A Production Cross-Hedge for Long and Medium Grain Rough Rice Using Soft Red Winter Wheat Futures

by

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ABSTRACT

Routine preharvest cross-hedging of rice utilizing futures prices for wheat is examined. Average net prices from cross-hedging generally exceeded harvest pricing. Compared to harvest pricing, cross-hedging price distributions exhibited less variability. Results indicated that an April cross-hedge was the preferred marketing strategy under the third-degree stochastic dominance criterion.

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For agricultural commodities that have futures markets, producers can use hedging as a risk management tool. Direct hedging involves establishing a position in the futures market opposite to that of the cash position held, the primary objective being to reduce price risk by allowing futures market gains or losses to approximately offset changes in the cash position.

When price variability creates substantial risk and no viable futures market is available for the commodity, an alternative marketing procedure is cross-hedging. Even though there is no active futures market for rice, the central hypothesis of this study is that producers can reduce risk exposure through cross-hedging cash rice with wheat, a commodity having an established futures market.

The Problem

Cross-hedging is the pricing of a cash commodity position by using futures for different commodities (Hieronymus). Simple cross-hedging uses futures of one commodity to offset a cash position, and multiple cross-hedging uses two or more different commodities (Elam, et al.). This analysis concerns itself only with simple cross hedging.

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 substitutes or complements in the production or marketing process

(Elam, et al.). Wheat is selected as a cross-hedging vehicle for the this analysis because of its hypothesized relationship as a substitute food grain for rice.

The simple cross-hedges to be performed require specifying the appropriate quantity of wheat futures necessary to offset the cash rice positions. A simple regression analysis of harvest time rough rice prices (cash) on wheat futures will indicate the appropriate direction and size of the futures position. This will determine how closely the cash and futures prices are related so that futures market gains or losses approximately offset cash market changes.

A further complication involves establishing expected prices and determining the typical basis which varies as wheat futures and cash rough rice prices rise and fall (Anderson and Danthine). The estimated equation from the regression analysis could be used by the hedger to translate the current price of the wheat futures contract into an expected realized net rice price (Hayenga and DiPietre). Producers can expect to achieve this price within the computed standard error of forecast (SEF) 95 percent of the time. The SEF reflects the basis risk faced by the hedger. It is a measure of the deviation of estimated about actual net returns.

This study will examine the potential of cross-hedging both long-grain and medium-grain varieties of rice in Louisiana using futures prices from the Chicago Board of Trade for the September soft red winter wheat contract. Four selected preharvest routine cross-hedging dates are compared to harvest pricing for the two classes of rice. Separate regressions are computed to determine the relationship between long-grain (LG) cash rice and September wheat futures, and between medium-grain (MG) cash rice and September wheat futures. The regression results are applied to a cross-hedging marketing strategy for both classes of rice over an eleven year sample period, 1975-85.

Analytical Framework

The basic linear regression models to be estimated are adapted from the model used by Hayenga and DiPietre in their analysis of cross-hedging wholesale pork products and live hog futures. The ordinary least squares (OLS) model for the long-grain rice - wheat regression is:

$$(1) \quad CPLG_t = b_0^{LG} + b_1^{LG} FPWH_t + U_t$$

The OLS model for the medium-grain rice - wheat regression is:

$$(2) \quad CPMG_t = b_0^{LG} + b_1^{MG} FPWh_t + U_t,$$

where $CPLG_t$ is the cash price for long-grain rice during harvest each year t. $CPMG_t$ is the cash price for medium-grain rice during harvest each year t. $FPWH_t$ is the mid month closing price of the September wheat futures contract from the Chicago Board of Trade corresponding to the rice harvest season each year t, and U_t is the error term.

Regression (1) will determine the relationship between long-grain cash rice prices and September wheat futures as of August 15.

Regression (2) will determine the relationship between medium-grain cash rice and September wheat futures as of August 15.

$FPWH_t$ is the independent variable because the initial futures market price is predetermined in hedging, and the corresponding cash price is to be estimated (Hayenga and DiPietre).

The estimated slope coefficient (b_1) indicates the typical cash rice price change associated with a one dollar change in the September wheat futures price during mid August. Reversing the ratio provides the appropriate ratio to determine the size of the futures position to be taken for a given amount of cash rice position held (Hayenga and DiPietre).

