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SIMPLE AND MULTIPLE CROSS HEDGING OF RICE BRAN

by

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Abstract

The feasibility of forward pricing sales of rice bran via cross-hedging is investigated. Corn, oats, wheat, and soybean meal futures are considered as simple and multiple cross-hedging media. Sinmulation results indicate that simple cross-hedging using corn futures would be most effective in reducing price risks.

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Introduction

Rice bran and millfeed are important by-products of the rice milling industry. On average, a hundredweight of rough rice yields approximately 71 pounds of milled rice, 10 pounds of bran, and 19 pounds of hulls. Bran and hulls are sold separately or combined and sold as millfeed (or rice-mill by-product). Based on 1979-82 average prices, bran and millfeed sales accounted for only about two percent of the total value of products from 100 pounds of rough rice. On a national scale, however, the value of rice bran and millfeed production is substantial. Using the 1979-82 average rough rice millings of 145 million hundredweight, the value of rice by-products produced in an average year was approximately $50,000,000. Rice bran and millfeed prices are variable both within and across marketing years. Using Arkansas prices to illustrate, the September 1980 rice bran price was $92.50/ton. By September 1981, the bran price was $58.50/ton. During the period from September 1980 to January 1981, rice bran increased in value to $110/ton. By April 1981, bran prices fell from $110/ton to $67.50/ton, a decrease of 39 percent.

By-product price variability is a source of risk for rice millers. Consider the situation in which a forward contract for milled rice at a fixed price has been negotiated. Until the input has been purchased and the by-products have been sold, the miller is short the rough rice market and long the by-products. The branded rice miller who sells milled rice output at relatively stable prices but purchases the rough rice input and sells the by-products at highly variable prices also faces price risks. When to sell the by-products and when to price the rough rice input is a speculative decision based on the miller's judgment of the subsequent course of prices in light of the firm's disposition toward risk. The rough rice input can be purchased in the cash market and stored, bought on forward contracts from farmers, or hedged in rough rice futures trading on the New Orleans Commodity Exchange. But until the by-products are sold, the milling margin is not set.

In the absence of futures markets for millfeed products, millers are faced with a problem if they desire to forward price their millfeed output. One alternative is to forward contract with feed mixers who use millfeed as ingredients or with livestock feed users. However, millers generally find that their opportunities for forward contracting without making price concessions are limited. Also, there is always a question of the integrity of the forward contracts.

Another alternative for rice millers is to cross-hedge their bran and millfeed output using futures markets for other commodities. Hieronymus has suggested in the case of wheat millfeed that wheat millers may forward price their millfeed production by using corn, oats or soybean meal futures as cross-hedging vehicles. Since rice-mill by-products are substitute feed ingredients for wheat millfeed, feedgrain and soybean meal cross-hedges should be appropriate also. However, no empirical evidence as to the potential effectiveness of such cross-hedges has been offered. The objective of this paper is to examine the potential for both simple and multiple cross-hedging of rice bran. Subsequent sections provide a discussion of cross-hedging mechanics, an analysis of simulated cross-hedges of rice bran, and conclusions.

Cross Hedging Mechanics

Cross-hedging may be used as a risk management tool when direct hedging is not feasible. By definition, cross-hedging is the hedging of cash commodity positions by using futures markets for different commodities (Hieronymus). In its simple form, cross-hedging involves using the futures of only one commodity to offset a cash commodity position. Multiple cross-hedging involves the offsetting of a cash commodity position by using the futures of two or more different commodities. While direct hedging involves speculation in cash and futures price relationships for the same commodity, cross-hedging involves speculation in the relationship between cash and futures prices for different commodities.

Although a theoretical treatment of cross-hedging has been provided by Anderson and Danthine, there is only limited empirical evidence regarding the feasibility of using cross-hedging as a risk management tool. Previous studies have dealt with the simple cross-hedging of wholesale beef cuts with live cattle futures (Miller, 1980; Miller and Luke; Hayenga and DiPietre, 1982b), and wholesale pork cuts with live hog futures (Hayenga and DiPietre, 1981a). The feasibility of multiple cross-hedging has been considered for the case of distillers dried grains with corn and soybean meal futures (Miller, 1982a). Miller (1982b) found that cross-hedging of feeder pigs with both live hog and corn futures was more effective than the use of only live hog futures.

