Hedging Hard Red Winter Wheat: Kansas City versus Chicago

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INTRODUCTION

Traditionally, the Kansas City futures contract is used to hedge hard red winter wheat and the Chicago futures contract is used to hedge soft red winter wheat. The Kansas City contract allows the delivery of hard red winter wheat only. The Chicago contract allows delivery of both hard and soft red winter wheat at par value. Chicago usually trades at a lower price than Kansas City because a futures market reflects the cheapest to deliver commodity which is usually soft red winter wheat. Thompson, Eales, and Seibold (1993) show that conducting transactions in the Kansas City futures market is more expensive than in the Chicago futures market and suggest hedging hard red winter wheat in Chicago. The objective of this article is to determine if a hard red winter wheat hedger's utility would be maximized by using the Chicago contract or the Kansas City contract.

According to Thompson et al. (1993), trading on the Kansas City Board of Trade can be more expensive, from a minimum of $0.54 per contract for the July wheat contract traded in June to $14.01 per contract

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for the lightly traded September contract traded in February. This is mainly due to market slippage from low trading volume and the lack of liquidity at Kansas City. Chicago trades over twice as many contracts as Kansas City (N'Zue, 1995). Thompson et al. (1993) also found a significantly higher transaction cost at Kansas City which is independent of trading volume. If hard red winter wheat could be hedged using the Chicago contract, then hedging costs could be reduced.

Because the Chicago contract is not specifically a hard red winter wheat contract, Vukina and Anderson (1993) would classify hedging hard red winter wheat in Chicago as a cross hedge. (All hedges are cross hedges to some degree because of differences in grades, location, and time.) Thus, hedging hard red winter wheat with the Chicago contract will likely be less effective than hedging with the Kansas City contract. There is a hedge risk and hedge cost tradeoff that needs to be evaluated.

Regression analysis is used to determine the static minimum risk hedge ratios (which are called regression hedge ratios since they certainly are not optimal) for both the Kansas City and Chicago contracts for 1, 5, 10, 21, 65, and 130 market-day hedges. Even though a regression hedge ratio is utility maximizing only with unrealistic assumptions, such regressions do provide a statistic needed in calculating expected utility maximizing hedge ratios. It is common for price levels to be used when empirically estimating hedge ratios. Brown (1985) shows, however, that this leads to misspecified hedge ratios. Witt, Schroeder, and Hayenga (1987) defend price-level regressions, stating that the price difference model is preferred only if the order of price differences matches the estimated order of autocorrelation. Most hedgers, though, are not so much concerned with the price level, as with the risk of a price change. If hedging is effective it will protect the hedger from changes in the price. Also, this study estimates the higher-order autocorrelation coefficients which match the order of price differences. Therefore, price changes are used which should yield more accurate hedge ratio estimates.

Finally, transactions costs, including commissions and liquidity costs estimated by Thompson et al. (1993), are subtracted from the assumed mean hedging returns of zero. Utility function values are computed for five different levels of risk aversion. This information is used to determine which exchange hedgers should use based on a given risk aversion level.

EXPECTED UTILITY MAXIMIZATION

Benninga, Eldor, and Zilcha (1984) show that mean-variance hedge ratios developed by Johnson (1960) and Stein (1961) are consistent with utility maximizing hedge ratios under the following assumptions: (i) the decision maker is not allowed to participate in alternative activities, (ii) no transactions costs, (iii) no production risk, (iv) cash prices are a linear function of futures prices with an independent error term, and (v) futures prices are unbiased. According to Leuthold, Junkus, and Gordier (1989, p. 99), relaxing (v) results in the following mean-variance utility maximization problem:

$$\text{Max } E(U) = X_s E(\tilde{R}_s) + X_f E(\tilde{R}_f) - \lambda/2(X_s^2\sigma_s^2 + X_f^2\sigma_f^2 + 2X_f X_s \sigma_{sf}) \quad (1)$$

where $E(U)$ is the expected utility: X_s is the amount of the cash position; X_f is the amount of the futures position; $E(\tilde{R}_g)$ is the expected return on the cash position; $E(\tilde{R}_f)$ is the expected return on the futures position; λ is the risk aversion coefficient; σ_g^2 is the variance of the cash returns (price change); σ_f^2 is the variance of the futures returns (price change); and σ_{sf}^2 is the covariance of the changes in futures and cash returns.

