The Value of Deregulating Over-The-Counter Options

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and

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Abstract:

Hedgers located far from organized commodity exchanges suffer the mismatch between their local prices and exchange prices. Futures and options traded on the exchange may still be valuable to distant hedgers but only to the extent that basis risk is small. Forward contracting allows hedgers to manage risk using a local delivery price, but the CFTC has long banned the sale off-exchange options, limiting the opportunities available to hedgers. Recently, Agricultural Trade Options (ATOs) have been introduced as over-the-counter option products designed specifically for hedgers. To date, ATOs have found little interest from potential sellers, but the potential demand for these options may be substantial. This paper describes and quantifies the demand for corn ATOs by dairy farms in Southeastern Pennsylvania and estimates the value these farms might place on options contracts offered locally.

Keywords: Agricultural Trade Options, corn prices, hedging, over-the-counter options

Introduction

Futures, options, and forward contracts are the traditional risk management tools for controlling price risk in agriculture. Futures eliminate up-side and down-side risk simultaneously, while options eliminate down-side risk without eliminating up-side potential. Futures and options are highly liquid but are traded only on organized exchanges, resulting in basis risk that can be considerable for many hedgers. Forward contracts can be tailored to local conditions, but their liquidity is typically low or nonexistent. As a result, hedgers must choose among three risk management instruments or "goods" with different combinations of desirable attributes: liquidity, up-side potential, and basis risk.

If it were possible to provide hedgers with another alternative, their welfare might be increased. One such alternative is over-the-counter options. Over-the-counter options would provide a risk management tool with the up-side potential of options but with little or no basis risk. The result is to combine the positive aspects of options and forward contracts into a new product for hedgers.

For many years, the CFTC has banned forward contracts that involve option-like payoffs. The potential for misuse has seemed too great for option-like contracts to be allowed outside of the heavily regulated exchanges. Only recently has serious pressure been mounting to deregulate and allow off-exchange options contracts to be sold to agricultural producers and agribusinesses. Their notable proponents include U. S. Senator Pat Roberts of Kansas (Associated Press, 1998), U. S. Senator Richard Lugar of Indiana, Then-Treasury Secretary Lawrence Summers, and Federal Reserve Bank Chairman Alan Greenspan (Associated Press, 2000).

Political pressure has resulted in a new product called Agricultural Trade Options (ATOs). ATOs are essentially options contracts sold by licensed merchants, such as banks and grain elevators, to hedgers who negotiate terms directly with the merchant. ATOs provide the up-side potential of options contracts without significant basis risk. Another advantage of ATOs is that they do not mandate fixed contract sizes, so small farms and businesses can tailor ATOs to their individual needs.

ATOs have been available (in theory) since the CFTC began its three-year pilot program in June 1998, but the number of merchants licensed to trade them is negligible. One possible reason for the dearth of merchants is that ATOs are still highly regulated. Capitalization requirements and other regulatory requirements have been dropped or substantially reduced in recent months to help promote the use of ATOs. Pressure to deregulate ATOs further has resulted in a continuing series of revisions to the program since its inception. The latest changes allow regulatory exemptions for highly capitalized firms and are described in the *Federal Register* for December 13, 2000.

It is not clear yet what the eventual response will be to deregulating over-the-counter options, such as ATOs, but the tools exist for a serious analysis of the potential benefits from doing so. Frechette (2000) developed a methodology for computing the value of hedging opportunities using futures and forward contracts, and Frechette (2001) incorporated options using Lapan, Moschini, and Hanson's (1991) framework. The next step is to apply this new methodology to the broader issue of deregulating over-the-counter options trading. We use corn inputs purchased by Pennsylvania dairy farms as our example, which allows us to treat the quantity hedged as predetermined.

Optimal Hedging Model

The model involves four risk management tools: Chicago futures contracts, Chicago options contracts, Pennsylvania forward contracts, and Pennsylvania options contracts. The local contracts are assumed to have no basis risk, although there may be a small basis risk in practice. Each tool is used within a risk management strategy to some extent, or possibly to no extent. There are four hedge ratios, each of which is a choice variable. The hedger chooses a value for each hedge ratio to maximize expected utility. The hedger's surplus is the hedger's willingness to pay for the opportunity to trade over-the-counter (local) options contracts, such as ATOs. The hedger's surplus, therefore, can be interpreted as the value that would be gained by the hedger if over-the-counter options were made available.

