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Options, Futures, and Agricultural Commodity Programs

Symposium Proceedings

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ABSTRACT

Forward markets for agricultural commodities have coexisted with farm programs for more than 50 years. The Food Security Act of 1985 required the U.S. Department of Agriculture to investigate how farmers might use forward markets to gain price stability and income protection, the extent of such stability and protection they might reasonably expect, and the Federal budgetary impact of widespread use of such markets by farmers. In May 1987, the Economic Research Service, USDA, cosponsored a symposium with the Commodity Futures Trading Commission and the Farm Foundation. The purpose was to gather additional insight from industry leaders and the academic community into the relationships, both competitive and complementary, that exist between forward markets and farm programs. Substance of that symposium is reported here.

Keywords: Options trading, futures trading, agricultural commodity programs, research, price supports

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PREFACE

Forward markets for agricultural commodities are more the 100 years old. They were developed by Chicago merchants with "to arrive" contracts during the middle part of the 19th century. Current futures contracts and options are somewhat different versions of forward contracts.

Farm programs are more than 50 years old. They were developed by Congress with legislation during the aftermath of the economically turbulent 1920s. Various versions of voluntary and mandatory programs generally have not been cost effective in balancing production with needs.

Farm program provisions sometimes interfere with the normal workings of forward markets. This is especially true when farm prices are near Government support levels. At such time, producers have little incentive to use risk bearing and sharing offered by the private sector.

With Government outlays for farm programs at record levels and continuing to increase, Congress in The Food Security Act of 1985 asked the U.S. Department of Agriculture to determine how farmers might use forward markets to gain price stability and income protection, the extent of price stability and income protection they might reasonably expect, and the Federal budgetary impact compared with the cost of applicable established price support programs.

In connection with the study, a pilot program is mandated involving producer trading of wheat, feed grains, soybeans, and cotton in at least 40 counties. As part of the pilot program, an extensive educational program is to be conducted for producers in the counties involved. Participating producers are to be assured of net returns no less than the price support loan level for commodities allocated to the program. An advisory panel of producers, processors, exporters, and futures and options traders is to be used in formulating the program.

The Economic Research Service, USDA, cosponsored a symposium with the Commodity Futures Trading Commission (CFTC) and the Farm Foundation in May 1987. More than 80 leaders from commodity groups, farm organizations, futures and options exchanges, administration and legislative policymakers, and university and Government economists explored various aspects of the study and the pilot program. This report is the proceedings of that symposium.

The first session provided a review of the analytical basis for farm programs, especially for price supports and their relationship to put options. The second session described the level of use of futures and options by farmers, identified factors affecting the level of use, and estimated the effect of such trading on the level and variability of incomes of farmers. The third session identified alternatives that might be used to increase farmers' knowledge about and use of futures and options markets. The fourth session estimated the effect of some of the previously identified alternatives on farmers' incomes and Government expenditures. A fifth session, a luncheon address, described the current regulatory environment for commodity traders, including farmers. In the sixth session, researchers reported results of independent efforts on various aspects of the general problem areas. The seventh session concluded the symposium with comments by representatives of producers, the industry, and the exchanges about characteristics of forward trading that restrict farmers use and about opportunities and prospects for lifting the restrictions.

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PART I: OVERVIEW

CURRENT FARM PROGRAMS AND HOW THEY RELATE TO FUTURES AND OPTIONS

Bruce L. Gardner

The common feature of most farm programs is price support. Subsidiary, second-level features of farm programs are the means of achieving price support. These means vary greatly from one commodity to another. Third-level features involve regulatory mechanisms to deal with unforeseen or unwanted response by farmers to price support programs. An understanding of all three levels is required to draw out the full parallels between farm programs and futures or option contracts and where the parallels end.

Economics of Farm Programs

Price Supports

Preparing its platform for the 1984 Presidential election, the Democratic Party held a series of hearings around the country on agricultural policy. The conclusion was that from the farmers' point of view, "when all was said and done it came down to one word: price" (1).1/ For over half a century, U.S. farm policy has focussed on supporting commodity prices. This focus has produced policies that have been irrelevant to or even counterproductive in dealing with some of the real economic problems of rural America. These problems include the obsolescence of small farms and the skills of older farm operators, the low level of schooling and mobility in some rural communities, and, more recently, the debt burdens of farmers who expanded operations in the late 1970s when land prices and interest rates were high. The focus on price is more relevant to one underlying problem of agriculture, however: The instability of market receipts with which farmers must cope. Even here, while price support and price stabilization overlap, they are not the same thing.

In any case, price support is the aspect of agricultural policy that has been and appears destined to remain the essence of U.S. agricultural policy. It is what generates the $20-25 billion annual Federal budgetary outlays, and it is the topic of most lobbying, legislation, and farmer complaints.

U.S. support prices have fallen steadily in real terms during the post-World War II period. Attempts to maintain them resulted in chronic Government stock buildup during the 1950s and 1960s which, in the end, forced support prices down. By 1972, using 1960 as a base, the real support price had fallen by 67 percent for wheat, from $283 to $95 per ton in 1982 dollars. In this same period, the real support price of corn fell 62 percent, cotton 65 percent, and milk 14 percent (6). However, during the late 1970s, it appeared that the markets had sufficient underlying strength that farmers' distress, particularly with reduced market prices for wheat, could be met by price support boosts that would not create traditional surplus problems. Thus, the wheat loan rate was increased by 56 percent in real terms between 1975 and 1976, the largest one-

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

time jump on record. This was done under administrative authority of President Ford during the 1976 election campaign. The Food and Agriculture Act of 1977, under the succeeding Carter administration, continued the higher loan rates and also increased target prices.

By 1982 as compared with 1975, the real loan rates had been increased by 59 percent for wheat, 41 percent for corn, 1 percent for cotton, and 10 percent for the milk support price. The target prices for grains were increased even more. These increases in the face of weak markets, particularly export markets for U.S. commodities, caused the high budgetary outlays of the mid-1980s. The response to this situation was the Payment-In-Kind (PIK) program of 1983 and the reforms of the Food Security Act of 1985. The 1985 Act governs current crops and, unless Congress intervenes, will set policy through 1990 for the major crops.

The main item of contention in developing the 1985 Act was whether support prices should be maintained or cut back to resume the longer term trend that was interrupted in the mid-1970s. Congress decided to cut the crop loan-rate and dairy supports, but maintain the target prices in nominal terms for 2 years with cuts adding up to 10 percent for the grains over the last 3 years of the act (cuts scheduled to start in 1987 for rice and cotton). This amounts to an anticipated average 4- to 5-percent annual decline in real target prices over 1986-1990. Cuts in real loan rates have been much more substantial, falling 35 percent for wheat and 40 percent for corn between 1984 and 1987.

Maintaining small cuts in target prices along with large cuts in loan rates allows the market to clear at lower prices and helps allay surpluses while cushioning farm income from the lower market prices. This cushioning is accomplished by deficiency payments equal to the difference between the target and loan rates. Economists and the relevant congressional committees realized that the cushioning is a kind of price insurance and is analogous to the price protection achievable by purchase of a put option. Hence, we have the provision of the 1985 Act under the influence of which this conference is being held.