This study relaxes assumption (ii) rather than (v). They are equivalent, though, if transactions costs are considered to cause the bias in the expected return to the futures position. Following Leuthold et al. (1989, p. 99), eq. (1) can be rewritten in terms of price changes, which yields:

$$\begin{aligned} \text{Max } E(U) = {} & X_s(E(\tilde{S}_1) - S_0) + X_f[(E(\tilde{F}_1) - F_0) - TC] \\ & - \lambda/2(X_s^2\sigma_s^2 + X_f^2\sigma_f^2 + 2X_f X_s \sigma_{sf}) \end{aligned} \quad (2)$$

where S_0 is the cash price at time, 0; $\tilde{S}_1$ is the expected value of the cash price at time, 1; F_0 is the futures price at time, 0; $\tilde{F}_1$ is the expected value of the futures price at time, 1; and TC is the transactions costs consisting of commissions and liquidity costs.

The first derivative of eq. (2) with respect to the decision of how much to hedge, X_f, yields:

$$\partial E(U)/\partial X_f = [(E(\tilde{F}_1) - F_0) - TC] - \lambda X_f \sigma_f^2 - \lambda X_s \sigma_{sf} = 0 \quad (3)$$

Rearranging terms (Leuthold, et al., 1989, p. 99) yields:

$$X_f = \{[E(\tilde{F}_1) - F_0) - TC]/\lambda\sigma_f^2\} - [X_s(\sigma_{sf}/\sigma_f^2)] \quad (4)$$

which is the futures position at a specified risk aversion level and allowing for transactions costs.

Assuming that firms do not speculate and that transactions costs are zero, the first part of eq. (4) goes to zero and the regression hedge ratio is

$$X_f^* = -X_s(\sigma_{sf}/\sigma_f^2) \tag{5}$$

The cash position is assumed to be exogenous, so the ratio of the futures position to the cash position is

$$b^* = X_f^*/(-X_s) = \frac{\sigma_{sf}}{\sigma_f^2} \tag{6}$$

which is the slope coefficient of a regression of cash price changes on futures price changes. This leads to regression eq. (7) for Kansas City and regression eq. (8) for Chicago:

$$(Cash_t - Cash_{t-k}) = \alpha_0 + \alpha_1(KCfut_t - KCfut_{t-k}) \tag{7}$$

$$(Cash_t - Cash_{t-k}) = \gamma_0 + \gamma_1(CHfut_t - CHfut_{t-k}) \tag{8}$$

where $Cash_t - Cash_{t-k}$ is the cash price difference from day, t, to day, $(t - k)$, and the futures price terms are similar. These regressions are used to estimate b^* as defined in eq. (6). However, since the study is about differences in transactions costs, it is not reasonable to assume that transactions costs are zero. As Brorsen (1995) argues, b^* is still a useful statistic. The optimal futures position defined in eq. (4) does depend on b^*. The next section explains the procedure used to estimate b^*.

REGRESSION HEDGE RATIOS

Since time-series data are used, first-order autocorrelation is likely. Further, due to overlapping time periods of the price change models, a moving average process with order equal to the length of the hedge period should also be present. This is because the change in price from day, t, to day, $(t - k)$ is equal to the sum of daily price changes over the same $(t - k)$ period (Harri and Brorsen, 1997). The moving average process is corrected by approximating it as an autoregressive process with lags of one and k. Similar hedge ratios are obtained when assuming the errors follow a moving average process. The autoregressive process is selected because it is more parsimonious, autocorrelation could exist for reasons other than the overlapping data, and the estimated moving average parameters differ greatly from their expected values if the overlapping data are the only source of autocorrelation.

The autocorrelation process may also be different across the contract month changes. A dummy variable which turns the autocorrelation function off across contract month changes is used to solve this problem. This yields the nonlinear least squares model. Rewriting eqs. (7) and (8) in general terms:

