FS 01-03 January 2001

Price Risk Management for Peanut Meal

Ecio F. Costa and Steven C. Turner*

* Graduate Research Assistant and Associate Professor, Respectively, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA 30602-7509; E-mail: ecosta@agecon.uga.edu. Paper presented at the Southern Agricultural Economics Association Meetings in Fort Worth, Texas, February 29, 2001.

Dept. of Agricultural & Applied Economics
College of Agricultural & Environmental Sciences
University of Georgia

PRICE RISK MANAGEMENT FOR PEANUT MEAL

Ecio F. Costa and Steven C. Turner

Department of Agricultural and Applied Economics

University of Georgia

Athens, GA 30602-7509

ecosta@agecon.uga.edu

ABSTRACT

Peanut meal is cross-hedged with soybean meal using peanut meal cash prices and soybean meal futures prices. Hedge ratios are obtained for short- vs. long-term data sets. Evaluation indicates positive gains for cross-hedged poultry/peanut producers, and that soybean meal futures can be used as a cross-hedging vehicle for peanut meal.

Key words: *peanut meal, soybean meal, cross-hedging, hedging ratios.*

PRICE RISK MANAGEMENT FOR PEANUT MEAL

INTRODUCTION

Of the three primary products generated by peanut processing plants, meal is the second most valuable product. Peanut meal is used principally as feed for beef cattle and/or poultry and is usually sold at a 48 percent protein level (Peanut Report, Agricultural Marketing Service, USDA, 2000). Its major value is as a protein concentrate. Peanut meal is used as a substitute for soybean meal in poultry and beef cattle production. In addition to its high protein content, peanut meal is healthier than its substitute vegetable proteins. It contains more unsaturated fat than soybean meal. However, peanut meal enters markets that are highly competitive facing other protein concentrates like soybean, cottonseed, sunflower and canola meals.

Peanut crushers face substantial risk similar to other feed ingredients processors in terms of input and commodity price variability. They find themselves short-handed in their market planning and risk management because no viable futures market currently exists for peanut products. The central hypothesis of this study is that even though there is no active futures market for peanut meal, processors can reduce price risk through cross-hedging cash peanut meal with soybean meal, which already has an established futures market. Additionally, it is hypothesized that the relationship between cash peanut meal prices and soybean meal future prices is strong enough so that cross-hedging can be executed, but only for shorter periods of time. This study shows that long data sets (6 years or more) may not yield as reliable hedge-ratios as short data sets (3 years). The final hypothesis is that net realized prices from cross-hedging will exhibit risk efficiency superior to cash pricing.

By definition, cross-hedging is the pricing of a cash commodity position by using futures for different commodities (Hieronymus, 1972). Simple cross-hedging uses futures of one commodity to offset a cash position. However, cross-hedging is more complicated than direct hedging. Difficulties arise in selecting the appropriate futures contracts as cross-hedging vehicles and determining the size of the futures position to be established. Potential cross-hedging vehicles must be commodities that are likely to be substitutes or complements in the marketing or production processes (Elam *et al*, 1984). Soybean meal is selected as a cross-hedging vehicle for this analysis because it is a close substitute and is thought to be influenced by many of the same supply and demand factors as peanut meal since both are primarily used as poultry and cattle feed.

According to Dahlgran (2000), when formulating a cross-hedging strategy, there are certain issues that must be resolved including (a) selecting the hedging vehicle, i.e., which futures contract(s) and maturities to use, (b) selecting the hedge ratio, i.e., what size futures position(s) to take, and (c) evaluating the hedging effectiveness, i.e., how successful the strategy will likely be. This study addresses the three issues mentioned by Dahlgram.

The cross-hedging analysis presented in this study is composed of three sections. First, an analytical framework is presented to justify the selected model. Second, separate regressions are computed to estimate the relationship between cash peanut meal and soybean meal futures for different time frames and analysis determines what type of data set gives a best hedge-ratio for the cross-hedging. Finally, the regression results and the hedge-ratios are applied to evaluate a cross-hedging marketing strategy for peanut meal showing the gains for cross-hedging peanut meal cash using soybean meal futures .

