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# COMMODITY OPTIONS: A NEW MARKET RISK MANAGEMENT TOOL FOR AGRICULTURE

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Options to buy and sell agricultural commodities began trading on the major U.S. commodity exchanges on November 1, 1984. Agricultural options trading had been banned following scandals associated with unregulated trading of options during the early 1930s. Current options trading is highly regulated and closely supervised by the commodity exchanges and the Commodity Futures Trading Commission. Options are traded under a pilot program which limits each major exchange to no more than two commodities. Agricultural options approved for trading include soybeans, wheat, live cattle and cotton. Corn and hogs are expected to be added during 1985.

Commodity options offer agricultural producers a new tool for market risk management. Options seem likely to find favor with those who need some of the downside risk protection of futures markets without eliminating the upside profit potential of cash markets. However, options are not clearly superior to either cash or futures but rather add another alternative to the variety of marketing tools available to producers. Producers will need a clear understanding of the unique risk characteristics of options if they are to use options wisely in their overall risk management strategies.

## Options Markets, Futures Markets and Cash Markets

Buyers of commodity options obtain a right, but not an obligation, to buy or sell the underlying commodity futures contract at a specified price. By contrast, those who hold commodity futures positions have both rights and obligations to deliver or take delivery of the underlying commodity at specified prices. Those who have made no market commitment (i.e. that hold neither futures nor options positions) have neither rights nor obligations to buy or sell at specified prices.

Risks are associated with commitments. Opportunities for profits likewise are associated with commitments. Those who have commodities in inventory or are committed to production have commitments and corresponding risks of losses or other unfavorable outcomes. However, those with commitments also have claim to any benefits from profitable or favorable outcomes. To hedge means to offset some or all of an existing risk. Those who hedge in futures make futures commitments with risks characteristics offsetting existing to risks associated with their inventory or production commitments.

However, positions which offset risk also offset profit potential.

Options currently traded are options to buy or sell futures contracts. An option to sell futures gives the holder the right to make an offsetting commitment without actually making the commitment. Thus, risk characteristics of options are related directly to the downside risk associated with a position in the underlying futures contract. Holders of options have no obligation, however, to take a futures position that would offset a profitable cash market outcome. They may choose to make no market commitment and thus retain all the profit potential associated with their production or inventory commitments. So, the profit characteristics of options relate to the upside potential of cash market outcomes with no prior price commitments.

An option position clearly would be preferable to either a futures commitment or uncommitted cash price position, other things equal. Options have the downside protection of futures and the upside potential of cash markets. An options position represents an asset to the buyer or holder of the option. But the option seller or writer has an obligation to buy or sell at a specified price with no right to buy or sell at that price. These obligations without rights represent risks of loss without any corresponding potential for profit. Thus, an options position represents a liability to the option writer or seller. Options sellers or writers would not take on the liability of an option position without an added economic incentive to do so. This economic incentive takes the form of an "options premium".

An options premium is its market price. Market prices, in general, equate marginal benefits to sellers with marginal costs of sellers. Thus, options premiums reflect values or options positions to both buyers and sellers. Once premiums are taken into consideration, options positions are not clearly preferable to either futures commitments or uncommitted cash positions.

The net value of options positions must be adjusted to reflect costs or returns associated with options premiums. For example, higher premiums mean higher costs and less net value of options positions to potential buyers or holders of options. But, higher premiums provide greater positive incentives for sellers or writers of options. Option premiums will adjust to equate the supply of and demand for options positions

among buyers and sellers. Option premiums must be acceptable to both buyers and sellers. Thus, premiums erase any obvious benefits associated with either holding or writing options at any given premium level.

Option premiums are made up of intrinsic value and time value. Intrinsic value reflects any difference between the option strike price (i.e. the specified buying or selling price) and the current price of underlying futures. Any premium amount over and above intrinsic value is called time value. Time value reflects the value of a right without an obligation and the corresponding cost of an obligation without a right. The term "time value" stems from the fact that such rights and obligations have potential benefits and costs only if they exist over some period of time. The greater the time duration of such rights and obligations, the greater their potential benefits or costs.

An option that is to be exercised immediately will have no time value. Such an option has no greater value than that of the underlying futures. However, an option to buy or sell at some future date has time value, even if it has a negative intrinsic value. Time value in such cases reflect the possibility that such options may have intrinsic value sometime before expiration. Time value is determined by expectations to those buying and selling options, their preceptions of potential risks and profits associated with underlying commodity market positions.