Means of Price Support

Prices may be increased either by enhancing demand for a commodity or by reducing its supply. The second approach was the first one implemented in the Agricultural Adjustment Act of 1933 and has been used ever since. It is natural to try to cure problems of surplus production by cutting back production. However, unless demand is very inelastic, producers will have to leave a significant fraction of their productive resources idle. This can make production control unattractive to producers.

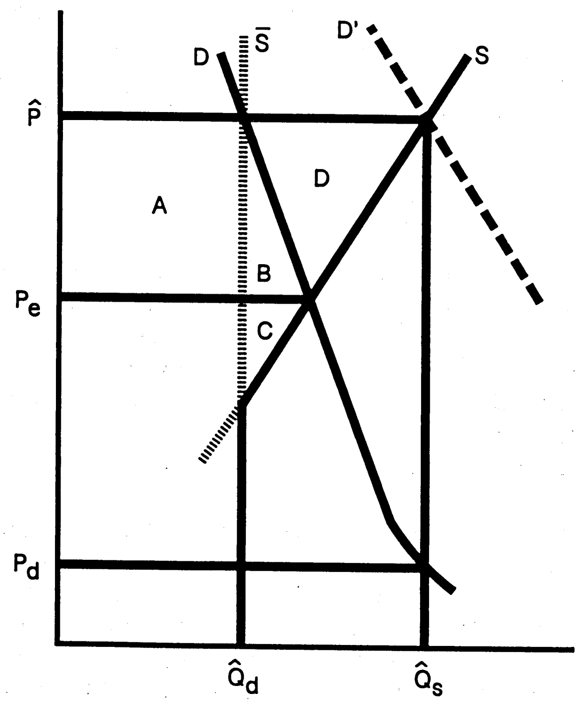
Figure 1 shows the problem in a simple supply-demand context. Suppose that price is to be supported at level $\hat{P}$. If this is accomplished by production control at $\bar{S}$, then producers obtain a higher price on quantity $\hat{Q}_d$ but must produce less than with no program. This means they lose some producers' surplus. Their net gain is area A - C. But if producers were permitted to produce all they liked at price $\hat{P}$, they would produce $\hat{Q}_s$. Their net gain would be A + B + D. Thus, comparing the two approaches, both generating price $\hat{P}$, we find that producers are better off by B + C + D when this is accomplished by policies which increase demand to D' as compared with restricting supply to $\bar{S}$. With more elastic demand--in the longer run or for an exported commodity--the situation is still more favorable for demand expansion and indeed production controls can actually make producers worse off (C > A).

So why isn't demand expansion always used? Government purchases of $\hat{Q}_s - \hat{Q}_d$ for its stocks can be quite costly to taxpayers. In the case shown, the cost is $\hat{P}(\hat{Q}_s - \hat{Q}_d)$. If the surplus is chronic, there is little hope of Government resale to offset the costs, and indeed stocks will accumulate indefinitely. This prospect in 1982 is what led to the switch to PIK in 1983.

Moreover, either demand expansion or production control causes an additional problem when the U.S. price sets the world trading price for the commodity. The higher world price sends a signal to foreign producers to increase output and cuts the cost of protection to other countries such as the EEC for its export subsidies. A third approach consequently becomes attractive; namely, paying producers the price $\hat{P}$ by supplementing the market price with deficiency payment. Making payments of $\hat{P} - P_d$ allows the producers to gain A + B + D but avoids building up stocks and stimulating foreign production. The drawback is that the budgetary outlays for the payments can become large. The area of payments, $\hat{Q}_s(\hat{P} - P_d)$, looks absurdly large as drawn, but the actual U.S. rice program for 1986/87 involves a target price roughly three times the market price level, so that potential payments are about twice as large as the market value of the commodity.

A policy response to these problems could be to introduce sequentially new approaches as problems arise. When the price of a commodity falls for what looks like a temporary reason, the Government supports the price by taking

Figure 1
Illustration of increasing price with demand expansion or production control

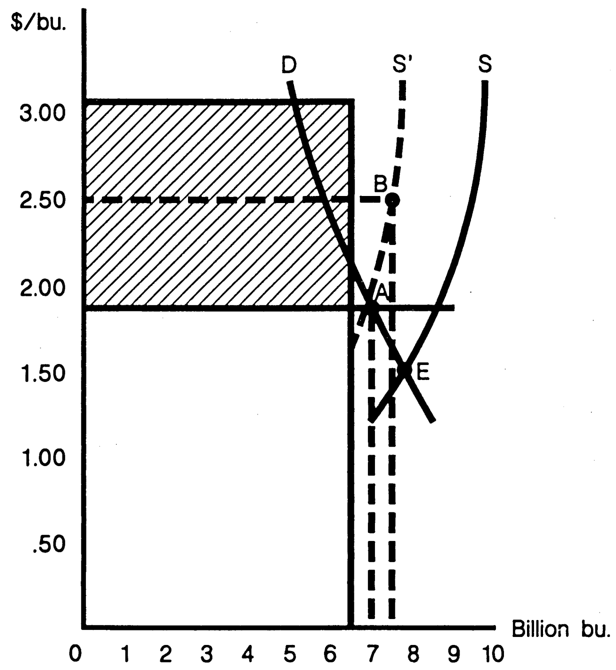


commodities off the market. If surpluses persist at that price, the support level is cut, but farm income is maintained. If overproduction continues, acreage set-asides are introduced. If stocks do not decline, subsidized domestic or foreign sales are added to the policy menu. Current policy consists of all of these mechanisms in simultaneous use.

A projected situation for corn in 1987 is shown in figure 2. The loan rate at the statutory minimum of $1.82 holds price at a level at which 7 billion bushels is used (domestic consumption plus export). This is point A. The actual market price in 1985 and 1986 fell well below the loan rate, mainly because of generic PIK certificates permitting farmers to receive the loan rate or more while selling at lower market prices. But, this effect is omitted from the 1987 projections on the assumption that the quantity of certificates will not be large enough to permit this to occur in 1987/88. (The fact that March 1988 futures as of May 1987 are at the $2.00 to $2.10 level, which means about $1.75 to $1.90 at the farm level, suggests that market expectations are consistent with this assumption).

USDA's projection of 1987 corn acreage is 68 million acres, which at last year's yield of 108 bushels per planted acre gives a 1987 crop of 7.3 billion bushels. The implied 1987 excess supply of 300 million bushels is not large. But, with carryover stocks as of September 1, 1987, at 5.0 billion bushels, the accumulated excess supply is still very large.

Figure 2
Illustration of corn program provisions



The target price of corn is ($3.03 - $1.82) = $1.21 on each eligible bushel. A producer's eligible bushels are the farm's established or program yield, based on past yields, times the farm corn base acreage, based on past plantings. With 88 percent of base acreage enrolled in the 1987 corn program, payments are made on less than expected output, but they still amount to about $7 billion (the hatched area in figure 2). Because of the fixed nature of payments, the $3.03 target price cannot be viewed as the incentive price to farmers.