REVIEW OF SELECTED LITERATURE

An extensive theoretical description of cross-hedging for a commodity for which no futures contract exists is provided by Anderson and Danthine (1981). Assuming a non-stochastic production process (no yield risk), Anderson and Danthine consider the problem of hedging in a single futures market but with many possible trading dates. Their cross-hedging model uses a mean-variance framework to derive an optimal hedging strategy assuming that the agent has knowledge of the relevant moments of the probability distribution of prices.

Kahl (1983) illustrates the derivation of optimal hedging ratios under different assumptions about the cash position. She argues that when the futures and cash positions are endogenous the optimal hedging ratio is independent of risk aversion. Comparing the studies of Heifner (1972, 1973) to those of Telser (1955, 1956) she shows that the optimal hedging ratio is not dependent on the risk parameter.

Following Wilson (1987), the optimal hedge ratios obtained from minimizing the variance of revenue are equivalent to parameters estimated from ordinary least squares regression (OLS) of cash price changes on future price changes. He also provides an empirical measure of the effectiveness of a hedge using the variance of revenue in an unhedged position and that in an optimally hedged position.

Myers and Thompson (1989) argue that the hedge-ratio obtained by means of traditional approaches (simple regression of spot price levels on futures price levels or spot price changes on futures price changes) are not appropriate as the estimated slope coefficients are the ratio of the unconditional covariance between cash prices and futures prices to the unconditional variance of futures prices. They suggest a generalized conditional approach that uses fundamental market information available at the time of placing the hedge to improve the performance of the estimated hedge-ratios.

Viswanath (1993) modifies Myers and Thompson’s model arguing that the basis at the time of placing the hedge should have power to predict changes in cash and future prices. When applying the basis-corrected method to grains, Viswanath finds that it produces significantly smaller hedged return variances in many instances but in some cases there is no significant variance reduction at all.

Hayenga et al. (1996) advocate that the fit of cross-hedging equations should improve if recent changes in market relationships persist during the period of the forward contract. They show that the conditional cross-hedge model formulation significantly improves the fit of the regressions for all meat cuts.

Dahlgran (2000) presents a cross-hedging consulting study performed for a cottonseed crusher. Applying a soybean crushing spread in a cross-hedging context with a portfolio risk minimization objective, he developed the desired hedge ratios for a variety of cross-hedging portfolios and for several hedge horizons. Risk minimizing hedge ratios are derived by regressing changes in prices for the cottonseed crush against changes in prices of potential hedge vehicles. Dahlgran reports that the effectiveness increases the longer the term of the hedge. He concludes that the economics of hedge management might be as important as the underlying risk aversion in determining hedging behavior.

DATA

The data used in this analysis is constructed from two sources. The cash peanut meal price data is obtained from the Peanut Report (Agricultural Marketing Service, USDA, 2000), where prices are reported for sales originated from the state of Georgia (which is responsible for 42% of all the peanut production in the United States, American Peanut Shellers Association, 2000) and for peanut meal that has aflatoxin levels that are less than 100 ppb (parts per billion) and are used for poultry and/or beef cattle. The observations are Thursday prices (or the nearest day) from January 7, 1993 through November 9, 2000. The soybean meal futures prices data are obtained from the Chicago Board of Trade (CBOT, 2000). The futures prices are also the

Thursday closing prices for the same time period and are always for the contract nearest to maturity.

The justification for the use of soybean meal as a vehicle for the peanut meal cross-hedging is due to the fact that one product can substitute for the other in poultry or beef cattle production and their prices are related as well. One can notice by looking in Figure 1 that peanut meal cash prices follow a similar path to soybean meal futures prices.

ESTIMATION OF THE OPTIMAL CROSS-HEDGE RATIO

Linear Regression Model For Cross-Hedging

The linear regression model to be estimated is adapted from the model used by Hayenga and DiPietre (1982) in their analysis of cross-hedging wholesale pork products using live hog futures. The Ordinary Least Squares (OLS) model for peanut meal cash prices and soybean meal futures prices is

$$PNM_C = b_0 + b_1 SBM_F + u \tag{13}$$

where, PNM_C is the Thursday price of peanut meal in the cash market, SBM_F is the Thursday price of soybean meal futures contracts on the CBOT, $\hat{a}_0$ is the intercept term and u is the stochastic disturbance.

