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Chicago Board of Trade Crop Yield Insurance Contracts

David D. Lehman*

As Elizabeth Tashjian recently pointed out, designing successful futures contracts is no easy task. Since October 1992, the Chicago Board of Trade (CBOT®) has launched new contracts on diammonium phosphate, anhydrous ammonia, barge freight rates and edible oils, all of which have failed to achieve 5,000 contracts in open interest. While the specific reasons for the failure of these new products are not easy to identify, they likely include poor contract design, incomplete market research, and relatively small and highly concentrated underlying markets.

In an attempt to improve the success rate for new products, the CBOT board of directors adopted a new product development process in September 1994 which gave staff more responsibility for developing new products and placed greater emphasis on product and market research. At the same time, the Exchange's committee system and staff were restructured in an effort to streamline the decision making process. In implementing these changes, the number of exchange committees was reduce from 92 in 1993 to 33 in 1994, and the Economic Analysis & Planning Department, which was previously responsible for product development and contract maintenance, was merged with the Education and Marketing Department. The newly created Market and Product Development Department was given the responsibility to develop new products and maintain existing contracts in addition to carrying out marketing and education programs to support all new and existing products.

The first new agricultural contracts to be designed under the new product development process are the Crop Yield Insurance (CYI) futures and options contracts. This complex, which was approved by the CFTC in February 1995, includes contracts on Iowa Corn, Illinois Soybeans, Kansas Winter Wheat, and North Dakota Spring Wheat state average yields. The Iowa Corn contracts, which were launched on June 2, 1995, will give businesses which depend on crop yields, such as grain elevators, barge lines, feedlots and implement dealers, as well as producers, the ability to hedge risks associated with crop yields. In addition, the CYI contracts will provide crop insurance companies with an alternative source of reinsurance.

The development of the CYI complex at the CBOT will also further test the ability of the private sector to develop market-based risk management tools as an alternative to government price support and subsidy programs. The Options Pilot Program (OPP), authorized in the 1990 Farm Bill, has demonstrated that exchange-traded put options are an effective alternative to deficiency payments and price support loans. With the introduction of the CYI contracts to hedge production risk, it will be determined if futures and options contracts on crop yields can be used to manage production risk in the same manner as Federal Crop Insurance and ad hoc disaster programs.

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Under the Federal Crop Insurance Reform Act of 1994, which was implemented for the 1995 crop year, participants in Federal price and income support programs are required to purchase a minimum level of crop insurance. While the level of the mandatory coverage is low (50% of expected yield at 60% of expected market price), the Reform Act is also expected to result in a significant increase in additional or buy-up coverage due to the repeal of the emergency designation status for crop losses. Without emergency status, spending for ad hoc disaster programs must be offset with reductions in other programs, making Congressional approval much more difficult. As a result, USDA projections indicate that, in the early years of the Reform Act, approximately 80% of eligible acreage will be covered with crop insurance, with about half at the catastrophic level and half covered with buy-up coverage. Historically, 30 - 40 percent of eligible acreage has been covered with crop insurance.

Iowa Corn Yield Insurance Futures

Removal of the emergency designation status for crop losses under the Crop Insurance Reform Act will force crop producers to take a more active role in managing crop production risk. By requiring catastrophic coverage as a condition of enrollment in price and income support programs, USDA hopes to solve the adverse selection problem inherent in the Federal Crop Insurance programs of the past. Also, by increasing the level of the subsidy for "buy-up" coverage to 41 percent from 30 percent, USDA projects that, eventually, nearly two-thirds of total acreage covered with crop insurance will be covered at a "buy-up" level.

The CBOT's Iowa Corn Yield Insurance futures and options contracts will give corn producers an alternative to crop insurance for hedging production risk. While purchasing the catastrophic level of crop insurance is still required for participation in price and income support programs, producers can use Iowa Corn Yield Insurance futures and options contracts as an alternative to "buy-up" crop insurance coverage. The salient features of the Iowa Corn Yield Insurance futures contract include the following:

Underlying Instrument: Iowa Corn Yield Insurance futures track the official United States Department of Agriculture (USDA) monthly estimate of corn yield for the state of Iowa (i.e., the ratio of Iowa's total corn-for-grain production to Iowa's total corn-for-grain acres harvested).

Unit of Trading: Each monthly contract will reflect the Iowa yield estimate x $100.

Standards: The final settlement amount for monthly contracts shall be equal to the USDA's estimate of corn-for-grain yield for the state of Iowa x $100. The yield for the state of Iowa is expressed by USDA in units rounded to the nearest bushel.

