Basis Risk for Rice

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Introduction:

Basis estimation is often a problem in agricultural commodities. When cross hedging is involved, basis risk creates even more complications. Although the effectiveness of cross- hedging and the hedge ratio have been analyzed, few studies have examined how basis affects the cross-hedging of agricultural products. In this paper, the relationship between basis risk and cross-hedging hedge-ratios are examined using rice. We formulate a cross-hedging model, incorporating basis fluctuation. The objective of this paper is to develop a cross-hedging model for rice that minimizes basis risk and accounts for the existence of the non stationary nature of basis. By analyzing autocorrelated cash prices and basis, we try to model basis risk. In addition, since agricultural products often exhibit seasonality patterns, basis risk under seasonality is examined.

In a cross-hedging situation, the dual problems of the covariability between the commodities and the basis are present. In a simplified hedging model, it is assumed that the deterministic portion of basis is captured in the intercept term of the cross hedging regression model. In agricultural products where hedgers take a position against their production under uncertainty, seasonality in basis and non stationary errors are often observed. If basis exhibits a pattern, hedgers can increase profit by incorporating this information.

Several researchers have empirically analyzed basis fluctuation. Kenyon, et al.(1987) examined the relationship between volatility in prices and loan rates. Their results showed some seasonality in grain and no seasonality in livestock. They also found a positive relationship between price volatility and the ratio of future prices to loan rates for grain. In research on a relationship between stock and inventory(supply), Malick and Ward(1987) studied frozen concentrated orange juice, and Netz (1996) analyzed corn. These studies suggested the existence of some seasonality and a strong relationship between basis and storage level. Hayenga and DiPietre(1982) examined the cross hedging effectiveness of wholesale beef product using live cattle futures and implied a basis risk effect on cross hedging results.

The time affect on basis has been studied by Castelino(1989, 1990, 1991 and 1992). His study found some systematic relationship among basis volatility, hedge ratio, and time to maturity. He modeled a hedging activity in terms of basis and rewrote minimum variance criteria in terms of basis. His study suggested that the time dimension effects of a hedge-ratio is much stronger in financial products than agricultural products. Viswanath's study(1993) incorporated the basis time dimension on the corn, wheat, and soybeans' hedge-ratio and evaluated the hedge using minimum variance criterion. His results showed variations of effectiveness depending on products. Lee, Hayenga, and Lence (1995) examined cross hedging of rice and their results showed no significant improvement using basis information in their hedge ratio calculation.

In this study, the time dimension and convergence in basis is incorporated into cross hedging models. We first study nonstationarity in basis and analyze basis patterns by month and by year. To incorporate the seasonality effect and time variation in basis, lag operators and dummy variables are used to calculate the hedge ratio. Then, we evaluate the effectiveness of the hedge by using a minimum variance criterion for several different states and rices.

Theoretical background:

Anderson and Danthine (1981) modeled a hedging activity as maximizing expected profit by choosing the quantity of futures and cash position. Their model included positive parameters of agent's risk aversion as follows,

$$\max\ E\ (\Pi)\ -\ 1/2\ *\ \Upsilon *\ (var(\Pi)) \qquad \textbf{(1)}$$

where π is the profit,
Υ is the risk aversion parameter,
and var(π) is a variance of expected profit.

Further they defined a profit as,

$$\Pi = C_t * Q_c - C(Q) - (F_t - F_{t-i}) * Q_f \qquad \textbf{(2)}$$

where C_t is cash price at the futures contract exit day,
Q_c is the quantity of cash position,
C(Q) is the cost function associated with production,
F_t is the futures price on the exit day,
F_{t-i} is the futures price at the day of entering,
Q_f is the amount of futures contract to hold.

They, then, separated the optimal futures position into a pure speculative part and pure hedging part. From the first order necessary condition, they equated marginal revenue and marginal cost and showed the optimal future and cash position. In this study, we focused on their marginal conditions, especially on the revenue side of equation (2). The marginal condition for this equation follows,

$$C(Q) + \Upsilon * Q_C * \sigma_{00} * (1 - R^2) = C_t + \beta * (F_t - F_{t-i}) \qquad \textbf{(3)}$$

where σ_{00} is variance of cash price,
R^2 is correlation coefficient between cash and future price,
and β is a hedge ratio.