The equation above is used to identify the relationship between peanut meal cash price and soybean meal futures. SBM_F is the independent variable, since the initial futures market price is predetermined in hedging and the corresponding cash peanut meal price is to be estimated. The intercept term $\hat{a}_0$ reflects the mean difference between the soybean meal futures prices and peanut meal cash prices. It indicates any spatial and temporal market dimensions or any qualitative variations. The slope coefficient $\hat{a}_1$ indicates the typical cash price change associated with a one dollar change in the futures. It provides the hedge-ratio to determine the size of the futures position to be taken for a given amount of cash position held. A positive slope indicates a direct price relationship and calls for the usual inventory selling hedge. A negative slope would indicate an inverse price relationship and call for a buying hedge.

EMPIRICAL RESULTS

Six separate regressions of cash peanut meal prices are run on the soybean meal futures prices using the data and employing the OLS model defined above (parameter estimates are presented in Table 1). The first five estimated equations have 3-year periods and the last column in the far right uses a 6-year period to estimate a model that covers the whole data set. It is found that all estimated slope coefficients have values greater than 0.60 (with t-values significantly different from zero in all equations).

R-squares tend to increase from 0.4703 for the first 3-year period to 0.8893 in the most recent 3-year period. The last estimation has a R-square equal to 0.6670 which is below most of the R-squares presented in the other estimations. A high R-square value indicates that the variation in peanut meal cash prices about its mean is explained by soybean meal futures with a high probability. This results show that using longer periods of data may result in less explanatory power, by looking at the R-square for the last estimated model, and that peanut meal price variations are following more closely soybean meal futures price variations.

These results follow the discussion and results presented by Hayenga et al (1996). They argue that the fit of cross-hedging equations improve if recent changes in market relationships are found in the period of the forward contract, i.e., the use of long-term forwarding contracts (in this study, long-term data sets) will cause the fit to be worse because of the interaction of many policy or market changes that affect the forward contract.

Calculated F-values are found to be greater than the corresponding critical values. Therefore, it can be concluded that the variation in cash prices accounted for by the estimated regression is significant. Overall, the obtained results suggest that soybean meal futures can be used as a cross-hedging vehicle for peanut meal.

EVALUATION FOR CROSS-HEDGING PEANUT MEAL

Since peanut meal production depends on peanut production, peanut meal crushers must base their marketing decisions on expected yields. In the planting period for peanuts, peanut meal producers would know the acreage committed and have an expectation of total peanut production. As the peanut growing season continues, yields may be estimated with greater accuracy. Peanuts are typically planted throughout March and early April, and harvested in October-November. So, by May, a peanut meal producer would have an estimated amount of production. To protect from fluctuation of peanut meal prices, one would like to place cross-hedges around May or the latest in June.

On the first example, assume it is the beginning of May 1996. A peanut meal producer in Georgia would have the information about the acreage committed to peanuts and the expected production of peanut meal is 1,000 tons. On May 1, 1996 peanut meal is trading at the price of $180.00 per ton in Atlanta. The producer expects that peanut meal prices to be much lower by October 1996. To protect against the falling price, the peanut meal crusher decides to cross-hedge using soybean meal futures. The May 1 soybean meal futures closing price is $249.30 per ton (CBOT; 1 contract = 100 tons of soybean meal). The peanut meal producer decides to place the cross hedge on May 1, 1996. To place the cross-hedge the producer needs to determine the number of soybean meal futures contracts necessary to offset 1,000 tons of peanut meal. Using the hedge-ratio estimated for that 3-year period (01/1993-12/1995), the producer should sell 14 contracts (1,000 / 100 x 1.3369 = 13.37, i.e., approximately 14 contracts) at the CBOT.