The hedger is assumed to maximize expected utility of profits by choosing four hedge ratios. x_{CH} is the portion of output hedged in the futures market in Chicago, x_{PA} is the portion hedged using forward contracts in Pennsylvania, z_{CH} is the portion of output hedged in the options market in Chicago, and z_{PA} is the portion hedged using over-the-counter options in Pennsylvania. Futures and forward contracting are accomplished using long futures, so an input hedger will typically have positive x_i. Options contracting is accomplished using long calls so an output hedger will typically have positive z_i. Only one option strike price, k_i, is considered per market. There are two periods, with the current futures or forward price denoted f_i and the terminal futures or spot price denoted p_i when realized, or $\tilde{p}_i$ when treated as a random variable. The options premium is denoted r_i, and the terminal option value is denoted v_i or $\tilde{v}_i$ when treated as a random variable: $v_i = 0$ if $\tilde{p}_i >= k_i$, and $v_i = k_i - p_i$ if $p_i < k_i$. The two-period assumption is not restrictive because ATOs are not fungible.

The hedger faces additional costs beyond f_i and r_i, the unbiased expectations of $\tilde{p}_i$ and $\tilde{v}_i$. Call these extra costs t_{xi} per unit hedged with futures and t_{zi} per unit hedged with options. Utility is a function of profits, $\tilde{p}$, treated as a random variable:

$$
\begin{aligned}
(1) \qquad \tilde{p} = -\tilde{p}_{PA} + (\tilde{p}_{CH} - f_{CH})x_{CH} + (\tilde{v}_{CH} - r_{CH})z_{CH} + (\tilde{p}_{PA} - f_{PA})x_{PA} + (\tilde{v}_{PA} - r_{PA})z_{PA} \\
- t_{xCH}|x_{CH}| - t_{zCH}|z_{CH}| - t_{xPA}|x_{PA}| - t_{zPA}|z_{PA}| - c
\end{aligned}
$$

where c represents other net costs, per unit. All money values are adjusted by appropriate discount rates, suitably defined. The use of unit values does not sacrifice any generality in our case because the quantity hedged is assumed to be predetermined.

The utility function $u(.)$ is assumed to be continuous, monotonic increasing, and strictly concave: $u' > 0$ and $u'' < 0$. The hedger's optimization problem is

$$(2) \qquad Max_{\{x_i, z_i\}} E[u(\tilde{p})],$$

with E representing the expectations operator over all sources of uncertainty. The first order conditions are

$$(3a) \qquad E[u'(\tilde{p})(f_i - \tilde{p}_i - t_{xi}\,\mathrm{sgn}(x_i))] = 0 \text{, and}$$

$$(3b) \qquad E[u'(\tilde{p})(r_i - \tilde{v}_i - t_{zi}\,\mathrm{sgn}(z_i))] = 0 .$$

The second order conditions are satisfied because of the conditions imposed on $u(.)$.

Marginal transaction costs are the prices faced by the hedger. These prices include broker's fees, opportunity costs, and learning costs associated with futures and options hedging. They also include the hidden costs of illiquidity. These costs are certain to be higher in the local over-the-counter market than they will be in the centralized exchange. Therefore, basis risk can be reduced or eliminated only at an extra cost. There will be a substitution effect between exchange-traded and over-the-counter hedging instruments, leading to four positive hedge ratios in the most general case.

This approach allows us to compute the value of deregulating over-the-counter options trading using the hedger's surplus, as in Frechette (2000). If

(4) $$u^* = Max_{\{x_i, z_i\}} E\left[u(\tilde{p})\right],$$

then the hedger's surplus for over-the-counter options is e_{zPA}, which is defined implicitly by

(5) $$u^* = Max_{\{x_i, z_{CH} | z_{PA}=0\}} Eu\left(\tilde{p} + e_{aPA}\right).$$

The value of e_{zPA} will depend on the t_{xi}, t_{zi}, and the other parameters.

Empirical Application

This section applies the model from the previous section to the hedging decision for dairy producers in Southeastern Pennsylvania. The dairy producers hedge their purchases of corn using long futures and long call options. The negative exponential (constant absolute risk aversion) utility function is assumed, which results in a convenient way to compare results for different levels of risk aversion. Basis is specified as local price minus Chicago price. Expected utility is computed as a numerical integral over price and basis risk, which were modeled using a bivariate normal distribution. Price means were modeled using an autoregressive specification, as in Frechette (2000, 2001). Expected utility was then maximized numerically with respect to the four choice variables: x_i and z_i. The integrals were calculated by the trapezoidal method, and optimization was achieved by the simplex method.