The left-side of the equation is minimized marginal cost and the right hand side of equation is maximized revenue. Since our study is a cross-hedge, R^2 is non-unity. The left hand side of equation becomes the production cost plus extra costs due to cross hedge and hedgers' risk preferences. The right hand side, maximized revenue equation, can be further written as,

$$REV = C_t - \beta*(F_{t-i} - C_t) - \beta * (C_t - F_t) \qquad \textbf{(4)}$$

where F_{t-i} - C_t is future price forecasting on spot market price, and
C_t - F_t is basis on the exit day associated with this contract.

From equation (4), maximized revenue is a function of cash price on future exit day, market price projection, and basis. The optimal hedging condition can relate to two separate components. One component is the future price projection of spot market price. The other component is a projection of all other costs associated with the hedging activity. The first projection depends on market supply and demand conditions while the latter depends on transportation, insurance, storage, and some other costs. Both components are subject to projection errors and minimizing these two types of estimating error results in maximizing revenue. Since basis is defined as cash minus futures, these two components are both embedded in basis.

The cost of carry model describes the latter component. Since agricultural products and financial products have different characteristics, some differences are noted between financial and agricultural products. While in financial products, most of the error arises from estimation of interest rates, in agricultural products, most of the errors arise from a projection of storage, insurance, and transportation costs. Moreover, when cross hedging is involved covariability between two commodities also has to be considered. If seasonality of basis exists, it must affect the latter component in equation (4). While some researchers contend that seasonality affects on agricultural futures market are much stronger than maturity affects, the results from several seasonality analysis have not confirmed this claim as a general statement for agricultural products (Malick and Ward(1987), Netz(1996), and Choi and Longstaff(1985)). Therefore, this analysis examined basis patterns, hedge ratios including basis information, and the length of the hedge interval.

Research methods:

In this analysis 513 observations are divided into two groups, one consisting of the first 400 observations and another consisting of the final 113 observations. The first data set is used to calculate hedge ratios and the second data set is used to analyze cross hedging effectiveness using these hedge ratios.

For determination of the seasonality in basis, dummy variables are included in two basis models. These two models are:

smodel I; $C_t - F_t = D_1 + D_2 + ,..., + D_{12}$,
smodel II-1; $C_t = D_1 + D_2 + ,..., D_{12} + \beta_1 * F_t * D_1 + \beta_2 * F_t * D_2 + , ..., + \beta_{12} * F_t * D_{12}$,
smodel II-2; $C_t = \alpha + \beta_1 * F_t * D_1 + \beta_2 * F_t * D_2 + ,..., + \beta_{12} * F_t * D_{12}$,
smodel II-3; $C_t = D_1 + D_2 + ,..., + D_{12} + \beta * F_t$,
smodel II-4; $C_t = \alpha + \beta * F_t$,

where D_i are dummy variables for each month, α is an intercept, an average basis to be estimated, and β is a hedge ratio to be estimated.

We then test the hypothesis of parallel slopes and different intercepts, using price level model as well as autocorrelation adjusted model. We also test the significance of the monthly parameter estimates by selecting the harvest month as a base month.

For determination of an effective cross-hedging hedge-ratio, five different models are compared;

(a) the price level model; $C_t = \alpha + \beta * F_t + e_t$,
(b) the price change model; $(C_t - C_{t-1}) = \alpha + \beta * (F_t - F_{t-1}) + u_t$,
(c) the percentage change in prices model; $\text{Ln } C_t = \alpha + \beta * \text{Ln } F_t + e_t$,
(d) the price change with basis information model;
$(C_t - C_{t-1}) = \alpha + \beta_1 * (F_t - F_{t-1}) + \beta_2 * B_{t-8} + u_t$, and,
(e) the autocorrelation adjusted model; $(C_t - \rho * C_{t-1}) = \alpha + \beta * (F_t - \rho * F_{t-1}) + e_t$

where C_t is the cash price at time t,
C_{t-1} is the cash price a week prior to current cash price,
F_t is the futures price at time t,
F_{t-1} is the futures price a week prior to current,
B_{t-8} is the basis 8 weeks prior $(C_{t-8} - F_{t-8})$ to current basis,
$\text{Ln } C_t$ is natural log of cash price at time t,

$Ln\ F_t$ is natural log of futures price at time t,
e_t random error at time t,
u_t is random error, $(e_t - e_{t-1})$,
ρ is rho between residual from price level regression at time t and time t-1,
α and β coefficient to be estimated.