Moreover, participation requires the idling of 20 percent of the farmer's acreage base, and the opportunity rental returns of this land must be subtracted from program benefits. In figure 2, the incentive price is placed at $2.50, implying that the program-restricted supply curve, S', passes through point B. On the assumption that in the absence of the program, the supply curve would involve the same yield but 84 million acres of corn land (the 1981 acreage), the no-program supply curve would be the one labelled S in figure 2.

Now we can analyze the effects of all the program elements taken together. Relaxing acreage controls moves the sector from S' to S. Dropping target-price guarantees moves farmers down the supply curve S. Dropping loan-rate supports moves us down the demand curve from point A. Using an elasticity of demand of -0.5 and an elasticity of supply of 0.3, the implied no-program equilibrium is at point E, with a price of $1.50 and output of about 8 billion bushels.

Regulatory Mechanisms

Similar programs exist for wheat, rice, cotton, barley, sorghum, and oats. The 1987 implementation of the key regulatory mechanisms is the same as for corn. There are three salient facts: (1) target prices are set well above no-program prices, (2) loan-rate supports are much lower than target prices and have been cut substantially under the 1985 Act, and (3) acreage controls are quite stringent, with idled acreage increasing from 49 million acres in 1986 to a projected 71 million acres in 1987 (table 1). Idled acreage will be almost as much in 1987 as it was under PIK in 1983.

The three main policy instruments have been adjusted to offset undesired consequences of their operation; for example, acreage reductions to offset the supply response to higher producer prices. In the Agricultural Acts of 1977 and 1981, payments were made on the base of the current year's production (still the case in the wool program). The move to place more weight on historical base acreage and yield is intended to counteract the resulting production incentive. Another adjustment is the use of export subsidies to counteract declining U.S. exports which are partly caused by the high loan rates. Finally, the belief that U.S. commodity programs encouraged the intensive cropping of fragile and marginal land led to the Conservation Reserve Program provisions of the 1985 Act. The CRP pays farmers to hold certain lands designated as erodible out of production for 10 years. The projection for 1987 is that 17 million acres will be in this program instead of producing crops.

These continual adjustments are a response to uncertainty in the commodity markets. The adjustments also cause uncertainty. The remainder of this paper discusses how uncertainty fits in with current farm programs.

Price Supports, Futures, and Options

Price support as embodied in current programs appears to be mainly the outcome of a political contest for income redistribution between interest groups. But, an economic service can be provided to market participants as a whole (consumers and producers jointly) through market stabilization. The question can be raised whether the social benefits are likely to cover the costs of providing this service, especially since some market means of market stabilization and coping with uncertainty exist. The question can also be raised whether the current programs really stabilize market prices over either the short term or the long term. In the short term, we have the phenomenon that the price of corn received by farmers varied between $1.36 and $2.39 per bushel in a 1-year period between March 1986 and March 1987, a range of 55 percent of the midpoint value. This is a much greater fluctuation than took place for soybeans or livestock products, less protected commodities, over the same period. And the corn price variability was less in the mid-1970s when the programs were inactive and speculation was rife.

These questions notwithstanding, the focus of this section is not on the consequences of programs but on parallels between them and commodity futures or options, and what these imply for the inherent capabilities of farm policies to stabilize markets.

Schultz (9) and Johnson (5) argued that the main social value of price supports was to generate stable production and consumption signals in line with underlying supply-demand realities.

Table 1--Acreage idled under USDA programs

Crop	1969	1982	1983	1984	1985	1986	1987 1/
				--- Million acres ---			
Corn	27.2	2.1	32.2	3.9	5.4	14.0	22
Grain sorghum	7.5	.7	5.7	.6	.9	2.8	4
Barley	4.4	.4	1.1	.5	.7	1.8	3
Oats		.1	.3	.1	.1	.7	1
Wheat	11.1	5.8	30.0	18.6	18.8	20.9	20
Cotton		1.6	6.8	2.5	3.6	3.6	3
Rice		.4	1.8	.8	1.2	1.4	1
Long-term diversion	7.8					3.8	17
Total	58.0	11.7	78.0	26.9	30.7	49.0	71

1/ Projections.
Source: USDA

> It is possible and highly desirable that we leave behind the support price program that emerged during the war and go over to a system of forward prices in agriculture. Such forward prices should present each farmer, as he proceeds with his production operations, with a schedule of relative prices for at least one production period ahead, considerably more dependable than heretofore. As this is accomplished it would increase the ability of farmers to allocate and use the resources at their disposal much more efficiently (9, pp. 270-71).

Johnson spelled out in more detail how a system of forward prices would work and discussed their parallels with futures prices. Houthakker (4) developed the parallel by proposing that the program actually be set up to intervene in futures markets to establish a stabilized price range. The purpose, he says, is "to enable the private sector to take a longer view" (p. 56). (A notable contrast to current discussion of stabilization is that all three of these authors emphasize the efficiency gains that market stabilization brings, but none of them gives any weight to the notion of risk aversion)

Price supports are more closely related to commodity option contracts than to futures because, like options, price supports increase farmers' receipts in low-price periods while leaving receipts free to fluctuate with the market when prices are high. However, the parallels are not perfect. The difficult task is to determine when a difference between a price support and a parallel financial instrument is only superficial and when it is important. Some examples follow.

Schultz and Johnson, in their works cited, recommend a price floor somewhat below expected price. Houthakker recommends such a price floor accompanied by a price ceiling at which the Government would sell the futures contracts (or delivered commodities) that it had acquired at the price floor. The former policy seems more nearly parallel to an option and the latter more nearly parallel to futures or price stabilization. Yet it is not obvious that there is any important difference between the price floor and the price band. Why? Because it depends on the mechanism of defending the price floor. The mechanism is typically Government acquisition of stocks. If this is the only mechanism of support, then the price floor specifies when stocks will be acquired. The ceiling price specifies when stocks will be released.

With no ceiling price, there are three possibilities: (1) the stocks may never be released, (2) the stocks may be released according to the Government's discretion, or (3) supplementary measures--acreage controls or export subsidies--may be used to draw down stocks. In case (1), the price floor and price band are fundamentally different. But, this is an uninteresting case because no Government would just keep on acquiring and never releasing stocks. In case (2), the Government would sooner or later sell every bushel it bought. Therefore, the effect on long run expected price is to a first approximation (neglecting curvature in demand or supply curves) zero. The absence of an explicitly stated ceiling price is not as important as it may at first appear. In case (3), the difference can be great, but it is not the lack of a ceiling price but of the introduction of, say, export subsidies that makes the policies differ.