On October 3, peanut meal cash price has decreased to $170.00 per ton, i.e., a decrease of $10.00 per ton from the price of May 1 ($180.00 per ton). Assume that the producer sells all of the peanut meal at $170.00 per ton, receiving a total of $170,000.00. At the same time, the peanut meal producer lifts the cross-hedge by buying 14 contracts of soybean meal futures at the CBOT. The October 3 soybean meal closing price is $244.60 per ton. Thus the futures transactions result in a gain of $4.70 per ton of soybean meal. The total gain from the futures transaction is $6,580.00 ($4.70 x 100 x 14). The net return is then $176,580.00 ($170,000.00 + $6,580.00), which is $176.58 per ton of peanut meal. The net realized price has exceeded the October 3, 1996 cash price by $6.58 per ton (Table 2 summarizes the cross-hedging presented in this example).

A similar example of cross-hedging is presented in Table 3 for a poultry producer in Georgia using 1996 March and May cash peanut meal and soybean meal futures prices. On March 20 1996, the producer places the cross-hedge, buying 14 soybean meal futures contract at $226.60 per ton. On May 1, the poultry producer buys the peanut meal at $180.00 per ton. On the same day, the producer lifts the cross-hedge by selling 14 soybean meal futures contracts at $249.30 per ton. The futures transactions result in a profit of $22.70 per ton. The net realized price ($148.22) is less expensive than the cash price at the time of placing cross-hedge by $21.78 per ton. Notice that the cash price has also increased following the expectation of the producer.

The same test procedure is carried out using the corresponding hedge-ratios for the four selected time frames and for the period that uses all the data set (cash sale prices and the net realized prices from cross-hedging are presented in Tables 4 and 5). In all cases for peanut producers, the futures transactions result in profits. Using soybean meal to cross-hedge peanut meal was not profitable for poultry producers in all cases though. Further, if soybean meal futures prices rise before the peanut harvest period, cross-hedging may result in losses.

Comparing the net realized prices obtained for the 3-year data sets and the realized price obtained for the data set that includes all observations, one can notice that the net realized profit (cash market price vs. net realized price) is higher for the period between 1996 and 1998. Net realized profits are lower though for the 1993 and 2000 evaluations. On the other hand, net realized profits for the year 2000 using all the data is in the lower range of all the profits for all other periods. This may indicate that using shorter data sets gives higher profitability for peanut meal producers.

SUMMARY AND CONCLUSIONS

The general objective of this study is to explore the feasibility of cross-hedging cash peanut meal with soybean meal futures in order to manage risk protection for producers that market peanut meal as an output or input in their production processes that will depend on price variations. The cash-futures price relationships are determined to be statistically significant by regressing peanut meal cash prices on soybean meal futures. The cash peanut meal prices and soybean meal futures demonstrate a direct price movement relationship. Examples of cross-hedging using the estimated hedge-ratios are presented. The net realized prices from cross-hedging can exhibit risk efficiency superior to cash pricing. Thus simple cross-hedging using soybean meal futures is found to be effective as a potential pricing risk management for peanut meal producers, but not all the time for poultry producers.

Finally, this study provides an alternative marketing strategy for peanut meal that improves profitability of peanut crushing. The empirical findings suggest that in the absence of a futures market for peanut meal, soybean meal futures can effectively be used as a cross-hedging to minimize the price risk.

REFERENCES

American Peanut Shellers Association. “Peanut History and Production Information”. 2000. http://www.peanut-shellers.org/Facts/Types/types.html

Anderson, R. W. and J-P. Danthine. 1981. “Cross Hedging.” *Journal of Political Economy* 89: 1182-1196.

Chicago Board of Trade. *Historical Futures Data*. http://www.cbot.com

Dahlgran, R. A. 2000. “Cross-Hedging the Cottonseed Crush: A Case Study.” *Agribusiness* 16: 141-158.

Elam, E. W., Miller, S. E. and Holder, S. H. 1984. “Cross-Hedging Rice Bran and Millfeed”. *Rice Situation*. USDA. March:14-19.

Hayenga, M. L., B. Jiang and S. H. Lence. 1996. “Improving Wholesale Beef and Pork Product Cross Hedging.” *Agribusiness* 12: 541-559.

Hayenga, M. L. and D. D. DiPietre. 1982. “Cross-Hedging Wholesale Pork Products Using Live Hog Futures.” *American Journal of Agricultural Economics* 64: 474-751.