Cross-hedging is more complicated than direct hedging on several counts. First, the appropriate futures commodity or commodities to be used for cross-hedging must be selected. The cash and futures commodities may be substitutes, complements, or some combination thereof.

Also, the cash and futures may be associated as inputs and/or outputs of a production or marketing process. Partial correlations of the cash commodity price and a particular futures commodity price given other futures commodity prices, may be used to evaluate the potential usefulness of particular futures commodities as cross-hedging media (Anderson and Danthine).

After selection of the appropriate futures for cross-hedging, the amount of futures required to offset a cash position must be estimated. This is accomplished by estimation of the historic relationship between cash and futures prices in a regression framework. Let the estimated regression be represented as

$$\widehat{CP}_t = b_o + \sum_{i=1}^{k} b_i \, FP^t_{i,t} \tag{1}$$

where $\widehat{CP}_t$ equals the per unit predicted cash price at time t; $FP^t_{i,t}$ equals the per unit price at time t of the ith futures commodity contract nearest maturity at time t, with the second subscript indicating the time at which price is measured and the superscript indicating the time of maturity of the futures contract; and $b_0, b_1, \ldots b_k$ are estimated parameters. Seasonal differences in the price relationship may be accounted for by including seasonal intercept and/or slope shifters as additional regressors, as appropriate. The estimated regression coefficient for the ith per unit futures price, b_i, indicates the units of the ith futures required to offset one unit of the cash commodity. If the estimated regression indicates a negative relationship between the cash price and a futures price, a short (long) cross hedge would involve buying (selling) that futures when the cross-hedge is placed. The indivisible nature of futures contracts complicates multiple cross-hedging. If QF_i is the quantity contract specification of the ith futures, only by chance would $(QF_1/b_1) = (QF_2/b_2) = \ldots = (QF_k/b_k)$. Thus, different contract multiples of the k futures would likely be required to obtain an approximate "balance" with the quantity of the cash commodity to be cross-hedged.

Target prices for cross-hedges to be lifted at time t+j (the date of cash millfeed sales) are calculated at time t by inserting the current prices of the futures maturing nearest to, but not before, time t+j into the estimated regression and solving for the predicted cash price. The target price may then be adjusted to reflect estimated hedging costs (round turn commissions and interest on margin). The target price equation for a short cross-hedge may be represented as follows

$$TP_t^{t+j} = b_0 + \sum_{i=1}^{k} b_i \, FP_{i,t}^{t+j} - \sum_{i=1}^{k} |b_i| \widehat{HC}_i \qquad (2)$$

where TP_t^{t+j} equals the per unit target cash price for time t+j as calculated at time t; $FP_{i,t}^{t+j}$ equals the per unit price at time t of the ith futures maturing at time t+j; and $\widehat{HC}_i$ equals the estimated per unit hedging costs for the ith futures commodity.[1]

The net price from a short cross-hedge is given by the actual price of the cash commodity at time t+j when the cross-hedge is lifted plus the gain from futures, less actual hedging costs; i.e.

$$NP_{t+j} = CP_{t+j} + \sum_{i=1}^{k} b_i \, (FP_{i,t}^{t+j} - FP_{i,t+j}^{t+j}) - \sum_{i=1}^{k} |b_i| HC_i \qquad (3)$$

where NP_{t+j} equals the per unit net price of the cash commodity at time t+j; CP_{t+j} equals the per unit price of the cash commodity at time t+j; and HC_i equals the actual per unit hedging costs for the ith futures commodity. Conversely, the net price from a long cross-hedge is the actual price of the cash commodity at time t+j less futures gains plus actual hedging costs.

If the regression relationship between cash and futures prices holds exactly at time t+j, then

$$CP_{t+i} = b_o + \sum_{i=1}^{k} b_i \, FP_{i,t+j}^{t+j} \, . \qquad (4)$$

If hedging costs are estimated correctly ($\widehat{HC}_i = HC_i$), and Equation (4) holds, the net price from cross-hedging will equal the cross-hedging target price, as may be seen by substituting Equation (4) in Equation (3).