Marcus and Modest (7) treat the CCC loan program as the issuance at no charge to farmers of a random number of put options. The number of puts varies with the size of the crop. There is an important difference between CCC loans and put options, however, in what the option writer does with commodities tendered on exercise. With commercial puts, the writer takes a loss (which may or may not offset the premium earlier received) equal to the difference between the market price and the exercise price, and the market price is at the same level it would have been without the put. On the other hand, when CCC puts are exercised, the Government is obligated to hold the commodity. This is what makes CCC loans a market price support program. This is, of course, a key feature of CCC price supports and is the reason why CCC directly influences the price received and paid by all those who don't own puts. This is a fundamental difference between CCC loans and commercial puts.

The Marcus-Modest model is more nearly applicable to CCC loans as supplemented with generic PIK certificates in 1986-87. These let the CCC out from under its commitment to store commodities at the exercise (loan) price by giving farmers, along with the put option at the loan rate, a call option. The call option allows farmers to buy from the CCC at a lower price, the posted-county price. The farmer can even "quick PIK," buying back the same commodity that would have been delivered to the CCC had the put been exercised. This locks in a further income gain to the farmer if the posted county price is below the actual market (or own-use) value of the commodity, which it often has been.

Petzel (8) and the Farm Income Protection Insurance Task Force (3) also consider CCC loans as analogous to put options. But, in addition, they take the more general view of put options as price insurance, which links options more closely to the deficiency payment program than to the CCC loans. Deficiency payments make up the difference between the target price and the market price and are thus equivalent to the value of a put option when exercised, with the option's strike price being the program's target price.

Fackler (2) emphasized that deficiency payments on an unspecified quantity of output--the quantity that an eligible farmer happens to produce each year--are not exactly equivalent to a put option on futures as traded on the Chicago Board of Trade. The U.S. wool program involves payments on unlimited output. The producer maintains documented sales records and the receipts are supplemented by a subsidy payment equal to the percentage by which the national average wool price received falls short of the wool support price. A traded option contract would be for an output level fixed in the contract, and the producer is "naked" on any quantity produced above or below that output. This is not necessarily bad, however, because in the case of a quantity shortfall coupled with low price--the worst case for the producer--the fixed number of puts generate a larger profit than the lower number that the wool-program type of payments would generate.

Consider a standard gross profit diagram for output hedged with commercial-type options compared with wool-program type payments when an output shortfall occurs (fig. 3). Q^* is intended output and the quantity covered by put options. The strike (support) price is $\hat{P}$, which is chosen to be the breakeven price. If intended output is produced, market profits are shown by the line $0'Q^*$. The value of the put option, π, is shown as the hatched line segments π_1 and $\pi = 0$ for $P > \hat{P}$. The vertical sum of the market profits and put option profits are shown along $\pi_1\hat{P}Q^*$ in the lower panel of figure 3. This is the standard gross profit line for a put option hedge (for net profit, the cost of the put must be subtracted).

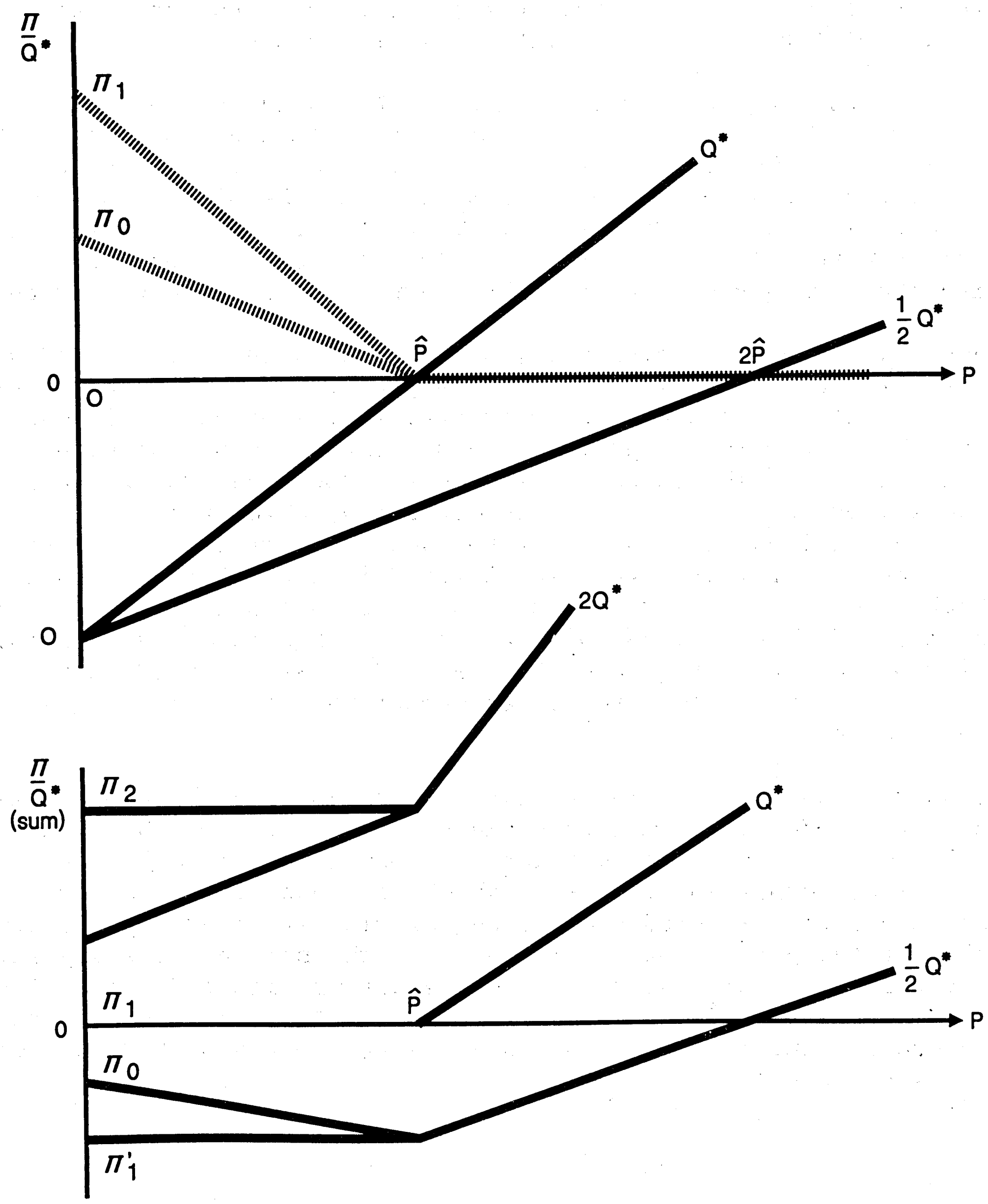
These results can be expressed mathematically as follows. Uncertainty in production is introduced by writing $Q = \theta Q^*$, where θ is a nonnegative random variable with mean equal 1. With no target-price or put option protection, profits (normalized by Q^*) are:

$$\pi^* = (P - \hat{P})\theta Q^* - C^* \tag{1}$$

Where θ is the ratio Q/Q^*, actual output divided by intended output, and C^* is cost per unit intended output. Adding a commercial put option, the sum of profits from production and puts is:

$$\pi^* = \begin{cases} (P - \hat{P})\theta Q^* - C^* - T & ; P \geq \hat{P} \\ (P - \hat{P})\theta Q^* + (\hat{P} - P)\, Q^* - C^* - T & ; P < \hat{P} \end{cases} \tag{2}$$