Many practitioners prefer the price level model. The price change model is generally preferred by researchers for hedge ratio calculation. The third model is a percentage change in price model using a logarithmic transformation. The fourth model is unique to this analysis. It was driven by equation (4) and included basis information as suggested by several researchers (Bond, Thompson and Lee (1987) Castelino(1990), and Viswanath(1993)). We chose basis eight weeks prior to current basis because the cash price time series structured in this data set seem to be influenced by the basis eight weeks prior to the current price. While in a cost of carry model, basis of the same commodity approaches zero at expiration day, basis of the different commodity may not approach zero even at expiration day. Therefore, a lag of eight is a reasonable time period to observe basis as a contract approaches expiration in this cross-hedging model. The last model corrects heavy autocorrelation in the price level regression. With these hedge-ratios, the effectiveness of hedging is evaluated using the second data set. Minimum variance criterion are used to evaluate cross hedge effectiveness. Then, the hypothesis is tested for a significant variance reduction between unhedged and hedged position. In addition, we compare the effectiveness by varying the hedging holding period for approximately two months, three months, six months, and night months. Then the results are analyzed.

Data collection:

Daily future prices (long-grain, rough rice) are collected from Future Data 1959-1996 of Prophet Information Services and weekly average prices are calculated since cash prices were only available on a weekly basis. The transition from one contract price (which is about to expire) to the later maturing contract was made in the last week of the month before the earlier contract expired. Since only milled rice prices were available in the U.S. domestic market and exporting milled rice seems to be more common than exporting rough rice, milled rice prices were used for the cash position. The weekly domestic milled-cash price(in $/cwt)data are collected from Rice Market News from August 25, 1986 to June 24 1996. Six weekly price series(in $/cwt) for the United states had complete data sets of 513 observations: (1) milled, long-grain from; Arkansas, (2) Texas, (3) Louisiana, (4) milled medium-grain from; Arkansas, (5) Louisiana, and (6) California.

The empirical results:

For determination of seasonality, we compared smodel I and smodel II-3 and tested monthly seasonality using four variations of model II. Comparison of the intercept terms of the two models showed similar results. When the harvested month (November for California rice and September for all other rices) was used as a base month, it showed differences on particular months. For example, the smodel I showed significant differences between September and February, September and March, September and April, September and November, and September and December for all rices except California at a 0.05 significance level. The smodel II -3 also showed significant differences in prices between September and March, and September and April for all rices except California rice. In addition to the above results, a graphical analysis showed some seasonal pattern in basis.

In spite of these indication of seasonality, a hypothesis test failed to reject monthly basis seasonality using the price level model. The hypothesis of parallel slopes and different intercepts were rejected at a 0.05 significant level for all rices except for Arkansas's long-grain rice, using F-test for model reduction with (11,376) and (22, 376) degree of freedom. On the other hand, the autocorrelation adjusted models showed some seasonality. The same hypothesis was accepted at 0.05 significant level for both long-grain and medium-grain rice from Arkansas. The hypothesis of separate intercepts were accepted at 0.05 significant level for California medium-grain rice. The results were compatible with common beliefs and with results from several other researchers using different products. Since seasonality would affect the covariance matrix between cash and future prices, this result suggested the hedge ratio under seasonality is not efficient. Therefore, unless an adjustment was made for monthly seasonality prior to any adjustment, the calculated hedge-ratio is not as effective as it would be without seasonality.