The intercept (b_0) reflects average wheat futures-cash rice price differences during the rice harvesting period that are unrelated to price level changes (Hayenga and DiPietre). This would indicate spatial and temporal market dimensions such as relative location to the transportation facilities, storage facilities, and the consuming market. Varying quality characteristics of the grain may also be incorporated in the intercept term.

The Data

The data to be used in the analysis are selected to allow initiating the cross-hedge at various stages of the preharvest period. The futures offsetting date of August 15th allows closing of the September futures position well before the delivery month for wheat.

The opening futures transactions dates are March 15, April 15, May 15, and June 15. Closing prices for each of these dates were recorded for an eleven year period, 1975-1985. This range of opening dates is selected to allow futures pricing in the preplanting, planting, and growing stages of rice production.

Rough rice harvest prices available in southwest Louisiana during mid to late August are utilized in computing net cross-hedging returns. These cash or "to arrive" prices also serve as a control against which to compare net returns from cross-hedging. The prices were obtained from U.S.D.A. Rice Market News Reports and derived as weighted averages of various lot sizes and qualities.

Regression Results

Using ordinary least squares the estimated equation for the long-grain cash rice-wheat futures simple regression is:

LG Rice - Wheat

CPLG =	4.228 +	1.341 (FPWH)
Std. Dev.	(1.930)	(.532)
t-calc.	(2.191)	(2.522)

The slope coefficient for LG is 1.341 with a calculated t-value of 2.522 which is significant at the 5 percent level.

The estimated equation for the medium-grain cash rice - wheat futures simple regression is:

MG Rice - Wheat

CPMG =	3.731 +	1.357 (FPWH)
Std. Dev.	(1.851)	(.510)
t-calc.	(2.015)	(2.660)

The slope coefficient for MG is 1.357 with a calculated t-value of 2.66 which is also significant at the 5 percent level. The cash-futures price relationships appear to be sufficiently strong such that cross-hedging can be carried out.

The estimated coefficients for LG and MG indicate a positive relationship between wheat futures and cash rice prices. Therefore, the appropriate cross-hedge calls for a typical selling hedge, ie. selling wheat futures as an opening transaction and buying futures in August to close out the futures position.

Realized Price Distributions from Cross-Hedging

Net cross-hedging returns are calculated using the information gained in the regression analysis. The slope coefficient is multiplied times the gain or loss on the futures market and added to the actual cash rough rice price received in August. The specific formulas used are:

$$\text{Realized Price LG} = [FPWH_t^I - FPWH_t^E] \times b_1^{LG} + CPLG_t$$

$$\text{Realized Price MG} = [FPWH_t^I - FPWH_t^E] \times b_1^{MG} + CPMG_t$$

where $FPWH_t^I$ is the initial wheat futures price for the four opening dates each year t, $FPWH_t^E$ is the ending or August wheat futures price each year t, $CPLG_t$ is the actual rough rice price at harvest for long-grain rice each year t, $CPMG_t$ is the actual medium-grain rough rice price each year t, b_1^{LG} and b_1^{MG} are the cross-hedging ratios as determined by the regression analysis.

Applying the appropriate data to the formulas yields the realized price from cross-hedging. These realized prices are presented in Table 1.

Table 1. Realized Prices From Production Cross-Hedging with Futures Contracts for Soft Red Winter Wheat by Placement Date and Class of Rough Rice, Louisiana, 1975-1985.

Year	March	April	May	June	Cash
			(dollars per cwt)		
Long grain class					
1975	8.449	8.288	7.862	8.06	9.16
1976	7.361	7.19	6.959	7.117	6.54
1977	9.169	9.062	8.8	8.576	8.19
1978	7.158	7.547	7.533	7.576	7.55
1979	8.66	8.683	9.152	10.279	10.155
1980	10.041	9.581	9.893	9.658	10.044
1981	11.975	12.011	11.659	11.472	11.19
1982	8.689	8.917	8.658	8.283	8.028
1983	10.248	10.429	10.285	10.268	10.58
1984	9.144	9.17	9.107	9.221	9.11
1985	9.086	9.093	8.935	9.072	8.66
Mean	9.089	9.088	8.986	9.04	9.019
Std. Dev.	1.344	1.319	1.316	1.32	1.4
Medium grain class					
1975	8.241	8.078	7.647	7.847	8.96
1976	6.881	6.708	6.474	6.633	6.05
1977	9.081	8.972	8.707	8.48	8.09
1978	7.413	7.807	7.793	7.688	7.81
1979	8.721	8.745	9.22	10.36	10.234
1980	10.117	9.652	9.967	9.73	10.12
1981	11.284	11.321	10.965	10.775	10.49
1982	8.388	8.619	8.358	7.978	7.72
1983	8.928	9.111	8.965	8.949	9.264
1984	7.414	7.441	7.377	7.492	7.38
1985	8.671	8.678	8.518	8.657	8.24
Mean	8.649	8.648	8.545	8.599	8.578
Std. Dev.	1.256	1.214	1.249	1.27	1.375

Stochastic Dominance

The price distributions for each marketing strategy are examined using stochastic dominance analysis. Results of the stochastic dominance (SD) analysis for both LG and MG rice are summarized in Table 2.