Data

The data set is the same one used by Frechette (2000, 2001) and consists of (i) weekly corn cash prices collected by the Pennsylvania Department of Agriculture (PDA); and (ii) the nearby corn futures price in Chicago. Local cash prices were collected through surveys and phone calls for five regions: Southeastern, Central, South Central, Western, and the Lehigh Valley. This study considered only the Southeastern region. The prices were collected and reported by PDA on Monday mornings before the market opened and the futures price that corresponds most closely is the previous Friday's settlement price for the nearby futures contract. If the Chicago Board of Trade was closed due to a Monday holiday, then the closest day was used, matching the information sets as closely as possible in each case. All prices are reported in cents per bushel, for the years 1997-1998.

Table 1 displays summary statistics and the covariance structure used in this analysis. The table shows that the covariances are negative and relatively large in magnitude between the Chicago price and each regional basis, indicating that the hedge ratios may be quite low in these regions. These statistics represent actual results for the sample period, and therefore the results represent optimal *ex post* behavior in the sense that hedgers are assumed to have known the covariance matrix before the sample period began. Individual hedgers' expectations will depend on the sample period and available information.

Results

Figure 1 illustrates a typical demand curve for over-the-counter options using a specific combination of hedging costs for x_i and z_{CH}. In the figure, $t_{xPA} = 2.00$, $t_{xCH} = 1.50$, and $t_{zCH} = 0.75$, all measured in cents per bushel, and the coefficient of absolute risk aversion ($CARA$) is 2.0. The figure shows that a high marginal transaction cost of over-the-counter options hedging will drive hedgers out of the market. The critical transaction cost is approximately 1.20 cents per bushel. On the other hand, if over-the-counter options were costless, the optimal hedge ratio would rise to approximately 1.06.

Table 2 shows the optimal hedge ratios for all four hedging instruments under different combinations of marginal transaction costs and different $CARA$ values. Some results in the table are straightforward and act as expected. For example, when all marginal transaction costs are zero (Case 1), hedging is dominated by local forward contracts, and risk is completely eliminated at no cost. When costs rise (Cases 2 and 3), the hedge ratios fall. As futures and forward contracts become more expensive than options (Cases 4 and 5), options tend to be chosen in higher proportions. All these results follow from neoclassical demand theory and previous analyses of risk-averse behavior.

More noteworthy are the cases where multiple hedge ratios are positive. For example, in cases 6 and 7, Chicago futures, PA forward contracts, and PA options all exhibit positive hedge ratios for $CARA$ = 2.0 or 0.2. For example, these values are 0.04, 0.76, and 0.22 in Case 7 with $CARA$ = 2. There are several cases in which local options are used together with traditional hedging instruments to form the optimal hedging strategy.

This revelation leads us to ask some natural questions. How much welfare have hedgers been losing due to the ban on over-the-counter options trading? How much might they stand to gain under deregulation? How valuable might ATOs be to hedgers if sufficient numbers of ATO merchants are registered? These questions can be answered by estimating the hedger's surplus for over-the-counter options.

Table 2 also shows the hedger's surplus estimates under various combinations of marginal transaction costs and $CARA$ values. The maximum estimate is 0.904 cents per bushel ($45 per 5000-bushel contract), which occurs when $CARA$ = 0.2 if $t_{xPA} = 2.00$, $t_{xCH} = 1.50$, and $t_{zCH} = 0.75$, and $t_{zPA} = 0$. The minimum is zero, which occurs whenever $z_{PA} = 0$. The value of the opportunity to trade over-the-counter options was less than one cent per bushel for all cases we considered.

This value is subject to a great deal of guesswork because we do not know the true marginal transaction costs involved for specific hedgers. The value will also vary depending on individual hedgers' risk preferences. This estimate is also dependent on the market involved and the type of hedger, which was restricted to corn input hedgers on dairy farms in Southeastern Pennsylvania. The good news is that we can use this number as an indicator of the general magnitude of the value of deregulating over-the-counter options markets, even if the specific numerical result is only applicable to a narrowly defined population of hedgers.

Conclusion

The value of our study lies primarily in the estimation of the value of deregulating over-the-counter options contracts tailored to local conditions. ATOs are such a product, and so we have calculated an estimate of the value of ATOs. We apply the Frechette (2000, 2001) methodology and treat ATOs as a hedging good that exists as part of a demand system for hedging goods. The hedger's surplus is the natural extension of the consumer's surplus from neoclassical demand theory. We calculate the hedger's surplus gained by hedgers when ATOs become available.

Our calculations show that ATOs have relatively small potential value to dairy farmers in Southeastern Pennsylvania. It is reasonable to conclude that other hedgers in other locations would also find ATOs valuable if they were made available. In the end, it may not be possible to induce merchants to supply ATOs, but this study shows that a potential demand side of the market exists for the product. The demand exists, so further efforts may be warranted to refine and revise the requirements for ATO merchants so that more merchants choose to supply them.