If the regression relationship does not hold exactly, or the hedging cost estimate is incorrect, the target and net prices will differ. A means of evaluating cross-hedging as a risk management tool is to examine the degree to which the target and net prices differ. If the target prices are not "good predictors" of subsequent net prices, cross-hedging may not be acceptable as a risk management tool.

Cross-Hedging Simulation

In this section, the results of simulated simple and multiple cross-hedges of rice bran are compared. It was assumed that bran sales were made at mid-month. Arkansas bran prices ($/ton) at mid-month, as reported in the Weekly Rice Market News, were used as the bran prices. The futures for oats, corn, soybean meal, and wheat were considered as cross-hedging vehicles. As noted above, Hieronymus has suggested the use of oats, corn, and soybean meal for the hedging of wheat millfeeds, a substitute for rice millfeeds. Although wheat is mainly a food grain, it is also used as a livestock feed. The futures prices were those at closing on the trading day nearest the 15th of the month. January 1972 was chosen as the first observation in estimating cross-hedging levels, with 48 observations being included in the initial sampling interval for estimation of Equation (1). The regressions used to determine cross-hedging levels were reestimated each month in the simulation using data available at that month.[2] Eighty cross-hedges were simulated for each futures used as a cross-hedging vehicle, with the final cross-hedges being lifted in December 1982. Although alternative cross-hedging horizons from one to twelve months were simulated, only the results of the cross-hedges of three month's duration (j = 3) are reported here. However, the results for other horizons were similar.

Average forecast errors (AFE) and mean-squared forcast errors (MSFE) were calculated for each of the futures used singly for simple cross-hedging and for all combinations of futures used jointly for multiple cross-hedging. The AFE's may be used to determine whether target prices are biased forecasts of subsequent net prices. The MSFE's may be used to measure the risks associated with the divergence of realized net and target prices with cross-hedging. For comparative purposes, the target prices were also used to generate forecasts of cash prices without cross-hedging. Following Peck, the forecasting errors from the latter forecasts provide measures of the uncertainty of subsequent rice bran cash prices faced by rice millers in the absence of cross-hedging.

The results of the simulations are presented in Table 1. Simulation number 1 indicates the results of cash-only sales. The simple

Table 1. Summary of Simulated Arkansas Rice Bran Cross-Hedges[a]

Simulation Number	Corn	Oats	Wheat	Soybean Meal	Net Price[b] Mean	Net Price[b] Variance	Target Prices as Forecasts of Net Prices with Cross-Hedging[b,c] AFE	Target Prices as Forecasts of Net Prices with Cross-Hedging[b,c] MSFE	Target Prices as Forecasts of Cash Prices without Cross-Hedging[d] AFE	Target Prices as Forecasts of Cash Prices without Cross-Hedging[d] MSFE
	---------bushels-------			----tons----	$/ton	($/ton)^2	$/ton	($/ton)^2	$/ton	($/ton)^2
1	--	--	--	--	70.08	214.84	--	--	--	--
2	20.23	--	--	--	71.56	204.11	-0.84	100.25	-2.12	150.10
3	--	34.50	--	--	70.42	219.96	-5.87	183.72	-5.88	186.59
4	--	--	11.27	--	71.32	249.19	1.50	127.88	0.37	121.52
5	--	--	--	0.09	70.34	202.63	1.44	157.30	1.23	182.19
6	19.84	0.98	--	--	71.84	207.49	-0.50	103.35	-2.01	151.27
7	17.77	--	1.88	--	71.65	209.35	-0.64	101.04	-2.01	143.91
8	19.65	--	--	0.03	71.54	205.06	-1.64	102.12	-2.87	160.76
9	--	22.27	6.38	--	71.11	229.39	-3.59	129.90	-4.34	147.40
10	--	33.39	--	0.05	70.31	229.26	-6.88	200.71	-6.77	212.12
11	--	--	10.82	0.05	71.44	244.50	0.42	120.59	-0.79	128.65
12	14.86	4.79	2.42	--	71.78	214.05	-0.80	105.30	-2.25	144.83
13	18.43	2.76	--	0.04	71.59	210.89	-1.92	105.78	-3.17	163.01
14	17.31	--	1.80	0.03	71.59	210.03	-1.50	101.40	-2.80	153.61
15	--	22.26	5.97	0.04	70.87	234.78	-4.86	137.70	-5.36	164.12
16	13.60	6.42	2.36	0.04	71.52	217.92	-2.19	107.13	-3.37	156.34

a. Number of simulated cross-hedges = 80.