#### Options Evaluations

When evaluated after expiration, options outcomes will rank no better than second best to alternative futures or cash market outcomes for options holders. Time related options premiums represent a cost to buyers or holders of options. Option holders will find it beneficial to either exercise or offset options positions whenever cash market prices at delivery are less than the effective minimum price represented by their option. Price outcomes in such markets will be identical for hedgers and holders of options assuming equal initial futures prices and option strike prices. However, options holders will have the added cost of the premium they paid for the right to buy or sell at the specified price without the obligation. Thus, options will be second best to futures positions in market situations where options holders find it to their advantage to exercise or offset options positions.

Options holders will find it to their advantage to allow their options to expire whenever cash market prices at delivery are above their effective minimum options price. In such cases the option will be worthless at time of delivery. Thus, options holders will be better off to sell their commodity in the cash markets realizing the benefits of higher cash market prices. But, options holders in these cases also will have paid premiums for

options that are now worthless. Thus, their net outcomes will be second best to those who made no prior market commitment and simply sold in the cash market.

Options outcomes may be inferior to both other alternatives. Options premium losses may more than offset any advantage gained by exercising or offsetting an option position, even in cases where options have some positive value at time of delivery. Likewise, premium costs may drop net returns below alternative futures outcomes even in cases where options positions are worthless at time of delivery. But at best, an option position will be no better than second best in comparison with cash of futures positions, when evaluated after expiration.

However, risk is defined as the probability or chance of a loss or otherwise unfavorable outcome. Profit potential likewise is a future prospect even though profit may be more typically viewed in a realized profit context. Decisions which have profit potential also imply risks. Thus, such decisions must be viewed in a future expectations context.

Agricultural producers generally take risks of loss in pursuit of potential profits. They do not know with certainty whether the outcome of that pursuit will be a profit or a loss. Producers take risks associated with unfavorable yield and/or cost of production outcomes. Those holding inventories take risks of loss or deterioration of quality of stored commodities. Producers also take risks associated with unfavorable price outcomes. Producers' profits or losses depend on their ability to make decisions in an environment of risks.

Thus, the relevant context for decision making is future expectations. Decisions which have potential for added profits must be made without certain knowledge of their ultimate outcomes. Decisions regarding commodity options must likewise be evaluated in terms of expectations. Upon expiration, options rank no better than second in comparisons with alternative futures or cash market outcomes. However, options may well be preferable to either of the other two basic pricing alternatives in future planning. The key concept in analysis of decision alternatives are profits and risks. The potential for profits must be weighed against the risks of loss. Decision risk analysis is an essential step in profitable decision making.

#### Options Decision Risk Analysis

Objective decision risk analysis requires that prospects for profits be weighed against risks of loss for each logical decision alternative. Possible outcomes for each alternative may be evaluated in terms of probabilities. Thus, a knowledge of probability distributions associated with alternative decision outcomes provides an objective basis for decision risk analysis.

Risks may be defined in terms of probabilities of unfavorable outcomes. Risk may be measured as the probability of loss, probability of failing to cover cash costs, probability of failing to achieve profit objectives, or of failing to cover any other level of economic relevance to a given decision. Probability measures of risks require estimates of expected or mean values as well as variability standard deviations of net revenue distributions. The probability of failing to achieve some critical level depends on the expected or most likely outcome as well as variability of possible outcomes about that expected level.

Comparisons of risks among alternatives are expedited by using standard measures of risks. One such set of standard measures has been termed risk ratings (Ikerd and Anderson). Risk ratings utilize three standardized probabilistic outcomes to represent the total distribution of possible outcomes from a given alternative. The most likely outcome is designated as the "expected" outcome. For symmetrical distributions, the mean, median and modal values are all equal to this expected value. For nonsymmetrical distributions, the expected rating is equivalent to the modal value. In general terms, expected values represent the more likely of all possible outcomes.

"Optimistic" outcomes are defined as favorable outcomes with an estimated one-in-six chance of an outcome at the optimistic level or better. "Pessimistic" outcomes are defined as unfavorable outcomes with an estimated one-in-six chance of outcome at the pessimistic level or worse. The range from "pessimistic" to "optimistic," by definition, has a two-thirds probability of containing the ultimate outcome. The pessimistic-optimistic range is equivalent to the average plus or minus one standard deviation for "normally" distributed outcomes. In general terms, optimistic and pessimistic values allow simple, yet meaningful, comparisons of risks associated with decision alternatives. Such an approach can be used to evaluate the risk characteristics of commodity options in contrast with futures markets and cash market alternatives.