The second objective of this study was to find the best hedge-ratios using a minimum variance criterion. A total of 120[1] hedging models were tested for the null hypothesis of equal variance between an unhedged and a hedged position. Despite much criticism of the price level model, this model[2] showed the most effective reduction in minimum variances. On the other hand, despite the popularity of using a price difference model, our analysis showed this model failed to reduce variance. The results from both autocorrelation[3] adjusted models and percentage change models showed effectiveness (table I). A total of 24 autocorrelation adjusted models[4] tested, eight out of the 24 models indicated reduction of variance at a 0.1 significant level and two thirds of long-grain rice models showed effectiveness. A total of 32 out of 120 (26%) models rejected the null hypothesis at a .10 significance level and 18 out of 120 (15%) rejected the

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[1] 120 models are the six rices for each of five models with four different variations in holding periods; eight , twelve, twenty four and thirty six weeks.

[2] Myers and Thompson(1989), Bond, Thompson and Lee(1987) point out the shortcomings of price level regressions.

[3] The price level and percentage change models showed a strong autocorrelation. Durbin -Watson statistic for these two models were less than 0.2 and first order autocorrelation indicated more than 0.9 for almost all rices.

[4] There are six different rices and four holding periods.

null hypothesis at a .05 significance level. Among long-grain rices, 28 out of 60 (47%) rejected the null hypotheses at a .10 significance level. Only 4 out of 60 (7%) medium rice models rejected the null hypotheses. These results suggest cross-hedging using a long-grain rough rice contract is not suited for medium-grain rice. Despite the popularity of the price change model, none of the price change models rejected the null hypothesis, indicting poor performance. None of the basis information models rejected the null hypothesis.

Although the basis information model showed poor results in reducing variance, this outcomes suggest some interesting implications. The comparative results from the eight weeks holding period to the longer holding periods were quite different. All results, except those of eight weeks, had almost the same F-statistic. Moreover, the eight week holding period was the only possible result close to rejecting the null hypothesis. This result suggests information from the contract previous to the nearby contract helps to reduce hedged position variance. Furthermore, if the hedge-ratio from model (d) is effective, then incorporating nearby cross-hedging information into a price difference model and rolling over contracts might be a good hedging strategy for controlling basis variability. This result also relates to our equation (4) with basis effects on maximized revenue. We suspect that an imperfection in lag operation might weaken our result by distorting the main purpose of including the nearest cross-hedge basis information. The choice of an eight weeks prior basis was a rough approximation of the nearest to last cross-hedge information(rice contracts are every other month). However, since the number of weeks in a month varies from either four or five, a lag of eight used in this model did not necessarily pick the closest information. As time proceeds, the gap between the week supposed to be picked and the one actually picked can get larger. In addition, there was no July futures contract in 1987 and 1988. Our lag eight operation, therefore, might be a poor approximation for nearby cross-hedging basis information.

The last objective of this analysis was to examine the effect of the length of the hedge holding period. Our results support Castelino's time dimension about hedge ratios. Because of our data construction[5], the affect of the time dimension on holding length showed up as a stable hedge ratio over the different holding periods as it was seen in our results. Due to this data construction, however, time affect on beta was not explicitly observed. Our results also showed systematic movement in variance of basis. The variance increases as you moving away from the harvested month. It reaches a peak around April and starts to decline as it approaches December for California rice and October for all other rices.

Conclusion:

Our analysis found seasonality in Arkansas's long-grain and medium-grain rice and California medium-grain rice. The existence of seasonality requires incorporation of seasonal adjustments prior to autocorrelation adjustment in calculating a hedge-ratio. Our results suggest incorporating prior basis information improves hedge ratio calculation under minimum variance criterion. The combination of basis information and time dimension shown in the results suggest the best hedging strategy for maximized revenue. A simple price difference model was not effective in reducing variance. The functional relationship between basis risk and production information was also found in this analysis. This result suggest that basis risk is a decreasing function of information about certainty on production. The cross-hedging between rough rice future contract and medium-grain rice was found to be ineffective.

[5] Our data construction used the closest contract price to convert one futures to next futures contract.

