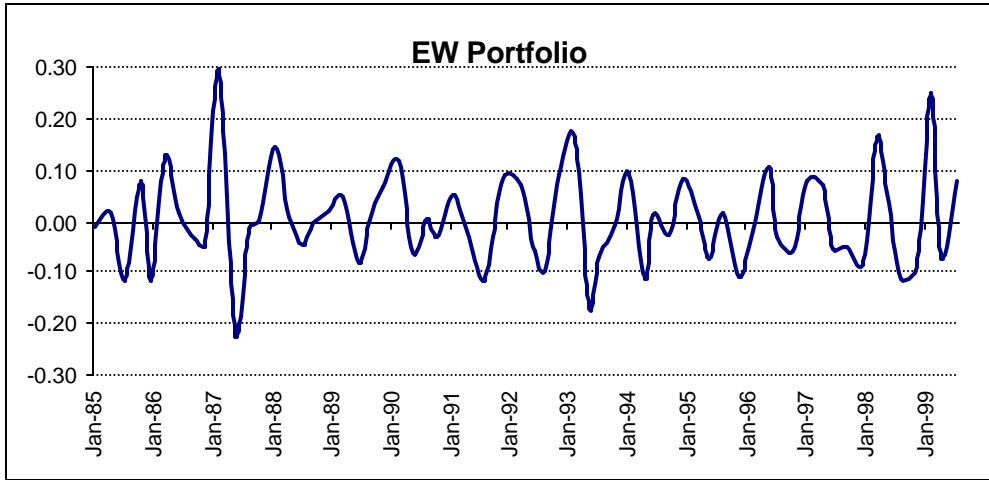


Figure 3. Hedging effectiveness

Unconditional hedge (R^2)

Conditional hedge (MSE reduction)