Heifner, R. G. 1973. “Hedging Potential in Grain storage and Livestock Feeding.” Washington DC: U. S. Department of Agriculture. Agr. Econ. Rep. No. 238.

Heifner, R. G. 1972. “Optimal Hedging Levels and Hedging Effectiveness in Cattle Feeding.” *Agricultural Economic Research* 24: 25-36.

Hieronymus, T. A. 1977. “Economics of Futures Trading for Commercial and Personal Profit”. 2nd. edition. New York: Commodity Research Bureau, Inc.. U.S. Department of Agriculture. *Rice Market Weekly News*, 1972-1982.

Kahl, K. H. 1983. “Determination of the Recommended Hedging Ratio.” *American Journal of*

Agricultural Economics 65: 603-605.

Myers, R. J., and S. R. Thompson. 1989. "Generalized Optimal Hedge Ratio Estimation." *American Journal of Agricultural Economics* 71: 858-868.

Telser, L. G. 1955/56. "Safety First and Hedging." *Review of Economic Study* 6:1-16.

Viswanath, P. V. 1993. "Efficient Use of Information, Convergence Adjustments, and Regression Estimates of Hedge Ratios." *Journal of Futures Market*s 13: 43-53.

Wilson, W. W. 1987. "Price Discovery and Hedging in the Sunflower Market." *Journal of Futures Markets* 9: 377-391.

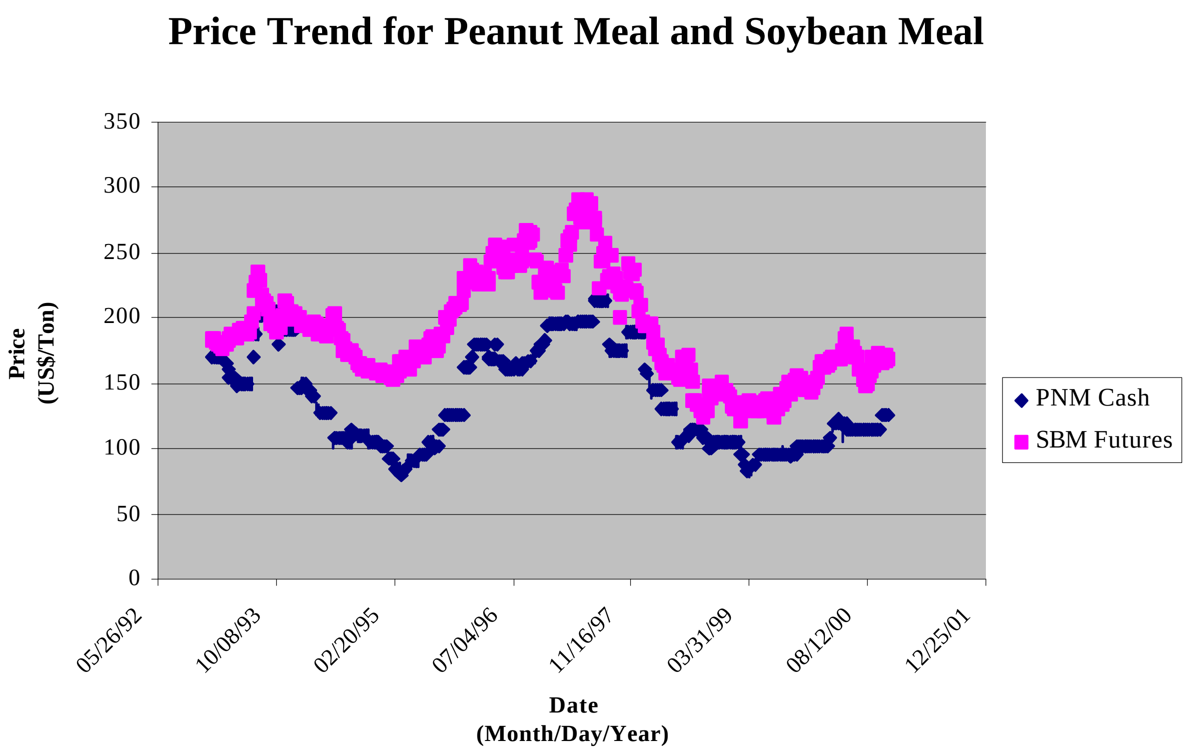

Figure 1. Price Trend for Peanut Meal Cash Prices and Soybean Meal Futures Prices for the Period from 01/07/93 until 08/26/99.