$$CASHDIF = \beta_0 + \beta_1(FUTDIF)$$

$$+ \rho_1[(L_1CASHDIF) - \beta_0 - \beta_1(L_1FUTDIF)] * DUMCH$$

$$+ \rho_n[(L_n\, CASHDIF)\, \beta_0 - \beta_1(L_n\, FUTDIF)] * DUMCH \tag{9}$$

where *CASHDIF* is the difference in the cash price over the hedge period; *FUTDIF* is the difference in the futures contract price over the hedge period; $L_1CASHDIF$ is the *CASHDIF* lagged one period; $L_1FUTDIF$ is the *FUTDIF* lagged one period; $L_nCASHDIF$ is the *CASHDIF* lagged n times corresponding to the length of the hedge period; $L_nFUTDIF$ is the *FUTDIF* lagged n times corresponding to the length of the hedge period; ρ_1 is the first-order autocorrelation parameter; ρ_n is the nth-order autocorrelation parameter where n is equal to the hedge period; and *DUMCH* is a dummy variable equal to 0 when the contract month changes and 1 otherwise.

Autocorrelation causes inefficiency and biased estimates of the variance and invalidates hypothesis tests. Another problem is heteroskedasticity in the error terms due to the cyclical periods of high and low volatility in the wheat futures contract. Lagrange multiplier tests of homoskedasticity performed by regressing squared errors vs. lagged squared errors indicate the presence of conditional heteroskedasticity. Therefore, a generalized autoregressive conditionally heteroskedastic (GARCH) process is used.

Estimated generalized least squares (EGLS) is used to correct for autocorrelation and heteroskedasticity. The three steps to the EGLS process are (i) estimate eq. (9) with nonlinear least squares, (ii) estimate a GARCH (1,1) for the residuals of (i) with maximum likelihood estimation, and (iii) estimate eq. (9) with weighted nonlinear least squares. The correction for autocorrelation is done first since GARCH parameter estimates are not consistent in the presence of autocorrelation. The estimates are obtained using SHAZAM (1993).

The regression hedge ratios are used in eq. (4) as the estimate of σ_{sf}/σ_f^2 to calculate the optimal hedge ratios. In calculating the optimal hedge ratios, futures are assumed unbiased. The variance of futures prices, σ_f^2, is calculated from the data in the usual way. The overlapping data problem does not bias the estimate of the variance. The expected utilities are calculated as in eq. (2) with $X_s = 1$, unbiased futures markets, no expected change in the cash price, and the variances calculated directly from the data. In reality, there would often be some expected change in the cash price, such as in the case of a storage hedge. All expected utilities are negative due to assuming no expected return in the cash market.

UTILITY MAXIMIZING HEDGE RATIOS AND RISK AVERSION

Utility maximizing hedge ratios from eq. (4) are computed for four levels of the Pratt-Arrow risk aversion measure ranging from 0.001 to 1.0. This range is chosen because it represents coefficient levels from near risk neutral to extremely risk averse where the utility maximizing hedge ratios in eq. (4) converge to the regression hedge ratios estimated in eq. (5). A risk aversion level of 0.0001 is considered also, but hedging is never preferred (Buck, 1996). The results for 0.0001 are not included to simplify the presentation.

In this study, the data are measured in cents/bushel. Therefore, care must be taken to transform the risk aversion coefficients to the appropriate units when comparing these risk aversion levels to other studies (see Raskin and Cochran, 1986).

After the hedge ratios allowing for transactions costs are calculated using eq. (4), the next step is to compute the utility function values. Utility values are calculated by plugging the utility maximizing hedge ratios, the transactions costs, and the level of risk aversion into the utility function specified in eq. (2). This will give the maximum utility for each hedge period and each exchange for five levels of risk aversion. The task then is to choose the higher utility value between Kansas City and Chicago. The difference in the utility levels should be calculated also to determine the break-even level of liquidity cost difference between Kansas City and Chicago.

The final step in determining if and when hedgers should use the Kansas City or Chicago Boards of Trade to hedge is to compute the utility associated with hedging on each exchange. Using the utility maximizing hedge ratios for producers and commercial firms under both low and high liquidity costs, utility is calculated under five different levels of risk aversion. Then one can choose the higher utility value between Kansas City and Chicago under the desired hedge period and risk aversion level. Because a quadratic utility function is used, the expected utilities represent certainty equivalents in cents/bushel.

INCORPORATING TRANSACTIONS COSTS

Market makers are important to providing a liquid market. The greater the number of market makers, the less expensive it is to transact. This transaction expense is called slippage and refers to the difference between where an order is placed and where it is filled. For instance, if someone places an order to sell at $4.500 and the order is filled at $4.495, the slippage is equal to $0.005.