Figure 3
Illustration of market profits and put option profits



where T is the cost of the option (the premium). With deficiency payments of the wool program type (on actual output), profits are:

(3)
$$\pi^{*} = \begin{cases} (P - \hat{P})\theta Q^{*} & ; P \geq \hat{P} \\ (P - \hat{P})\theta Q^{*} + (\hat{P} - P)\theta Q^{*} \\ (=0) & ; P < \hat{P} \end{cases}$$

With deficiency payments of the grain program type (on program output, Q'):

(4)
$$\pi^{*} = \begin{cases} (P - \hat{P})\theta Q' - C^{*} & ; P \geq \hat{P} \\ (P - \hat{P})\theta Q' + (\hat{P} - P)Q' - C^{*} & ; P < \hat{P} \end{cases}$$

Equation (3) gives results equivalent to a put option in the certain-production case ($\theta = 1$). Equation (4) is identical to (2) with $C = 0$ and $Q' = Q^{*}$, that is, the put is costless and program output is breakeven (zero profit or competitive equilibrium) output. Equation (4) with $P < \hat{P}$ can be rewritten as:

(4a)
$$\pi^{*} = (P - \hat{P})\ (1 - \theta)\ Q' - C^{*},$$

showing that when $\theta = 1$, the wool and grain programs are equivalent since $\pi^{*} = 0$ when $P < \hat{P}$.

Now let actual production be only half of intended production. Any given level of profit per unit of intended production requires twice the price it did before, shown by the line labelled 1/2 Q^{*} in the upper panel. For put option profits, we must distinguish two cases. First in the standard put option case, when $P < \hat{P}$ profits are made on Q^{*}. So the profit line is still π_1. Therefore, adding vertically π_1 and 1/2 Q^{*} gives a new result in the profit line in the bottom panel, the line with circles inscribed labelled π_0 and 1/2 Q^{*}. The second case is the wool program one in which the quantity of puts equals actual output. In this case profits on puts are also reduced by one-half, shown as the hatched line segment labelled π_0 in the upper diagram. The sum of π_0 and 1/2 Q^{*} generates a profit line in the bottom diagram composed of the line segment π_1' and 1/2 Q^{*}, indicated by X's.

Comparing the profit lines with circles and X's suggests that it is preferable to have a fixed quantity put option program than to have a variable quantity as in the wool program. However, we also have to consider the situation when output is larger than intended output. This is not shown is the upper panel, but the lower one shows as a line with circles the profit line when $Q = 2Q^{*}$ and the number of puts is fixed at Q^{*}. With variable puts (wool program) the profit line is π_2 with x's to the left of $\hat{P}$. Therefore, in this case, it is preferable to have the variable-put program.

The biggest deficiency payment programs--the ones for grains and cotton--make payments on a fixed output base (permitted acreage times program yield). When a farmer has a short crop, the payment is still made on this fixed base. Therefore, the profit lines are like those with circles inscribed in figure 3. That is, the results are the same as owning a (free) commercial put option.

From these diagrams and equations, we cannot show the expected value of profits or price under any of the options. For this, we need the joint probability density function of price and output (P and θ). There is some warrant to suppose as a point of reference that in a competitive industry expected profits will be zero so that the breakeven price $\hat{P}$ is the expected value of the market price. Note also that these diagrams are easily convertible to aggregate profits by multiplying by a constant, Q^*. This changes the slopes of all the line segments but leaves them unchanged relative to one another. Normalization by Q^* is convenient because then the slope of the line labelled Q^* is one, and it is easy to calculate other slopes. In the bottom diagram, the slope of $1/2Q^*$ is 1/2, of π_2 is -1, and of π_0 is -1/4.

In sum, the existence of output uncertainty affects the profit diagram for both commercial options and deficiency payment programs. If the deficiency payment is made on base output, as for grains and cotton, the profit diagram is the same as for a commercial put option, but both are different from the certainty case. If payments are made on actual output, whatever its level, then the uncertain output profit diagram is the same as for a put option in the certain-output case when market price is less than the strike price.

The whole discussion of support prices as put options is somewhat academic in the immediate policy environment because puts at the target price levels are so far in the money and stocks are so large that the Government's loan-rate and PIK certificate policies essentially determine market prices. Still, the idea of price support as a kind of price insurance program that farmers could conceivably even pay for as well as receive indemnity payments from may be pertinent for the longer term. The notion of price supports as puts comes into its own in these circumstances.

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PART II: POTENTIAL BENEFITS OF FUTURES, OPTIONS, AND CASH FORWARD CONTRACTS

TRADING ACTIVITY AND EXTENT OF COMMERCIAL USE OF OPTIONS AND FUTURES TODAY

Eugene J. Moriarty

I will provide a brief history of regulatory developments in options trading, which has been provided to the Congress in various interim reports during the pilot program, and some factual background regarding the extent of agricultural options and futures trading and commercial participation in that trading. In the options program there have been 43 contracts designated by the Commodity Futures Trading Commission (CFTC) to date, 16 of which are on domestic agricultural futures. The overall regulatory structure for the trading of options was adopted on November 3, 1981, when the CFTC approved regulations governing a 3-year pilot program to permit the trading of nonagricultural options on exchanges. The first designations to trade options occurred in August 1982. In December 1982, the rules of the program were expanded to include options on nonagricultural physicals. The statutory bar to trading options on domestic agricultural commodities was repealed by section 206 of the Futures Trading Act of 1982. This enabled the CFTC to establish a pilot program, for a period not to exceed 3 years, for the trading of options on agricultural commodities.

On January 31, 1984, the CFTC established an additional pilot program for options on domestic agricultural futures contracts, with each exchange permitted to trade up to 2 agricultural options on futures. On April 9, 1986, CFTC expanded the program to five options on agricultural futures per exchange.

In removing the statutory ban and permitting a pilot program for the trading of options on domestic agricultural commodities, Congress indicated that such options might benefit producers by offering protection from adverse price movements without sacrificing the potential profits from favorable price movements.

The CFTC approved six exchanges' applications to trade options on agricultural futures contracts under its pilot program on October 29, 1984. In January 1987, the pilot status of domestic agricultural options was terminated with rule changes which made that trading permanent.

The statutory ban on the trading of agricultural options was enacted in 1936, largely as a result of trading abuses and the limited commercial use of options during the 1920s and 1930s. During this period, the options that were traded were primarily "dailies," which expired at the end of the next day's futures trading. "Weeklies" were also available, but there was no regular trading in options with monthly or longer durations as there is under current exchange trading of options. With the options expiring each trading day, exercises were normally concentrated in the futures closing period. This often resulted in congestion at the close when options exercises were added to the liquidation of positions by day traders. In addition, the very short-term nature of these options made them of very limited usefulness for longer term hedging, and this contributed to the scant commercial use.