Months Traded: September and January.

Yield Quotation: Bushels and tenths of a bushel per acre harvested. Each bushel per acre harvested equals $100. For example, a yield of 131.2 is equivalent to $13,120.

Tick Size: One-tenth (0.10) of one bushel per acre harvested ($10 per contract).

Position Limits: 1,000 contracts net long or short in any one month, or all months combined.

Trading Limits: Fifteen (15) bushels per acre harvested ($1,500 per contract).

Last Day of Trading: Shall be on the last business day of the month prior to the USDA's release of the September and January corn crop production estimate reports for the state of Iowa.

Settlement: In cash, following USDA's release of the September and January corn crop production reports for the state of Iowa.

Trading Hours: 10:30 a.m. - 12:45 p.m., Central Time

Ticker Symbol: CA

The greater flexibility offered by options may result in a significant portion of yield trading being conducted in those markets. A potentially powerful application of the crop yield insurance futures or options contracts is to combine price and yield hedging to establish a fixed or minimum level of revenue per acre. With the pressure in Congress to reduce the budget for farm programs, insuring revenue using futures and options contracts on prices and yields could help transfer some of the risk currently assumed by the federal government to the marketplace.

The following example shows how the CBOT Iowa Corn Yield Insurance options contracts could be used to establish a minimum revenue contract. This is accomplished by combining Iowa Corn Yield Insurance put options with a standard minimum price forward contract.

Minimum Revenue Hedge

Assumptions - Planting

- Sep Iowa Corn Yield Insurance futures @ 125 bushels per acre (bpa)
- Sep Iowa Corn Yield Insurance 125 put options @ 7 bpa[2]
- December corn futures @ $2.60 per bushel
- December corn $2.60 calls at $0.18 per bushel
- Producer's local harvest basis is $0.20 under December futures

A producer forward contracts with an elevator to deliver 10,000 bushels of corn from 80 acres of production at a minimum price of $2.40 per bushel for harvest delivery. Based on this contract, the producer expects to realize a minimum of $24,000 in revenue from the 80 acre field. The producer hedges his production risk by purchasing Iowa Corn Yield Insurance put options with a

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[2]Theoretical yield option premium calculated using the Yield Option Evaluation Program developed by Mario Miranda, Ohio State University.

125 bpa strike price and purchases December $2.60 call options to enable him to gain from a price increase. The number of corn yield option contracts purchased is calculated as the forward contract price divided by the contract multiplier times acres hedged:

($2.40 / $100) x 80 acres = 1.92 (2 contracts)

Declining Yields

Assume the average Iowa corn yield and the producer's yield decline by 20%, resulting in a CYI futures yield of 100 bpa and a yield for the producer of 108 bpa. As result of the decline in yields, assume that the December futures price increases to $2.80/bu. The revenue hedge would produce the following results:

Price Hedge

Time	*Futures*	*Options*
MAY	December futures price = $2.60/bu	Buy 2 Dec $2.60 calls $0.18/bu
AUG	December futures price = $2.80/bu	Sell 2 Dec $2.60 calls @ $0.25/bu
Result	+$0.20/bu	+$0.07/bu

Yield Hedge

Time	*Cash Yield*	*Yield options*
MAY	Expected corn yield = 135 bpa	Buy 2 Sep Iowa corn yield 125 bpa puts @ 7 bpa
OCT	Actual corn yield = 108 bpa	Sell 2 Sep Iowa corn yield 125 bpa puts @ 25 bpa
Result	-27 bpa	+18 bpa

Since the producer's actual yield was 108 bpa, he delivers 8,640 bushels to the elevator and pays a cancellation charge of $272 on the undelivered quantity (1,360 x $0.20/bu). The producer's net return from the price and yield hedges is as follows:

1) Deliver on forward contract (8,640 bu. x $2.40)	=	$20,736
2) Buy back 1,360 bushels of forward contract @ $0.20/bu	=	-272

3) Gain on Dec call option ($0.10/bu x 10,000 bu)	=	700
4) Gain on Jan yield put option (19 bu x $100 x 2)	=	3,600
Producer's Total Revenue		**$24,764**
		($309.55/acre)

While the producer's yield declined by 27 bpa, he realizes a gain of 18 bpa ($3,600) from the yield put options[1]. Adding the net return on the price call option ($700), the producer's net return increased by $4,300 ($52.75/acre) due to the price and yield hedge. If the producer had not hedged or forward contracted, he would have earned $22,464 (8,640 bu. x $2.60/bu), or $2,300 less than with the minimum revenue contract.