Thompson et al. (1993) measured this slippage in the Kansas City and Chicago wheat futures contracts. They found that the slippage was greater in Kansas City than in Chicago. Another common term for slippage is the bid–ask spread. Because the bid–ask spread is not recorded on the exchanges, Thompson et al. (1993) use two established methods [Roll's (1984) measure and the Thompson-Waller (1988) proxy] to approximate the bid–ask spread. The data used were seven sets of intraday price tick observations where a tick is one quarter of a cent. Thompson et al. (1993) cautioned that the data were from only one short time period, which could make the results peculiar to that time period.[1] However, the results were consistent with those found by Thompson and Waller (1988) for corn and oats.

To obtain robust results, this study takes the low and high liquidity costs for Chicago and Kansas City estimated by Thompson et al. (1993) and adds them to commissions costs for producers and commercial firms. Hedge ratios are computed for producers and commercial firms under each scenario.

According to Thompson et al. (1993), commissions costs for small off-floor traders may be as high as $80.00 per contract. Commissions costs for large firms, such as elevators, which have direct access to floor traders are considerably less. This difference in costs has a large impact on how risk averse a firm must be before it prefers a hedge to the cash market. Small hedgers (producers) commissions costs were assumed to be $80.00 per contract (1.6¢/bu.) and large hedgers' commissions costs were assumed to be $9.00 per contract (0.18¢/bu.). The low liquidity costs are 0.26308¢/bu. for Kansas City and 0.25232¢/bu. for Chicago, while the high liquidity costs are 0.54189¢/bu. for Kansas City and 0.26164¢/bu. for Chicago.

THE DATA

Daily price data are collected for the cash and futures prices. The daily closing prices of each contract month for both the Kansas City and Chicago Boards of Trade are collected from 1 January 1986 through 31 May 1994 (Technical Tools, 1986–1994). The hard red winter wheat cash prices are the Texas Gulf daily closing prices collected over the same time

[1]Another limitation is that Thompson and Waller's (1988) methods may underestimate liquidity costs for large orders. Large orders may be sufficient to move the market. Presumably, the higher volume market would be better able to absorb large orders.

TABLE I

Regression Hedge Ratios and Autocorrelation Coefficients: Kansas City Board of Trade

Variable	*1 Day Coefficient*	*5 Day Coefficient*	*10 Day Coefficient*	*21 Day Coefficient*	*65 Day Coefficient*	*130 Day Coefficient*
α_0	−0.0006	−0.0022	−0.0092[b]	−0.0174[b]	0.0291[b]	0.0581[b]
(constant)	(1.80)	(1.85)	(4.34)	(5.52)	(4.87)	(8.36)
α_1	1.0119[b]	1.0180[b]	1.0155[b]	1.0002[b]	1.0380[b]	1.0875[b]
(hedge ratio)	(132.31)	(136.82)	(131.40)	(110.65)	(78.92)	(79.54)
ρ_1	0.0439	0.8643[b]	0.9360[b]	0.9626[b]	0.9911[b]	0.9888[b]
(first-order autocorrelation)	(0.06)	(55.62)	(86.28)	(116.68)	(185.97)	(226.56)
ρ_n[a]		−0.1311[b]	−0.0722[b]	−0.0226[b]	−0.0109[b]	−0.0058
(nth-order autocorrelation)		(9.26)	(7.34)	(3.31)	(2.14)	(1.24)

Notes: The t-values for the test statistics are presented in parentheses.
[a]ρ_n is the nth-order autocorrelation parameter where n is the number of days in the hedge period.
[b]Significance at the 5% level.

period (Oklahoma Department of Agriculture, 1986–1994). Data before 1986 are excluded due to possible structural changes in the market due to the payment-in-kind program and the export enhancement program.

Regression hedge ratios as defined in eqs. (7) and (8) are calculated for 1, 5, 10, 21, 65, and 130 market-day hedge periods. This corresponds to one day, one week, two week, one month, three month, and six month calendar hedges and, therefore, provides a good distribution of short- and long-duration hedges. All hedging is simulated using data from the contract month closest to delivery (but not in delivery) at the time the hedge is to be exited. For instance, one day hedges exited in May and June will use the July futures contract. Hedges exited in July or August use the September contract.