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Unlike today's options on agricultural futures, those of the 1920s were not tradeable on the exchange. The tradeability feature of today's options lessens the potential problem of congestion in the underlying futures market. Moreover, it makes options more attractive to commercials and increases the opportunities for option buyers to recover at least part of the premiums paid.

Finally, the futures markets underlying the options of the 1920s and 1930s were often dominated by a few large buyers and sellers who sometimes possessed market power. Large traders, with a small outlay of funds for options, could obtain dominant positions in futures markets under manipulation.

The options markets of the 1980s have not been objects of frequent attempts at manipulation. When futures markets have high volume and an ample, known, and readily deliverable supply of the commodity, manipulation of the futures markets, either directly or indirectly through the options market, is difficult.

During the agricultural pilot program, CFTC did not find adverse or disruptive effects of option trading on the underlying futures. In fact, expirations of options generally have not resulted in major changes in futures open interest. No evidence has been found that price manipulation has occurred in options.

CFTC has established procedures to monitor each exchange's ongoing compliance with the trade practice criteria which a board of trade must satisfy as a designated contract market for agricultural options trading. Each exchange must maintain a continuing affirmative action program which must include surveillance of market activity, surveillance of sales and trading practices, examination of the books and records of member firms, investigation of customer complaints, investigation of all other alleged or apparent violations, and the taking of prompt and effective disciplinary action. The CFTC staff has conducted numerous rule enforcement reviews of the exchanges which have resulted in exchange implementation of CFTC recommendations concerning programs and staffing.

In addition, the CFTC program incorporates such regulations as those that require Futures Commission Merchants (FCMs) and contract market members to keep full, complete, and systematic records, including records of customer's orders and financial ledgers for customer's balances; that require these records to be kept for 5 years and to be open to inspection by any CFTC representative; that establish strict trading standards intended to ensure just and equitable trading practices by floor brokers and FCMs; and that require FCMs to send to their customers confirmation, purchase and sale, and monthly account activity statements.

Moreover, consistent with the requirements for trading futures options, each board of trade designated as a contract market for trading agricultural options is required to assist CFTC in monitoring the trading of those options. Each such board of trade must maintain a program to secure compliance with the provisions of the regulations and with all of the rules and regulations which the board of trade is required to enforce. As part of these duties, the board of trade must have a surveillance system which can be expected to detect congestion, manipulation, trade practice abuses, or other price distorting situations. To do this, the board of trade must have available to it records which enable it to investigate and to resolve potentially improper trade practices. This system of records enables the commodity options exchanges to detect and prevent such abuses as price manipulation, the improper allocation of trades, wash sales, and other types of noncompetitive and price-distorting trading.

CFTC conducts rule enforcement reviews to assess the effectiveness of exchange compliance programs. Prior to designating an option contract, CFTC must find, among other things, that the contract market uses due diligence in maintaining a continuing program to enforce all its rules and regulations. Since the inception of options trading, CFTC has conducted rule enforcement reviews of exchanges currently trading options on futures. These reviews, which cover the exchange's overall compliance program, found generally that the rule enforcement programs were in compliance with the standards of the Commodity Exchange Act and CFTC regulations.

While the methods and techniques for conducting trading-floor surveillance of options trading are similar to the procedures which have been established for futures trading, there are certain surveillance methods the exchanges have adopted to detect trading abuses which are unique to options trading. These include review of trade registers to monitor for instances of "front-running." Thus far, the exchanges generally have demonstrated an ability to adequately implement the self-regulatory responsibilities needed to detect these and other trade practice abuses.

In addition to their rule compliance program, the National Futures Association and each exchange engaged in options trading have undertaken an options sales practice audit program to monitor the marketing of exchange-traded options. These sales practice audits include investigation for the improper handling of discretionary accounts, the adequacy of internal supervision by firms engaged in the offer and sale of exchange-traded commodity options, fraudulent or high-pressure sales communication, compliance with disclosure requirements, and improper handling and disposition of customer complaints. As is the case with the surveillance of the financial condition of firms, the surveillance of option sales practices is conducted according to joint auditing plans entered into by the self-regulatory organizations. Each firm which is a member of more than one commodity exchange has its own options sales practice activities audited by one of those exchanges. Those firms which are not members of any exchange are audited by the National Futures Association.

CFTC monitoring of the internal compliance programs of FCMs engaged in the trading of options has indicated that those FCMs have instituted supervisory procedures in accordance with CFTC regulations. CFTC has also found that those FCMs are complying with the additional disclosure requirements related to options. Few abusive sales practices have been noted by the staff in reviewing the audit files of the exchanges and the National Futures Association, or in the staff's own spot check audits of FCMs.

CFTC believes that the fact that the regulations provide for trading of options on regulated exchange under the surveillance of exchange auditors has tended to discourage participation by questionable operators. These measures have resulted in a program which focuses self-regulatory responsibility on the exchanges and which substantially supplements CFTC's own enforcement resources.

In the consideration of exchange-traded futures and options in conjunction with farm programs, it may be instructive to look at the liquidity that exists in various of those markets.

For example, Chicao Board of Trade soybean futures contracts trade approximately 800,000 contracts per month with open interest of 125,000 contracts while the CBOT soybean options trades approximately 150,000 contracts per month with 90,000 open interest. Other major commodities subject to price supports with traded options and futures are CBOT corn with futures volume of approximately 800,000 per month and 125,000 open interest, and options volume of 70,000 per month with 60,000 open interest. CBOT wheat futures have had an approximately 200,000-contract monthly volume and 30,000 open interest, while the CBOT wheat option has had an approximately 10,000-contract monthly volume and 10,000 open interest. The New York Cotton Exchange's Cotton #2 futures contract had trading volume of approximately 150,000 contracts and open interest of 25,000 contracts while the cotton option has had average volume of 10,000 per month and open interest of 8,000 contracts.

A major factor in the congressional lifting of the 50-year statutory ban on domestic agricultural options trading was the possibility that options might be useful in offering an additional price protection mechanism to commercial entities. To monitor the commercial use of options, CFTC required as part of the options reporting rules that exchanges provide a month-end report of open interest held by commercial entities. Those reports indicate that the greatest percentage of open interest held by commercials is on the short side of the market (that is, short calls or long puts) where generally 25-35 percent of the open interest in CBOT soybeans, corn, and wheat and N.Y. cotton options is held by commercials, and up to 50 percent of Kansas City Board of Trade wheat options is held by commercials. On the long side of the option market (that is, long calls and short puts) the commercial participation generally ranges from 5 to 25 percent of the open interest, except for N.Y. cotton where 25-50 percent is generally held by commercials.