TABLE I REDUCTION IN VARIANCE EVALUATION

PRICE LEVEL MODEL

		HOLDING 8 WEEKS				HOLDING 12 WEEKS				HOLDING 24 WEEKS				HOLDING 36 WEEKS			
		OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST
UNHEDGE	ARAL	105	0.0047619	1.8097562	1.612613	101	0.1188119	2.25405	1.66373	89	0.6769663	3.151468	2.18235	77	1.7045455	3.6955982	2.25410
HEDGE		105	-0.33773	1.4251318		101	-0.4513	1.74752		89	-0.504132	2.1332949		77	-0.3258108	2.4614891	
UNHEDGE	TEXL	105	-0.07381	1.8492377	1.331287	101	-0.034654	2.356316	1.524285	89	0.3764045	3.569197	1.83768	77	1.3766234	4.1670254	1.90166
HEDGE		105	-0.414695	1.6027172		101	-0.602091	1.908537		89	-0.799155	2.6329095		77	-0.6442105	3.0217582	
UNHEDGE	LOUL	105	-0.019048	1.8281635	1.516171	101	0.0643564	2.282311	1.751243	89	0.5955056	3.1462359	2.39129	77	1.5795455	3.6700865	2.54327
HEDGE		105	-0.41208	1.4847077		101	-0.589885	1.724652		89	-0.759885	2.0345808		77	-0.750425	2.3013363	
UNHEDGE	ARAM	105	-0.135714	2.1663895	1.205652	101	-0.116337	2.690101	1.307333	89	0.3258427	3.798625	1.40513	77	1.2224026	4.5712841	1.45358
HEDGE		105	-0.425631	1.9729928		101	-0.598932	2.352748		89	-0.673949	3.2045628		77	-0.4962795	3.7915618	
UNHEDGE	LOUM	105	-0.195238	2.1179127	1.152203	101	-0.257426	2.72963	1.214366	89	0.0632022	4.0762496	1.29020	77	0.9301948	4.8373841	1.35236
HEDGE		105	-0.441446	1.9730744		101	-0.667263	2.477017		89	-0.785856	3.5886638		77	-0.5293706	4.1597181	
UNHEDGE	CALM	105	-0.440476	2.1015459	1.083411	101	-0.581683	2.904761	1.087751	89	-0.363764	4.46958	1.13479	77	0.1623377	5.6272315	1.15852
HEDGE		105	-0.615802	2.0190278		101	-0.873531	2.785132		89	-0.968384	4.1957372		77	-0.877029	5.22808	

PRICE ONE DIFFERENCE MODEL

		HOLDING 8 WEEKS				HOLDING 12 WEEKS				HOLDING 24 WEEKS				HOLDING 36 WEEKS			
		OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST
UNHEDGE	ARAL	105	0.0047619	1.8097562	1.267807	101	0.1188119	2.25405	1.239374	89	0.6769663	3.151468	1.29660	77	1.7045455	3.6955982	1.29675
HEDGE		105	-0.108584	1.6072872		101	-0.069864	2.024708		89	0.2860866	2.7676386		77	1.0326074	3.2453125	
UNHEDGE	TEXL	105	-0.07381	1.8492377	1.175712	101	-0.034654	2.356316	1.181078	89	0.3764045	3.569197	1.03647	77	1.3766234	4.1670254	1.20827
HEDGE		105	-0.174229	1.7054629		101	-0.201811	2.168174		89	0.3095287	3.5058403		77	0.7813202	3.7909104	
UNHEDGE	LOUL	105	-0.019048	1.8281635	1.196907	101	0.0643564	2.282311	1.189569	89	0.5955056	3.1462359	1.05320	77	1.5795455	3.6700865	1.22667
HEDGE		105	-0.108123	1.6710321		101	-0.083918	2.092569		89	0.5158589	3.0657451		77	1.0514922	3.313691	
UNHEDGE	ARAM	105	-0.135714	2.1663895	1.119026	101	-0.116337	2.690101	1.132744	89	0.3258427	3.798625	1.14921	77	1.2224026	4.5712841	1.15584
HEDGE		105	-0.240684	2.0479364		101	-0.291069	2.527567		89	-0.03615	3.5434577		77	0.6001222	4.2519672	
UNHEDGE	LOUM	105	-0.195238	2.1179127	0.978996	101	-0.257426	2.72963	0.979541	89	0.0632022	4.0762496	0.97826	77	0.9301948	4.8373841	0.97634
HEDGE		105	-0.176939	2.1405118		101	-0.226964	2.75799		89	0.1263093	4.1213015		77	1.0386784	4.8956373	
UNHEDGE	CALM	105	-0.440476	2.1015459	1.048488	101	-0.581683	2.904761	1.041942	89	-0.363764	4.46958	1.05383	77	0.1623377	5.6272315	1.05971
HEDGE		105	-0.505829	2.0523767		101	-0.69047	2.845697		89	-0.589137	4.3539312		77	-0.2250872	5.4664109	