Sources: Peanut Report (Agricultural Marketing Service, USDA 2000) for Peanut Meal Cash Prices and Chicago Board of Trade (CBOT, 2000) for Soybean Meal Futures Prices.

Table 1. Estimated Hedge Ratios for Cross-hedging Peanut Meal with Soybean Meal Futures.

Variable \ Period	01/93-12/95	01/94-12/96	01/95-12/97	01/96-12/98	01/97-12/99	01/93-12/99 (All Data)
$\hat{a}_0$	-114.0918	-47.0001	-58.2199	23.9087	-7.8723	-10.5492
	(21.3532)	*(7.3917)*	*(10.1087)*	*(6.4108)*	*(4.2835)*	*(5.5392)*
$\hat{a}_1$	1.3369	0.8956	0.9673	0.6460	0.8035	0.7921
	(0.1143)	*(0.0363)*	*(0.0447)*	*(0.0292)*	*(0.0228)*	*(0.0283)*
R^2	0.4703	0.7977	0.7521	0.7595	0.8890	0.6837
F-values	136.74	607.29	467.27	489.53	1241.93	784.75
n	156	156	156	157	157	365

Standard Errors are in parenthesis. All estimates are significant at 1%, with exception to the intercept for the last 2 columns. All columns with exception to the one in the far right represent a 3-year period that the equation is estimated for.

Table 2. Simple Cross-hedging Example of Peanut Meal Using Soybean Futures for Peanut Producer.

Date	Cash	Futures
May 1, 1996	$180.00/ton	Short 14 Soybean Meal Futures Contracts @ $249.30/ton
October 3, 1996	$170.00/ton	Long 14 Soybean Meal Futures Contracts @ $244.60/ton
		Gain = $4.70/ton

Revenue from Selling 1,000 tons of Cash Peanut Meal = $170.00 x 1,000 = $170,000.00

Profits from Futures Transaction = $4.70 x 100 x 14 = $6,580.00

Total Revenue = $170,000.00 + $6,580.00 = $176,580.00

Net Realized Price = $176,580.00 / 1,000 = $176.58

Table 3. Simple Cross-hedging Example of Peanut Meal Using Soybean Futures for Poultry Producer.

Date	Cash	Futures
March 20, 1996	$170.00/ton	Long 14 Soybean Meal Futures Contracts @ $226.60/ton
May 1, 1996	$180.00/ton	Short 14 Soybean Meal Futures Contracts @ $249.30/ton
		Gain = $22.70/ton

Expense from Buying 1,000 tons of Cash Peanut Meal = $180.00 x 1,000 = $180,000.00

Profits from Futures Transaction = $22.70 x 100 x 14 = $31,780.00

Total Revenue = $180,000.00 - $31,780.00 = $148,220.00

Net Realized Price = $148,220.00 / 1,000 = $148.22

Table 4. Comparison of Cash and Net Realized Prices for Peanut Producer.

3-Year Period	Cash Price	Net Realized Price	Net Realized Profit
01/93 - 12/95	170.00	176.58	6.58
01/94 - 12/96	175.00	250.69	75.69
01/95 - 12/97	108.00	137.80	29.80
01/96 - 12/98	95.00	109.21	14.21
01/97 - 12/99	115.00	127.16	12.16
01/93 - 12/99 (All Data)	115.00	127.16	12.16

Table 5. Comparison of Cash and Net Realized Prices for Poultry Producer.

3-Year Period	Cash Price	Net Realized Price	Net Realized Profit
01/93 - 12/95	180.00	148.22	- 40.22
01/94 - 12/96	197.50	194.26	- 3.24
01/95 - 12/97	130.00	137.20	7.20
01/96 - 12/98	90.00	91.82	1.82
01/97 - 12/99	120.00	107.36	12.64
01/93 - 12/99 (All Data)	120.00	107.36	12.64