This level of commercial participation on the long and short sides of the options market is substantial, although it does not reflect the full effect that agricultural options have had on commercial entities. Shortly after the trading of agricultural options began, there appeared in the cash market agreements known as minimum price guarantee contracts. These contracts generally provide that an entity such as an elevator or merchant will guarantee a producer a fixed minimum price, while allowing the producer to elect to receive the market price for the commodity if that is higher than the guaranteed price. In all cases, however, the producer would have to deliver the commodity to the merchant. The merchants would usually use exchange-traded options to hedge their contract exposure, thus enabling the producer to benefit indirectly from exchange-traded options. This is analagous to the indirect way producers benefit from exchange-traded futures via fixed price cash market contracts offered by merchants who hedge those contract with futures. The CFTC became involved in reviewing minimum price guarantee contracts as a result of requests for interpretations regarding the applicability of the continuing ban on off-exchange agricultural options to these contracts. After review by CFTC staff, the CFTC's Office of the General Counsel issued an interpretation which viewed these contracts as a hybrid of a fixed-price cash forward contract (which is excluded from CFTC jurisdiction by Section 2(a) (1) of the Commodity Exchange Act) and a cash-settled option contract. The interpretation indicated that, since a major characteristic of these minimum price guarantee contracts was the transfer of the physical commodity in commercial merchandising channels, these contracts could be considered 2(a) (1) of the act and thus, outside CFTC jurisdiction. This interpretation clarified the legal standing of these contracts with respect to the act and cleared the way for wider offering of these contracts.

In general, the regulatory program for the trading of options incorporated the futures market mechanism as much as possible. It was carried out in a generally phased expansion, with periodic reviews of the trading experience and reports on that experience to Congress. It appears that such an approach has resulted in an orderly and sustainable reintroduction of domestic exchange option trading. The ability of futures and options markets to further aid the agricultural sector in dealing with price risks and income variability is the subject of investigation and the discussions of this symposium.

FARMERS' EXPERIENCE IN USING FUTURES AND OPTIONS MARKETS

Jim Gill

I appreciate the opportunity to visit with you about one of my favorite subjects: marketing education and information. After I spent some time with Uncle Sam, I was in a family farming operation in central Illinois. I hope that operation will be there for several more generations. I have been trading commodities since 1967 and options since trading began.

Back in farm country, the joke about trading the markets until the farm is lost seems to have sort of disappeared in recent months. Nowadays, farmers worry about buying the farm and losing on the cattle, sometimes $60 to $70 a head, or having the President declare an embargo for some particular reason and see the market go limit down for 5 days. Then after hearing the trader down at the local cooperative elevator or coffee shop say it is going to go another 5 days, they pull the plug on a whole year's production of corn or soybeans. And, the next Monday, they see it go right straight back up again and they miss out on an enormous amount of money, sometimes the entire profit from a year's work. So farmers as a whole, I think we all recognize, are facing risks like they never really expected to when they got in this business of farming.

We in the Cooperative Extension Service and the teaching side of the Farm Bureau in Illinois have been fortunate to have a Board of Directors that was interested in adult education. We took a profile of our membership some time ago and found out that there are probably a little over 100,000 farms in Illinois. About 97,000 can be classified as full-time or commercial farms. Operators average 59 years of age. Of course, that accounts for Mom and Dad and others that may not fit the farmer profile right now. So our farm population is getting up in years.

Most of the folks that are the commercial farm operators have some education, quite a few finished high school, and some completed college. We did some testing to see what their reading comprehension level was so far as our farm information effort was concerned. The average Illinois farmer has a seventh grade level in reading comprehension. That, we felt, was very very important because it meant that average farmers, and this counts those that attended or are attending college, get the bulk of their news from television. They get it in short bursts and we in the agriculture education and information business have been overlooking this when we have been sending them information newsletters by mail. I know my Dad said he had to enlarge his standard mail box to handle all of the newsletters that were coming.

When you stop to think that the average level of reading comprehension is somewhere about the seventh or eighth grade level, then maybe we in the education area have to approach it differently. So what our folks get interested in doing is putting together a set of adult education courses that were actually taught by farmers, farmers who were college graduates, including ones who had some experience in education and economics as well as production agriculture. We were able to find 52 farmers and their spouses who were willing to have their expenses and some honorarium paid to go out and teach some other farmers. We have taught about 2,600 farmers more about marketing and more about marketing information in the last 2 1/2 years.

Jim Gill is with the Illinois Farm Bureau.

We have been teaching about where to look for information, about how to use it, especially about the uses of futures, and lately about the uses of commodity options. In fact, we had a rush-rush, hurry-hurry request for marketing PIK certificates. Now PIK certificates, you know, weren't even in the language of the farmer or anyone else until just the last several months. Yet there was an almost instantaneous demand to train people, the ordinary farmers, the seventh and eighth grade reading level people we just mentioned, how to handle these things. A brother in the grain elevator business during the time when the first batch of certificates were issued tells about a farmer who came in and showed him one of those white pieces of paper and asked him "what am I going to do with this bill from the Government?" The farmer actually thought it was a bill from the Government! When he was told he could sell it for more than face value, he really was incredulous.

You know these are the kinds of things the folks are facing and dealing with and I'll tell you they are in no way prepared for the day and age of complexity that we are in right now.

Selling at the bottom of an embargo low becomes such an emotional low that it affects them for quite a while. We feel maybe 6 or 7 percent of our 100,000 farmers have attempted to learn about futures markets and maybe half that number have attempted to learn about the options markets. Now they are all trying to learn about the PIK market because, as they visualize it now, it is a basically little or no risk method of marketing. The folks who didn't care to learn, and this may be half of them, are the ones who really want their price protection from farm programs. As you have seen in the last 2 or 3 years, this gets to be an expensive way to provide price protection and at taxpayers' expense. Of course farmers are taxpayers too.

So I guess the challenge is to make the education program more complete than it is today. Until then, we are going to have a large number of farmers who are saying they need price protection via some type of farm program. We have been very hopeful that adult education programs can help these people. We have seen a handful of young couples, who are replacing the ones who are retiring, take to educational materials. They are looking for ways to use the computer as a marketing tool. Not too many people have really put together anything that a farmer can actually use. That is a challenge.

Another thing that affects the use of futures and options at the farmer level is the relationship with the agricultural lender. The folks from Cargill, Continental, ADM, or the large cooperatives, of course, establish a lending line to cover all of their hedging and merchandising functions. But, a farmer may have a typical lending line during the crop season of $90,000 or $100,000. The farmer may need $50,000 or $60,000 of that to put in the crop. If so, not much cash flow is left to get through the year.

To run a marketing program that includes hedging in futures, you have to have an agricultural lender that can stand automatically the margin calls. Many farmers run into the experience of setting up a marketing game plan and seeing the market for whatever reason change abruptly, whether it be Chernobyl last year or the soybean spike we have just recently seen. Then the agricultural lender decides to pull out of the game, not advance the margin money, somewhere near the high day. They all fear it is going to be on the high day. It is almost like the market moves 6 days in a row to make sure the producer does not have enough margin money to get through it.

The lack of financing for hedge programs has caused some agricultural lenders to recommend to producers who want to use these price protection type programs that they use options, because the lender may know nothing about futures, except to be scared to death of it. Lenders do know that an option has a premium like an insurance policy and that it is a known entity. Margin risk is not a known. Rather, it goes on for weeks. So I've seen agricultural lenders recommend to farmers that they use or get interested in options instead of futures. I wouldn't be surprised that under the current agricultural lending situation that we see this kind of thought increase.