% CHANGE MODEL

		HOLDING 8 WEEKS				HOLDING 12 WEEKS				HOLDING 24 WEEKS				HOLDING 36 WEEKS			
		OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST
UNHEDGE	ARAL	105	0.0047619	1.8097562	1.341074	101	0.1188119	2.25405	1.308024	89	0.6769663	3.151468	1.39444	77	1.7045455	3.6955982	1.39625
HEDGE		105	-0.139625	1.5627653		101	-0.121535	1.97086		89	0.1790414	2.6687819		77	0.8485924	3.1275428	
UNHEDGE	TEXL	105	-0.07381	1.8492377	1.242124	101	-0.034654	2.356316	1.260794	89	0.3764045	3.569197	1.30768	77	1.3766234	4.1670254	1.31466
HEDGE		105	-0.218262	1.6592437		101	-0.275109	2.098512		89	-0.121746	3.1211906		77	0.5202831	3.6342953	

TABLE I REDUCTION IN VARIANCE EVALUATION

UNHEDGE	LOUL	105	-0.019048	1.8281635	1.381746	101	0.0643564	2.282311	1.389765	89	0.5955056	3.1462359	1.50246	77	1.5795455	3.6700865	1.51366
HEDGE		105	-0.195633	1.5552528		101	-0.229587	1.935994		89	-0.013455	2.5667912		77	0.5327169	2.9830579	
UNHEDGE	ARAM	105	-0.135714	2.1663895	1.134751	101	-0.116337	2.690101	1.152925	89	0.3258427	3.798625	1.17374	77	1.2224026	4.5712841	1.18231
HEDGE		105	-0.257571	2.0336973		101	-0.319179	2.505348		89	-0.094386	3.506225		77	0.5000125	4.2040881	
UNHEDGE	LOUM	105	-0.195238	2.1179127	1.128846	101	-0.257426	2.72963	1.148256	89	0.0632022	4.0762496	1.17830	77	0.9301948	4.8373841	1.20587
HEDGE		105	-0.342738	1.9933829		101	-0.502954	2.547326		89	-0.445458	3.7551974		77	0.0557878	4.4051446	
UNHEDGE	CALM	105	-0.440476	2.1015459	1.056396	101	-0.581683	2.904761	1.049589	89	-0.363764	4.46958	1.06484	77	0.1623377	5.6272315	1.07238
HEDGE		105	-0.519714	2.0446811		101	-0.713582	2.835311		89	-0.637018	4.3313656		77	-0.3073972	5.4340114	