RESULTS

The regression hedge ratios for Kansas City are presented in Table I. The hedge ratios are all slightly greater than one.[2] The autocorrelation parameter estimates are all significant except for 1st order in the one day hedge, in which there is no overlap of data, and 130th order in the six month hedge, when the autocorrelation coefficient is close to zero.

The regression hedge ratio estimates for Chicago are presented in Table II. The hedge ratios for Chicago are smaller than for Kansas City.

[2]The estimates are very close to the unreported ordinary least squares (OLS) estimates as they should be since autocorrelation and heteroskedasticity do not cause biased results. The only two that change much are the three and six month hedge ratios. This is likely due to the extreme autocorrelation present in the longer hedge periods.

TABLE II

Regression Hedge Ratios and Autocorrelation Coefficients: Chicago Board of Trade

Variable	*1 Day Coefficient*	*5 Day Coefficient*	*10 Day Coefficient*	*21 Day Coefficient*	*65 Day Coefficient*	*130 Day Coefficient*
α_0	−0.0009	−0.0041[b]	−0.0097[b]	−0.0172[b]	0.0367[b]	0.0683[b]
(constant)	(1.95)	(2.33)	(3.36)	(3.86)	(5.19)	(7.66)
α_1	0.7636[b]	0.7871[b]	0.7795[b]	0.7836[b]	0.9313[b]	1.0199[b]
(hedge ratio)	(68.00)	(74.79)	(71.94)	(65.72)	(61.55)	(67.33)
ρ_1	0.0307	0.8536[b]	0.9259[b]	0.9663[b]	0.9934[b]	0.9910[b]
(first-order autocorrelation)	(0.043)	(59.93)	(91.34)	(121.58)	(187.02)	(244.98)
ρ_n[a]		−0.1428[b]	−0.0823[b]	−0.0289[b]	−0.0107[b]	−0.0054
(nth-order autocorrelation)		(10.23)	(8.24)	(3.95)	(2.19)	(1.22)

Notes: The t-values for the test statistics are presented in parentheses.
[a] ρ_n is the nth-order autocorrelation parameter where n is the number of days in the hedge period.
[b] Significance at the 5% level.

This is because the Chicago contract is not solely a hard red winter wheat contract and, therefore, is less correlated with the cash price. As with Kansas City, all the autocorrelation coefficients are significant except for 1st order in the one day hedge and 130th order in the six month hedge.

Utility Maximizing Hedge Ratios

The regression hedge ratios assume no transactions costs. The utility maximizing hedge ratios defined in eq. (4) are based on a mean-variance utility function with positive transactions costs.

The utility maximizing hedge ratios for producers under low and high liquidity cost conditions are presented in Tables III and IV. The results show that until producers approach the strongly risk averse level and a long hedge period, they will not hedge. Lence (1996) also found that including transactions costs greatly reduces optimal hedge ratios. Also, the hedge ratios are lower than the ratios which assume zero transactions costs. As the risk aversion level approaches infinity, the hedge ratios converge to the no transactions costs hedge ratios.

The utility maximizing hedge ratios for commercial firms are presented in Tables V and VI. Commercial hedge ratios are larger than for producers because their commissions costs are much less. There is not as big a gap between the regression hedge ratios and those for commercial firms because their hedging costs are so low. The results show that the ratios have almost converged with the minimum risk ratios at the 0.1 risk aversion level compared to producers who still do not hedge at this level

TABLE III

Utility Maximizing Low Liquidity Cost Hedge Ratios for Producers with Four Levels of Risk Aversion

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	0.0	0.0	0.0	0.0	0.0	0.0	0.8858	0.6681
5 day	0.0	0.0	0.0	0.0	0.7445	0.5722	0.9906	0.7656
10 day	0.0	0.0	0.0	0.0	0.8774	0.6664	1.0017	0.7682
21 day	0.0	0.0	0.3700	0.2098	0.9372	0.7262	0.9939	0.7778
65 day	0.0	0.0	0.8460	0.7322	1.0188	0.9114	1.0361	0.9293
130 day	0.2444	0.1063	1.0032	0.9285	1.0791	1.0108	1.0867	1.0190

Notes: Trading costs are equal to commissions (1.6¢/bu.) plus liquidity costs (0.26308¢/bu. for Kansas City and 0.25232¢/bu. for Chicago). KC = Kansas City; Ch = Chicago.