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Figure 1. Demand Curve for OTC Corn Calls, Southeastern PA Dairy Farms

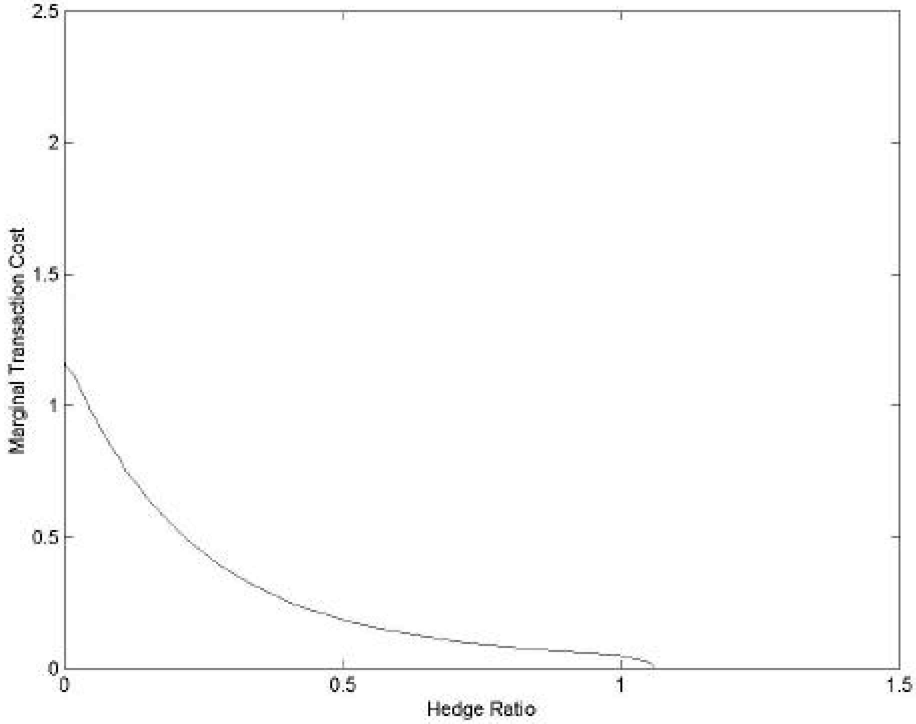

Table 1. Covariance structure of corn prices for Southeastern PA dairy farms in cents/bushel, 1997-1998, 104 observations.

	Mean	Variance	Covariance with Chicago futures price
Local Price	291.40	31.31	38.66
Basis	36.86	14.26	-21.59
Chicago futures price	255.22	60.27	

Table 2. Optimal Hedge Ratios for Southeastern PA Dairy Farms

	Transactions Costs								
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
t_{xCH}	0.00	1.00	2.00	1.00	2.00	1.50	1.50	1.50	1.50
t_{zCH}	0.00	1.00	2.00	0.00	0.00	0.75	0.75	0.75	0.75
t_{xPA}	0.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00
t_{zPA}	0.00	1.00	2.00	0.00	0.00	0.00	0.50	1.00	1.25

Table 2. continued.

Hedge Ratios and Hedger's Surplus

CARA (2.00)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
x_{CH}	0.00	0.01	0.02	0.02	0.13	0.04	0.04	0.04	0.03
z_{CH}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
x_{PA}	1.00	0.97	0.95	0.88	0.00	0.02	0.76	0.89	0.92
z_{PA}	0.00	0.00	0.00	0.14	1.09	1.04	0.21	0.04	0.00
e_{zPA}	0.00	0.00	0.00	0.02	0.26	0.30	0.21	0.00	0.00
CARA (2.00)									
x_{CH}	0.00	0.09	0.19	0.06	0.00	0.00	0.15	0.36	0.34
z_{CH}	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.07
x_{PA}	1.00	0.72	0.45	0.00	0.00	0.00	0.00	0.00	0.20
z_{PA}	0.00	0.00	0.00	1.24	1.26	1.41	0.87	0.36	0.00
e_{zPA}	0.00	0.00	0.00	0.22	0.56	0.90	0.34	0.04	0.00
CARA (0.02)									
x_{CH}	0.00	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.06
z_{CH}	0.00	0.14	0.00	0.87	0.87	0.00	0.62	0.00	0.00
x_{PA}	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00
z_{PA}	0.00	0.00	0.00	0.59	0.63	1.24	0.00	0.72	0.00
e_{zPA}	0.00	0.00	0.00	0.02	0.02	0.23	0.00	0.00	0.00