BASIS 8WEEKS LAG INCLUDED MODEL

		HOLDING 8 WEEKS				HOLDING 12 WEEKS				HOLDING 24 WEEKS				HOLDING 36 WEEKS			
		OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST
UNHEDGE	ARAL	105	0.0047619	1.8097562	1.234085	101	0.1188119	2.25405	0.988348	89	0.6769663	3.151468	0.99245	77	1.7045455	3.6955982	0.99244
HEDGE		105	-0.094558	1.6290991		101	0.1026548	2.267298		89	0.6566885	3.1634317		77	1.6833596	3.7096562	
UNHEDGE	TEXL	105	-0.07381	1.8492377	1.152826	101	-0.034654	2.356316	0.99297	89	0.3764045	3.569197	0.99470	77	1.3766234	4.1670254	0.99282
HEDGE		105	-0.160337	1.7223078		101	-0.048729	2.364642		89	0.3587386	3.5786861		77	1.3581664	4.1820679	
UNHEDGE	LOUL	105	-0.019048	1.8281635	1.158377	101	0.0643564	2.282311	0.994961	89	0.5955056	3.1462359	0.99449	77	1.5795455	3.6700865	0.99493
HEDGE		105	-0.090915	1.6985962		101	0.0526652	2.288082		89	0.5808327	3.1549374		77	1.5642155	3.6794287	
UNHEDGE	ARAM	105	-0.135714	2.1663895	1.11427	101	-0.116337	2.690101	0.993407	89	0.3258427	3.798625	0.99350	77	1.2224026	4.5712841	0.99650
HEDGE		105	-0.235814	2.0523025		101	-0.132621	2.699013		89	0.3054057	3.8110385		77	1.2010504	4.5792951	
UNHEDGE	LOUM	105	-0.195238	2.1179127	0.965145	101	-0.257426	2.72963	0.999535	89	0.0632022	4.0762496	1.00124	77	0.9301948	4.8373841	1.00051
HEDGE		105	-0.165161	2.1558169		101	-0.252533	2.730265		89	0.0693429	4.0737256		77	0.9366105	4.836151	
UNHEDGE	CALM	105	-0.440476	2.1015459	1.048673	101	-0.581683	2.904761	0.99814	89	-0.363764	4.46958	0.99721	77	0.1623377	5.6272315	0.99763
HEDGE		105	-0.506136	2.0521963		101	-0.592364	2.907466		89	-0.377169	4.4758301		77	0.1483319	5.6338995	

AUTO-ADJUSTED MODEL

		HOLDING 8 WEEKS				HOLDING 12 WEEKS				HOLDING 24 WEEKS				HOLDING 36 WEEKS			
		OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST	OBS	MEAN	STD	F-TEST
UNHEDGE	ARAL	105	0.0047619	1.8097562	1.33052	101	0.1188119	2.25405	1.297971	89	0.6769663	3.151468	1.37963	77	1.7045455	3.6955982	1.38112
HEDGE		105	-0.135077	1.5689535		101	-0.113964	1.978477		89	0.1947253	2.6830692		77	0.8755537	3.1446234	
UNHEDGE	TEXL	105	-0.07381	1.8492377	1.216101	101	-0.034654	2.356316	1.228255	89	0.3764045	3.569197	1.26450	77	1.3766234	4.1670254	1.26973
HEDGE		105	-0.200147	1.6769032		101	-0.244954	2.126127		89	-0.059275	3.1740245		77	0.6276724	3.6980365	
UNHEDGE	LOUL	105	-0.019048	1.8281635	1.386703	101	0.0643564	2.282311	1.395753	89	0.5955056	3.1462359	1.51170	77	1.5795455	3.6700865	1.52339
HEDGE		105	-0.198255	1.5524705		101	-0.233953	1.931837		89	-0.022501	2.5589324		77	0.5171679	2.9735153	
UNHEDGE	ARAM	105	-0.135714	2.1663895	1.167251	101	-0.116337	2.690101	1.199223	89	0.3258427	3.798625	1.23295	77	1.2224026	4.5712841	1.24753
HEDGE		105	-0.298422	2.0051848		101	-0.38718	2.45651		89	-0.235262	3.4210034		77	0.2578404	4.0927267	
UNHEDGE	LOUM	105	-0.195238	2.1179127	0.80819	101	-0.257426	2.72963	0.823101	89	0.0632022	4.0762496	0.82221	77	0.9301948	4.8373841	0.81265
HEDGE		105	-0.037754	2.3558695		101	0.0047224	3.008688		89	0.6062938	4.4953988		77	1.8637912	5.3660993	
UNHEDGE	CALM	105	-0.440476	2.1015459	1.049633	101	-0.581683	2.904761	1.043024	89	-0.363764	4.46958	1.05536	77	0.1623377	5.6272315	1.06145
HEDGE		105	-0.507743	2.0512576		101	-0.693655	2.84422		89	-0.595736	4.3507785		77	-0.2364308	5.4619078	

F-statisitics df=103: 0.05=1.3849, 0.10=1.2886: df=99: 0.05=1.394, 0.10=1.2951; df=87: 0.05=1.4526, 0.10=1.3179:df=75: 0.05=1.4656,0.10=1.3465

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