Table 2. Stochastic Dominance Efficient Sets.

	Long-Grain	Medium-Grain
FSD*	all inclusive	all inclusive
SSD	Cash, March, April June	Cash, March, April, June
TSD	April	March, April

* FSD - first-degree stochastic dominance, SSD - second-degree stochastic dominance, TSD - third-degree stochastic dominance.

The SD risk efficient set for the four cross-hedging dates and harvest pricing of long-grain grain rice is the mid April cross-hedge strategy. The April strategy dominates all others by either second-degree or third-degree stochastic dominance. The cash or harvest pricing strategy is dominated by all the cross-hedging strategies except May for which it is indifferent.

The SD risk efficient set for the medium-grain price distributions consists of both the mid March and mid April cross-hedge strategies. Stochastic dominance is unable to rank these two alternatives in terms of third degree risk efficiency. Again, however, the cash strategy is dominated by all of the cross-hedge strategies except May.

Stochastic dominance is able to identify specific attributes of the price distributions as indicated by the summary statistics in Table 3. Dominant strategies for both LG and MG provide higher average returns and lower variances than harvest pricing, and a higher positive skewness, which indicates that cross-hedging is appropriate for farm managers with decreasing risk aversion. Harvest pricing has negative skewness for both LG and MG.

Table 3. Summary Statistics.

Strategy	Mean	Std. Dev.	Skewness	Minimum Return
		(dollars per cwt)		
Long Grain Cross-Hedge				
Cash	9.019	1.400	- 0.113	6.540
March	9.089	1.344	0.513	7.158
April	9.088	1.319	0.651	7.190
May	8.986	1.316	0.367	6.959
June	9.040	1.320	0.223	7.117
Medium Grain Cross-Hedge				
Cash	8.578	1.375	- 0.124	6.050
March	8.649	1.256	0.558	6.881
April	8.648	1.214	0.529	6.708
May	8.545	1.249	0.271	6.474
June	8.599	1.270	0.306	6.633

The dominant strategies also provide the highest minimum return of any of the strategies. The minimum return for the April cross-hedge strategy for LG is $0.65/cwt. higher than the minimum for harvest pricing.

For MG the March strategy provides the highest minimum return, it is $0.83/cwt. higher than harvest pricing, and $0.17/cwt. higher than cross-hedging in April.

These lower tail values of the price distributions are critical particularly for very risk averse farm managers. A producer may face a situation in which he cannot tolerate a minimum return below a certain level.

In view of the results presented, cross-hedging would appear to provide a workable marketing option for Louisiana rice growers. Assuming these cash-futures price relationships extend beyond the sample period, rice growers in Louisiana could reduce risk exposure and increase income by cross-hedging their rice crop early in the production period, March and April.

Summary

This paper explores cross-hedging as a potential marketing alternative for rice growers in Louisiana. Four selected preharvest cross-hedging dates were compared to harvest pricing for long and medium-grain classes of rice. Cross-hedging involves determining the appropriate hedging ratio so that futures market gains or losses approximately offset cash market changes.

The cross-hedging technique was applied to the data in the sample period and examined using stochastic dominance. The March and April cross-hedge strategies were found to be preferable. These strategies demonstrate higher means and reduced variances. Perhaps the most important aspect in terms of price risk efficiency, however, is that cross-hedging provides the highest minimum returns, 10 and 14 percent higher than the minimum returns for LG and MG harvest pricing, respectively.

A major limitation of this analysis is the deviation that may take place between expected yields when the hedges are placed and that which actually occurs. This phenomena can have serious effects on net realized prices and is the subject of further research. It is noted, however, that virtually all rice grown in Louisiana is under irrigation and thus variation in yields is less than the case of row crops.

Cross-hedging appears to provide a viable marketing alternative and could increase the marketing flexibility of Louisiana rice growers.

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