Options premiums reduce the most likely or expected value of an options position in relation to expected values of the underlying futures or cash market alternatives. The expected outcome from a decision to take an options position will be equal to the higher of either the expected cash or underlying futures outcome minus the option premium. Thus, any advantage of options over the other two alternatives must come from aspects of options outcome distributions other than options expected values.

Options outcome distributions have downside price variability equivalent to downside variability of futures positions, since options represent options on futures contracts. Downside variability associated with futures positions are equivalent to basis error variability. Basis error results from

inability to accurately forecast relevant futures-cash market price differences. But, basis forecasts are typically more accurate than are actual price forecasts, when both estimates are made well in advance of delivery. Differences between cash and futures market prices are more predictable than are price levels of either market. Options will be worthless and will be allowed to expire whenever cash prices at delivery are above the options strike price. This gives options positions the same upside variance as cash markets for cash price outcomes above options strike prices.

In summary, a distribution of price outcomes from an options position will have a lower "most likely" value than either of the other two alternatives, but will have the smaller downside variability of a futures position and the larger upside variability of the cash market. The lower expected value of the options distribution is offset by a positive or upward skew of the distribution, thus tending to equalize the overall value of an options position relative to the other two alternatives.

There is no way of knowing in advance whether a given market outcome will be near its expected value, or near the pessimistic end or near the optimistic end of the alternative distributions of possible outcomes. Either the cash market or futures would be preferable to options for outcomes in the expected value range. Futures would be preferred to options for pessimistic outcomes and the cash market would be more favorable for optimistic outcomes. But options might well be preferred to either of the other two alternatives in realistic situations where the decision maker does not know whether ultimate outcomes in the future will be nearer expected, optimistic or pessimistic levels.

#### Risk Rating Options, Futures and Cash Market Outcomes

Risk rating concepts may be used to illustrate the alternative risk characteristics of options, futures and cash market outcome distributions. Data are available providing realistic estimates of error distributions for forecasts of cash market prices and futures market bases. A 1981 study reported in the American Journal of Agricultural Economics compared forecast accuracy of the major private econometric forecasting firms with forecasts of the U.S. Department of Agriculture and with the futures market as a forecast of later cash prices (Just and Rausser). The results were reported in terms of errors of forecasts over the three year data period. Thus, a price forecast plus or minus this error term will be equivalent to a pessimistic-optimistic risk rated range with the forecasted value equivalent to the expected risk rating. Errors are called risk factors in risk rating terminology. Percentage risk factors are errors expressed as a percentage of forecasted values.

General results of the 1981 study for forecasts made 4 to 6 months in advance of

delivery dates are shown in table 1. The study indicated that no one forecasting entity was consistently superior to any other. But more importantly, the study provides general indicators of the magnitude of risk factors associated with competent price forecasts. The general range of percentage risk factors for fed cattle forecasts was 12 to 14 percent. Thus, a forecast of \$75 for fed cattle would have an optimistic price level of \$84 [ $\$75 + 0.12(\$75)$ ] and a pessimistic price level of \$66 [ $\$75 - 0.12(\$75)$ ]. The probability of this range including the actual price is approximately two-thirds, with a one-in-six chance of the optimistic level being too low and a one-in-six chance of the pessimistic price being too high. Even larger risk factors were found for many other commodities, as indicated in table 1.

The Just and Rausser study indicated also that futures markets are about as accurate as other sources of outlook information. Table 2 shows results for futures markets in comparison with other sources for one, two and three quarter forecasts of fed cattle prices. All forecast errors tend to be larger for more distant forecasts. Risk factors for futures were generally somewhere near the mid-point between the best and worst of the forecasts of the econometric firms. However, futures tend to be relatively more accurate for forecasts of nearby markets and tended to be less accurate relative to other sources for more deferred delivery dates. Later studies in general have confirmed the results of the Just and Rausser study. Results of an Oklahoma study, shown also in table 2, indicated that extension economists at state universities forecasted at least as accurately as the private econometric forecasts (Ikerd and Darnell). This study confirmed the accuracy of futures markets as a source of price outlook information for cattle producers. Risk factors were smaller for current quarter forecasts. But for 4 to 6 month forecasts, percentage risk factors for cattle markets were still in the 12 to 14 percent range.