b. Target prices used as forecasts of net prices and net prices for simulation numbers 2-16 are inclusive of assumed hedging costs (round turn commissions and interest on margin accounts) of $0.01/bu for corn, oats, and wheat, and $0.50/ton for soybean meal, as appropriate.

c. AFE = average difference between net and target prices; MSFE = mean of the squared differences between net and target prices.

d. AFE = average difference between cash and target prices; MSFE = mean of the squared differences between cash and target prices.

cross-hedging results are reported in simulation numbers 2 through 5, and the multiple cross-hedges are reported in simulations 6 through 16. All of the cross-hedging simulations yield MSFE's which are smaller than the variance of cash prices. With the exception of simple cross-hedging with wheat futures, the MSFE's of target prices as forecasts of subsequent net prices are also smaller than the corresponding MSFE's of target prices as forecasts of subsequent cash prices without cross-hedging. Among the cross-hedging strategies, simple cross-hedging using corn futures produced the lowest MSFE and an AFE which was not significantly different from zero at the five percent level.[3] Thus, corn futures would appear to be the appropriate mechanism for cross-hedging rice bran.

The use of only corn would also simplify the problem of "balancing" futures contract multiples. Corn futures quantities are 1000 and 5000 bushels on the Mid-American Commodity Exchange (MCE) and the Chicago Board of Trade (CBT), respectively. Using the mean cross-hedging level from simulation number 2, these contracts would be sufficient to cross-hedge rice bran quantities as follows: MCE corn--490 tons, and CBT corn--247 tons. A "typical" two-shift (15 hour), 800 cwt per hour rice mill produces an average of 60 tons of rice bran per day or 300 tons per five-day week. One CBT and one MCE corn contract would be sufficient to cross-hedge the weekly rice bran output of such a mill.

Although there were no significant differences in the mean net prices across simulations, the mean net prices from cross-hedging were generally higher than the mean net price from cash sales only. This runs counter to expectations since the costs incurred in cross-hedging reduce mean net prices in simulation numbers 2 through 16. There were no significant differences in variances of net prices between simulations. This result is in agreement with Tomek and Gray who have shown that for grains, distant futures prices are just as variable as nearby futures.

Conclusions

The objective of this paper was to evaluate the feasibility of cross-hedging rice bran sales. Results of simulated millfeed cross-hedges indicate that corn futures are appropriate for simple cross-hedges. Given an acceptable target price, millers would face less risks from divergent net and target prices with simple cross-hedging using corn futures than without; or with using the corn futures market as a forecasting agency in predicting subsequent rice bran cash prices. The risks associated with cross-hedging using corn futures were not reduced by multiple cross-hedging strategies involving other futures.

Footnotes

[1]The target price for a long cross-hedge is calculated as in Equation (2) except that estimated hedging costs are added rather than subtracted.

[2]Monthly intercept shifters (with January as the base period) were included as regressors to account for seasonal differences in the regression relationships between bran and futures prices. The results of simulations in which monthly slope shifters (with January as the base period) were also included as regressors did not differ appreciably from those reported below.

[3]Statements as to statistical significance here and below are based on appropriate F and t tests using five percent significance levels. The simulations which produced average differences between target and net prices which were significantly different from zero were numbers 3 (oats), 9 (oats and wheat), 10 (oats and soybean meal), and 15 (oats, wheat, and soybean meal). These simulations along with numbers 8 (corn and soybean meal), 13 (corn, oats, and soybean meal), 14 (corn, wheat, and soybean meal), and 16 (corn, oats, wheat, and soybean meal) also produced average differences between target and cash prices without cross-hedging which were significantly different from zero.

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