Increasing Yields

Assume the average Iowa corn yield and the producer's yield increase by 20%, resulting in a CYI futures yield of 150 bpa and a yield for the producer of 162 bpa. As result of the increase in yields, assume that the December futures price declines to $2.30/bu. The revenue hedge would produce the following results:

1) Deliver on forward contract (10,000 bu x $2.40)	=	$24,000
2) Sell excess production spot (2,960 bu x $2.00)	=	5,920
3) Loss on Dec call option ($0.15/bu x 10,000 bu)	=	-1,500
4) Loss on yield insurance put option (7 bu x $100 x 2)	=	-1,400
Producer's Total Revenue		**$27,020**
		($337.75/acre)

With an increase in the producer's yield to 162 bpa, the producer loses the premiums for the yield put and price call options. Even with this loss, however, the producer's net return on the 80 acre field is $1,100 higher than if he did no hedging or forward contracting and sold 12,960 bushels at the harvest spot price of $2/bu. Also, the ability to hedge yield enables the producer to forward contract nearly all of his expected production from the 80 acre field.

Constant Yields

If the average Iowa yield and the producer's yield remained constant at 125 bpa and 135 bpa, respectively, and December futures prices remained at $2.60/bu., the producer would achieve the following results:

1) Deliver on forward contract (10,000 bu x $2.40)	=	$24,000
2) Sell 800 bushels spot (800 x $2.40)	=	1,920

[1]The 9 bushel per acre difference in the amount of the cash market yield decline and the gain from the yield put option is due to the 7 bpa time value of the put option when it was purchased and the assumption that state average yield and the producer's yield declined proportionately.

3) Loss on Dec call option ($0.07/bu x 10,000) (Buy @ $0.18/bu, sell @ $0.11/bu)	=	-700
4) Loss on yield insurance put option (3.4 bpa x $100 x 2) (Buy @ 7 bpa, sell @ 3.6 bpa)	=	-680
Producer's Total Revenue		**$24,540 ($306.75/acre)**

In this situation, the producer's net return is the revenue from the forward contract plus the return from selling an extra 800 bushels on the spot market minus the premium loss for the yield insurance put option and the price call options. This loss is less than the full premium due to remaining time value when the options are offset. If the producer had done no hedging, he would have earned $25,920 ($324/acre).

Basis Risk

The effectiveness of the Crop Yield Insurance contracts in hedging revenue at the farm level depends on the correlation between individual farm yields and the state average represented by the contract. Corn yield correlation analysis using Iowa county yields and Iowa state average yields for the 1972 - 1994 period resulted in correlation coefficients ranging from .65 in Louisa county to .93 in Hamilton county. Of the 99 counties in Iowa, 89 had correlation coefficients of .8 or above and 22 had coefficients of .9 and above. The correlations decline significantly, however, for Illinois and Indiana. Only two counties in Illinois had coefficients of .8 or above, and only 26 counties had coefficients of .7 and above. In Indiana, no county had a coefficient of .8 or above, and only 7 counties had coefficients of .7 or higher. When 1993 is removed from the data set, the Illinois correlations increase, on average, by .11, and the Indiana correlations increase by .21.

COUNTY CORRELATION COEFFICIENT DISTRIBUTION
(1972 - 1994)

State	.90-1.00	.80-.89	.70-.79	.60-.69	.50-.59	0.0-.49	Mean*
Iowa	31	62	6	0	0	0	0.87
Illinois	0	7	36	41	13	5	0.67
Indiana	0	2	16	49	23	2	0.66
Ohio	0	0	33	40	9	6	0.64

(1972 - 1994, excluding 1993)

State	.90-1.00	.80-.89	.70-.79	.60-.69	.50-.59	0.0-.49	Mean
Iowa	26	66	6	1	0	0	0.87
Illinois	3	42	41	13	3	0	0.78
Indiana	2	27	52	11	0	0	0.71
Ohio	0	13	44	26	3	2	0.77

The effectiveness of the Crop Yield Insurance futures and options contracts for hedging yield risk at the farm level will be determined primarily by the basis risk and the cost of crop yield options premiums. With the Iowa Corn Yield contracts being launched on a pilot basis, the exchange will consider developing additional state level contracts if the Iowa contracts are not an effective hedge for other major corn producing areas and if trading volume is sufficient to support additional contracts.

References

Tashjian, E., "Optimal Futures Contract Design". Proceedings from Conference on "Futures Markets in the 21st Century", presented by the Office of Futures and Options Research, University of Illinois at Urbana Champaign.