TABLE IV

Utility Maximizing High Liquidity Cost Hedge Ratios for Producers with Four Levels of Risk Aversion

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	0.0	0.0	0.0	0.0	0.0	0.0	0.8669	0.6676
5 day	0.0	0.0	0.0	0.0	0.7035	0.5712	0.9866	0.7655
10 day	0.0	0.0	0.0	0.0	0.8567	0.6659	0.9996	0.7681
21 day	0.0	0.0	0.2757	0.2069	0.9277	0.7259	0.9930	0.7778
65 day	0.0	0.0	0.8137	0.7312	1.0159	0.9113	1.0358	0.9293
130 day	0.1182	0.1018	0.9906	0.9281	1.0778	1.0107	1.0865	1.0190

Notes: Trading costs are equal to commissions (1.6¢/bu.) plus liquidity costs (0.54189¢/bu. for Kansas City and 0.26164¢/bu. for Chicago). KC = Kansas City; Ch = Chicago.

for a one day hedge period. Also, because commercial firms' commissions costs are so much lower than for producers, the liquidity cost difference between Kansas City and Chicago makes a larger difference in the hedge ratios when compared to producers.

The utility values for producers using hedge ratios that allow for transactions costs are presented in Table VII. These results are under high liquidity costs. The results show that a producer would choose Kansas City under all levels of risk aversion and all hedge periods with only

TABLE V

Utility Maximizing Low Liquidity Cost Hedge Ratios for Commercial Firms with Four Levels of Risk Aversion

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	0.0	0.0	0.0	0.0	0.7120	0.5406	0.9818	0.7413
5 day	0.0	0.0	0.3675	0.2857	0.9529	0.7369	1.0115	0.7821
10 day	0.0	0.0	0.6870	0.5156	0.9826	0.7531	1.0122	0.7769
21 day	0.0	0.0	0.8503	0.6496	0.9852	0.7702	0.9987	0.7822
65 day	0.5814	0.4667	0.9923	0.8848	1.0334	0.9266	1.0375	0.9308
130 day	0.8870	0.8067	1.0674	0.9986	1.0855	1.0178	1.0873	1.0197

Notes: Trading costs are equal to commissions (0.18¢/bu.) plus liquidity costs (0.26308¢/bu. for Kansas City and 0.25232¢/bu. for Chicago). KC = Kansas City; Ch = Chicago.

TABLE VI

Utility Maximizing High Liquidity Cost Hedge Ratios for Commercial Firms with Four Levels of Risk Aversion

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	0.0	0.0	0.0	0.0	0.5234	0.5358	0.9630	0.7408
5 day	0.0	0.0	0.0	0.2749	0.9120	0.7359	1.0074	0.7819
10 day	0.0	0.0	0.4802	0.5099	0.9620	0.7525	1.0101	0.7768
21 day	0.0	0.0	0.7560	0.6468	0.9758	0.7699	0.9978	0.7822
65 day	0.2941	0.4567	0.9636	0.8838	1.0306	0.9265	1.0373	0.9308
130 day	0.7608	0.8021	1.0548	0.9981	1.0842	1.0177	1.0872	1.0197

Notes: Trading costs are equal to commissions (0.18¢/bu.) plus liquidity costs (0.54189¢/bu. for Kansas City and 0.26164¢/bu. for Chicago). KC = Kansas City; Ch = Chicago.

two exceptions. If using a six month hedge under a 0.001 risk aversion level or a one month hedge under a 0.01 risk aversion level, producers would choose Chicago because its utility value is greater. The utility value differences for the six month and one month hedges are 0.0074 and 0.0117, respectively. These differences are extremely small compared to the actual levels of utility, which implies that neither Kansas City nor Chicago is a clear choice. Under low liquidity cost conditions where there is less of a difference between Kansas City and Chicago, a producer would

TABLE VII

Utility Function Values for Producers with Four Levels of Risk Aversion Hedging with Hedge Ratios Allowing for Transactions Costs and under High Liquidity Cost Conditions