Pricing errors for hedged commodities are determined by forecast errors for cash-futures basis relationships rather than actual price forecast errors. Once a hedge is placed, the net price outcome will differ from that expected only to the extent that the actual basis differs from the expected basis. Several studies have confirmed that bases are more predictable than are actual later cash market prices. A set of such results is shown in table 3. Errors of basis estimates are expressed as percentages of futures price levels to make them consistent with similar cash market price forecast errors. In general basis errors for fed cattle at Oklahoma markets were found to be only 2 to 4 percent compared with price forecast errors of 10 to 12 percent for the same markets for the same time period (Ikerd). Oklahoma basis estimates for wheat likewise were only one-fourth to one-fifth as large as wheat price forecast errors. Basis errors may differ widely for different commodities for different regions of

the country. Those in table 3 are shown for illustration purposes only.

Choices among the three alternatives of cash markets, futures contracts and options are never clear cut. The optimum choice will depend on: a) the individual's willingness and ability to bear the risks of outcomes below various critical price levels, b) the desire or necessity for possible prices above critical levels, c) expected outcomes from each of the three alternatives, and d) variability or risk factors associated with cash price and basis forecasts.

#### Risk Implications of Alternative Options Strike Prices

Options with several alternative strike prices are available for any given underlying futures contract at any given time. Each strike price represents a different distribution of potential options price outcomes. Options with higher strike prices have higher options premiums because of their greater intrinsic value in relation to the common underlying futures price. Options with lower strike prices have less intrinsic value and those below current prices of the underlying futures price have no intrinsic value. Options with strike prices above the price of the underlying futures contract are said to be in-the-money, those with strike prices below the underlying futures are called out-of-the-money.

At any given point in time, options with strike prices nearer current futures price levels have greater time value and thus have greater time value related premiums. Options that are deep in-the-money have less time value because there is less chance that cash prices at delivery will exceed strike prices and thus have less upside price potential than those less deep in-the-money. Options that are far out-of-the-money have less time value because there is less chance that they will move into the money before delivery and thus provide less downside risk protection than those less out-of-the-money. In general, strike prices nearer the price of the underlying futures have more upside potential with less downside risk for options holders and have more risk with less profit potential for options sellers or writers. Consequently, such options have greater time related market values or time premiums.

Risk implications of alternative strike prices can relate conceptually to the at-the-money strike price. The total premium for options at-the-money is a time value premium. Thus, the optimistic options outcome is reduced by the same amount as the expected or most likely outcome and the time premium will be near its maximum value. For options in general, the optimistic options value will be less than the optimistic cash market value by the amount of the total premium including both intrinsic and time value. But, only the time related premium need be subtracted from the underlying futures price to derive an expected options value for options that are in-the-money. Smaller time values will exist

for options more deep-in-the-money. Thus, options that are more deep in-the-money will have risk distributions more like futures risk distributions. Those deep-in-the money will have lower optimistic price outcomes, higher expected values and consequently higher pessimistic outcome levels, other things equal.

Options that are out-of-the-money have expected values related to expected cash market outcomes of current futures prices rather than options strike prices, assuming that futures are a reasonable forecast of later cash market outcomes. However, pessimistic options outcomes are derived from the lower options strike prices by subtracting options premiums and basis risk factors. Options premiums will consist of all time value and will be smaller for those options farther out-of-the-money. Smaller premiums will leave more upside price potential at the optimistic level since smaller total premiums will be subtracted from optimistic cash market outcome levels. Thus options farther out-of-the-money will have higher optimistic levels, lower pessimistic levels and overall risk distributions more like cash markets and less like futures market.

#### Overall Options Risk Management Implications

Options provide a new risk management tool of potential value to those producing or otherwise dealing with agricultural commodities. Those with commodity inventories or production commitments are taking the risks associated with those commitments with expectations of earning profits. Those commitments eventually will be translated into realized profits or losses through sale of the commodities or through offsetting pricing commitments. Commodity futures markets have provided those with commodity commitments an alternative to cash market sales. Futures hedging provides a method for offsetting risk associated with inventory or production commitments prior to delivery. However, futures positions offset potential profits as well as risks. Futures positions represent binding obligations that must be fulfilled regardless of later market developments.