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	−0.0094	−0.0094	−0.0939	−0.0939	−0.9392	−0.9389	−3.8523[a]	−4.6368[a]
5 day	−0.0465	−0.0466	−0.4651	−0.4657	−2.8906[a]	−3.0750[a]	−12.3160[a]	−18.9538[a]
10 day	−0.0925	−0.0927	−0.9252	−0.9272	−4.2751[a]	−5.0755[a]	−24.8120[a]	−37.8745[a]
21 day	−0.2099	−0.2106	−1.9789[a]	−1.9672[a]	−8.0128[a]	−10.0962[a]	−61.4387[a]	−86.6033[a]
65 day	−0.8547	−0.8606	−4.5033[a]	−4.7730[a]	−25.3458[a]	−30.6583[a]	−231.6650[a]	−287.8522[a]
130 day	−1.8528[a]	−1.8454[a]	−6.1022[a]	−6.8558[a]	−39.3470[a]	−49.3446[a]	−370.8696[a]	−473.4714[a]

Notes: Commissions are 1.6¢/bu. and liquidity costs are 0.54189¢/bu. for Kansas City and 0.26164¢/bu. for Chicago. KC = Kansas City; Ch = Chicago.
[a]Denotes that producers would have hedged.

use Kansas City exclusively. The low liquidity cost results are presented in Table VIII.

The utility values for commercial firms hedging with hedge ratios that allow for transactions costs and under high liquidity costs are presented in Table IX. Since commissions costs for commercial hedgers are much less than for producers, commercial hedgers will use Chicago slightly more. Under conditions where commercial firms would hedge they would choose Kansas City in all but six instances. These instances and the actual differences in utility are

Risk aversion level < 0.001, and three and six month hedges,

Risk aversion level < 0.010, and one week, two week, and one month hedges

Risk aversion level < 0.100, and one day hedge period

The results under low liquidity cost conditions are presented in Table X. Like the producer results, under low liquidity costs, commercial firms will use Kansas City exclusively. The differences are slightly larger for commercial firms but still small compared to the actual utility values. For the most part, Kansas City is still the best choice.

CONCLUSIONS

This research determines if and when hedgers should use the Chicago Board of Trade to hedge hard red winter wheat. The expectation is that hedgers might be better off hedging with Chicago because utility could be better maximized due to lower liquidity costs at Chicago. However, the effectiveness of the cross hedge must be considered also.

The results indicate that under almost all circumstances a producer who hedges will maximize utility by choosing Kansas City. Small off-floor hedgers with commissions costs of 1.6¢/bu. are high enough to render insignificant even the largest difference in liquidity cost of 0.28¢/bu. found by Thompson et al. (1993). Producers under the high liquidity cost differences would choose Chicago if they are slightly risk averse (level of 0.001) and for a hedge period of six months, and if they are risk averse (level of 0.01) and for a hedge period of one month. Further, this study shows that producers will actually prefer the cash market to a hedge unless very risk averse or when hedging over a period of one month or more. Under the low liquidity cost difference, producers would never choose Chicago when hedging. Also, for the type of hedging by most producers, the liquidity costs should be small because they use heavily traded contracts such as July.

TABLE VIII

Utility Function Values for Producers with Four Levels of Risk Aversion Hedging with Hedge Ratios Allowing for Transactions Costs and under Low Liquidity Cost Conditions

	Risk Aversion Levels							
	0.001		0.01		0.1		1	
Hedge Period	KC	Ch	KC	Ch	KC	Ch	KC	Ch
1 day	−0.0094	−0.0094	−0.0939	−0.0939	−0.9392	−0.9389	−3.6082[a]	−4.6302[a]
5 day	−0.0465	−0.0466	−0.4651	−0.4657	−2.6844[a]	−3.0693[a]	−12.0360[a]	−18.9463[a]
10 day	−0.0925	−0.0927	−0.9252	−0.9272	−4.0327[a]	−5.0688[a]	−24.5323[a]	−37.8668[a]
21 day	−0.2099	−0.2106	−1.8863[a]	−1.9643[a]	−7.7503[a]	−10.0884[a]	−61.1591[a]	−86.5950[a]
65 day	−0.8547	−0.8606	−4.2422[a]	−4.7643[a]	−25.0330[a]	−30.6479[a]	−231.3470[a]	−287.8417[a]
130 day	−1.7771[a]	−1.8428[a]	−5.7991[a]	−6.8455[a]	−39.0211[a]	−49.3335[a]	−370.5415[a]	−473.4603[a]

Notes: Commissions are 1.6¢/bu. and liquidity costs are 0.26308¢/bu. for Kansas City and 0.25232¢/bu. for Chicago. KC = Kansas City; Ch = Chicago.
[a]Denotes that producers would have hedged.

TABLE IX

Utility Function Values for Commercial Firms Four Levels of Risk Aversion Hedging with Hedge Ratios Allowing for Transactions Costs and under High Liquidity Cost Conditions

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	−0.0094	−0.0094	−0.0939	−0.0939	−0.7376[a]	−0.6259[a]	−2.5546[a]	−3.5895[a]
5 day	−0.0465	−0.0466	−0.4651	−0.4247[a]	−1.7215[a]	−2.0963[a]	−10.8782[a]	−17.8044[a]
10 day	−0.0925	−0.0927	−0.7681[a]	−0.6710[a]	−2.9804[a]	−3.9949[a]	−23.3816[a]	−36.7041[a]
21 day	−0.2099	−0.2106	−1.2334[a]	−1.2118[a]	−6.6483[a]	−8.8849[a]	−60.0122[a]	−85.3464[a]
65 day	−0.7856[a]	−0.6795[a]	−3.0902[a]	−3.3456[a]	−23.7442[a]	−29.0728[a]	−230.0445[a]	−286.2509[a]
130 day	−1.1006[a]	−0.9519[a]	−4.5219[a]	−5.2364[a]	−37.6838[a]	−47.6526[a]	−369.1982[a]	−471.7722[a]

Notes: Commissions are 0.18¢/bu. and liquidity costs are 0.54189¢/bu. for Kansas City and 0.26164¢/bu. for Chicago. KC = Kansas City; Ch = Chicago.
[a]Denotes that commercial firms would have hedged.

TABLE X

Utility Function Values for Commercial Firms with Four Levels of Risk Aversion Hedging with Hedge Ratios Allowing for Transactions Costs and under Low Liquidity Cost Conditions

	Risk Aversion Levels							
	0.001		*0.01*		*0.1*		*1*	
Hedge Period	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*	*KC*	*Ch*
1 day	−0.0094	−0.0094	−0.0939	−0.0939	−0.5657[a]	−0.6206[a]	−2.2838[a]	3.5822[a]
5 day	−0.0465	−0.0466	−0.4152[a]	−0.4217[a]	−1.4571[a]	−2.0891[a]	−10.5924[a]	−17.7967[a]
10 day	−0.0925	−0.0927	−0.6047[a]	−0.6657[a]	−2.7086[a]	−3.9874[a]	−23.0990[a]	−36.6963[a]
21 day	−0.2099	−0.2106	−1.0069[a]	−1.2048[a]	−6.3724[a]	−8.8767[a]	−59.7314[a]	−85.3381[a]
65 day	−0.6344[a]	−0.6734[a]	−2.7884[a]	−3.3355[a]	−23.4237[a]	−29.0623[a]	−229.7261[a]	−286.2404[a]
130 day	−0.8457[a]	−0.9427[a]	−4.2009[a]	−5.2254[a]	−37.3562[a]	−47.6415[a]	−368.8699[a]	−471.7610[a]

Notes: Commissions are 0.18¢/bu. and liquidity costs are 0.26308¢/bu. for Kansas City and 0.25232¢/bu. for Chicago. KC = Kansas City; Ch = Chicago.
[a]Denotes that commercial firms would have hedged.

The results are almost the same for commercial sized hedgers as for producers. Commercial firms will use Chicago only under slight risk aversion or for short hedge periods. Commercial firms will use Chicago more because their commissions costs are assumed to be much lower (0.18¢/bu.), which makes the liquidity cost differences between the exchanges relatively more important. As with producers, the results show that commercial firms have to be moderately to strongly risk averse before they will prefer a hedge over the cash market for short time horizons. For longer hedge periods (three and six months), commercial firms must be slightly risk averse to prefer a hedge over the cash market.

Thompson et al. (1993) concluded that commercial firms, such as millers, may prefer a hedge in Chicago over Kansas City. This study finds, however, that producers and commercial firms will rarely choose Chicago, and that the gains in utility from choosing Chicago are very small. The results of this study indicate that the liquidity cost differences between Kansas City and Chicago are small and that hedgers will better maximize utility by using Kansas City due to better price protection. Note that the high liquidity cost difference found by Thompson et al. (1993) occurs in the September contract observed in February, which is not likely to be relevant for hedgers. Therefore, hedgers of hard red winter wheat should continue to use the Kansas City contract.

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