Commodity options provide another risk management alternative. Options holders have the right to offset risks, without the obligations. Options currently traded are options on futures. Thus, options holders have the right to take a given offsetting futures position but are not obligated to take the position unless it is to their advantage to do so. Thus, options have some of the risk offsetting characteristics of the underlying futures position but have some of the profit potential of uncommitted cash market positions. The obvious advantage of upside profit potential without downside risks are partially negated by options premiums. Options premiums are prices that options holders must pay options writers to acquire rights to price protection without corresponding obligations.

Risk associated with a given marketing alternative is a function of the expected

price outcome and the distribution of possible outcomes about that expected level. Cash market distributions reflect the ability of decision makers to accurately forecast later price outcomes. Futures market outcome distributions reflect the ability of decision makers to accurately forecast cash-futures bases. In general, standard measures of forecast error indicate basis risk factors only one-fourth to one-fifth as great as cash market risk factors. Thus certainty of outcome can be significantly increased by hedging or forward pricing with futures.

Options outcome distributions have expected values less than expected futures or cash market outcomes because of the premium costs of options. The downside risk factors for options are identical to those of futures, since an option represents a right to a futures position. However, the lower expected (most likely) outcome for options results in greater downside risk for options than for futures. But, options still have less downside risk than cash markets. Options upside risk factors are identical to those for cash markets. Options premiums reduce upside profit potential relative to corresponding cash positions. But, options still have more upside potential than corresponding futures positions.

Alternative options strike prices result in different outcome distributions and consequently different market risks characteristics. Options strike prices near the price of the underlying futures price will differ more from either cash or futures alternatives with less downside risk than cash markets and more upside potential than futures. Options that are deep in-the-money will have risk characteristics more like futures markets with a minimum of downside risk but with only limited upside price potential. Options that are far out-of-the-money will have risk characteristics more like cash markets, with limited downside price protection but with most of the upside potential of cash markets.

Marketing decisions are never easy. Any market situation with a potential for profits has a corresponding risk of loss. Commodity options do not make marketing decisions easier. In fact the addition of options as another marketing alternative may make marketing decisions more complex. Options provide no more assurance of a profitable outcome than does either futures markets or cash market outlook. However, options do bridge the risk management gap between cash markets and futures. Options provide an opportunity to take varying degrees of downside risk with varying degrees of upside price potential.

Those who profit most from options will be those who understand basic risk management concepts and how those concepts relate to their particular operations. Options are simply another tool. The value of options, like any other tool, relates more to the skill of the user than any attribute inherent in the tool. Greater understanding of the risk characteristics of options become translated

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Source	Fed Cattle	Commodity			
		Wheat	Soy Beans percent	Cotton	Hogs
U.S. Dept. of Agri.	18-19	19-20	17-18	---	21-22
Chase Econ- ometrics	12-13	11-12	18-19	19-20	17-18
Data Resources	12-13	22-23	21-22	15-16	14-15
Doanes Agri. Services	12-13	15-16	17-18	15-16	18-19
Wharton Forecasting	13-14	12-13	23-24	18-19	17-18
Just and Rausser, cultural Economics.	American Journal of Agri- 1981.				

Commodity	Percent Variability
Slaughter steers and heifers	
Futures delivery months	2
Non delivery months	4
Feeder steers -	
med #1, 600-700 lbs	
Spring delivery months	3
Fall delivery months	4
Non delivery month	5
Wheat	
July contract - June delivery	3
July contract - July delivery	5
Dec. contract - Nov. delivery	3
Dec. contract - Dec. delivery	4

Just, Richard and Gordon Rausser, "Commodity Price Forecasting With Large-Scale Econometric Models and the Futures Market," *American Journal of Agricultural Economics*, 63:2, May 1981.

Outlook Source	Current Quarter	One Quarter	Two Quarter	Three Quarter
	- - - -	- - - -	- percent - - - -	- - - -
1979 California Study <sup>a</sup>				
Major Private Firms	-----	10-13	12-19	13-25
Futures Market	-----	10	14	18
1980 Oklahoma Study <sup>b</sup>				
University Economists	5-6	11-13	12-15	11-13
U.S. Dept. of Agri.	5	11	18	-----
Oklahoma State University	5	11	12	11
Futures (Oklahoma State University)	5	11	14	17
a. Just and Rausser, American Agricultural Economics Association, 1981.				
b. Ikerd and Darnell, Oklahoma State University Extension Facts, 1981.				