We also have started to work with agricultural lenders. We have 120 agricultural lenders, usually the young loan officers who have gone through a modified version of the basic course that has been developed strictly for agricultural lenders. They give it very high marks. There is hardly anywhere that agricultural lenders can go to get a hands-on type course in options and futures. Most of us have gone through a land-grant college course of some kind or other or a university business course. But up to the last 3 or 4 years, there weren't very many courses on futures and options. There were price forecasting type courses but that is a different application. So we think by combining courses for agricultural lenders and farmers that maybe we can conquer problems of education back in our State.

The information in the AgriVisor program was introduced about a decade ago. The Farm Bureau in Illinois put a little over a million dollars into that program to get it established and felt it was a well worthwhile effort. A million dollars in Washington really doesn't go very far. But, back in Illinois and Iowa farm country, a million dollars is a sizeable investment for education for adults.

Another observation. We have seen the cattlemen association suggest that the futures and options markets are something that this country doesn't need and propose on occasion to ban them. Those folks sometimes want to set up quotas or raise tariffs or otherwise interfere with the market place because they just don't know how the system works and they don't know how to use these kinds of tools. So I would venture to say there remains a big job to be done in educating the producers out there.

Where do we go from here?

I look at agricultural options as one of the newest tools for the farmers' toolbox. I see many farm wives who have the aptitude and interest to do marketing. I know a couple in western Illinois where the husband handles the fieldwork and the wife handles the marketing and raises the children. She has been to college and is a teacher of these particular courses. This couple is a real role model for these courses.

We feel that farmers can increase their net profit by use of futures and options if they learn how to do it. It takes about 20 years for any new technology to reach most of the producers. Sometimes you have to wait for the grandparents to retire and let the grandchildren take over to see the new farming technique really take hold. It doesn't make any difference whether it is the adoption of hybrid seed corn or the use of futures and options. We have to learn how to blend the use of the computer into these techniques because modern farmers are just as busy if not busier than their parents or grandparents. In fact, my mother has often said the biggest mistake farmers made was to put lights on their tractors because they don't come home at night now. Sometimes meals have to be taken out into the darkness.

They read of folks like the Board of Trade trader who supposedly takes $40 million or $50 million out of the market a year. They read about the stock market and the triple witching days that seemed to cause a lot of volatility in the futures and the stocks themselves and associate this with rising levels of risks and rising concerns about how to do their marketing.

Farmers have had trouble with futures hedging because they didn't understand it. They didn't have a chance to learn it in the school system. There is very little in the way of teaching this subject at the vocational agricultural level. That is where it has to start. There is a teacher in central Illinois that has taken on the responsibility of having all who go through his class know the terminology and philosophy associated with the use of these merchandising tools. I would hope we have confidence in those kinds of folks in the years ahead.

I think that options, as I mentioned before, can become a much more useful tool for the farmer than it is right now simply because of the problem that the farmer has with the agricultural lender. I personally feel that futures are a better forward pricing mechanism than options, but holding options can be taught to farmers as well as traders who use futures. I think perhaps 75-90 percent of them should and can learn how to use options. I think a mix of futures and options is what we will see used by farmers, not just the leading edge farms but by the top 50 percent of the farm operations a decade from now. I push it out a decade because now we are just nibbling at the problem.

My real hope is that the program that the Department is starting to work on now will shed some light and provide some impetus toward educating producers. Remember what I said at the start. Folks who don't get with a marketing program, the new type marketing programs, are those who holler and beat on congressmen to have more extensive farm programs.

In Iowa, hog producers can buy puts before the USDA hogs and pigs report. Farmers can consider options just before a USDA report as price insurance. A Texas cattle feeder can obtain price insurance on feeder cattle purchases. A Kansas wheat grower can establish a selling price for unharvested grain.

My conclusions. One, commodity options are a usable tool in the producers' toolbox just like futures. Two, agriculture needs an extensive set of education programs to teach people how to use them. Three, we need to have the agricultural lending people do their part in financing these programs. I see a huge problem there right now. Four, agricultural options, futures, and PIK certificates should be looked at as tradeable financial instruments that can be used by producers, processors, and exporters. Five, options usage should be expanded to play a role in farm programs. I have heard proposals that I think you will hear from speakers at this particular symposium. These ideas suggest that farm program could possibly be tailored to include greater use of options and futures whether in the hands of the Government or the producer.

I think change will come fast enough so that if we reconvene this conference a decade from now we would need to add a new set of words to the agricultural financial marketing vocabulary. My final forecast in that we will have a new set of words 10 years from now.

EFFECTS OF FUTURES AND OPTIONS TRADING ON FARM INCOMES

William G. Tomek

This paper reviews and appraises the evidence about the effects of options and futures trading on the level and variability of farmers' incomes. Futures and options markets are vehicles for price discovery and hedging (31), but other market institutions can play the same roles (36).1/ Thus, this paper is concerned not just with the returns from hedging, but with the question: What institution provides the least cost alternative for hedging? Futures markets typically are liquid and have a high degree of integrity. Therefore, for many firms, a futures contract provides the lowest cost hedge. But, these markets may not be the least cost alternative for the majority of farmers.

The theoretical and empirical evidence about the benefits of hedging is reviewed in the first section. This evidence suggests that hedging in futures (or options) should be beneficial, but that relatively few farmers use futures or options contracts for hedging. In this context, past analyses of the effects of hedging on farmer income are critiqued: In particular, costs of using futures and options markets are reviewed. The final section addresses the role of futures and options markets in influencing farm incomes, including the facilitation of forward cash contracts between merchants and farmers.

Potential Benefits to Farmers

Theory

It is convenient to divide the discussion of potential benefits into two categories: (1) the influence of hedging on the mean and variance of individual firm income and (2) the influence of futures and options trading on the mean and variance of market prices and quantities. This paper is largely about point (1), but theoretical models suggest that the introduction of a futures market can influence market prices and quantities, thereby indirectly affecting all farmers (and consumers). These results are summarized briefly.

Market effects. In typical models (for example, 34 and 39), the supply function shifts to the right and becomes flatter because producers are assumed to shift price risk at no cost with a futures market.2/ Thus, the mean price is lower and production larger than it would have been without an active futures market. Also, with a flatter slope, changes in demand will result in smaller price changes than under a supply regime without a futures market (fig. 1). However, this model treats producers as the only hedgers.

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

2/ The models typically assume that hedgers are risk averse and that they "pay" speculators to take the price risk through a risk premium. The market, however, does not have transactions costs.

A more complete model (for example, based on Anderson and Danthine, 3) would allow buyers of farm commodities to hedge as well. In such a model, both the demand and supply functions presumably would be affected by the introduction of a futures market, since it is again assumed to permit costless hedging. Firms therefore hedge, and a new futures market should have unambiguous positive effects on welfare (shifting both supply and demand to the right). In reality, hedging in futures is not costless, but the existence of active markets for many farm commodities implies that they have economic benefits.

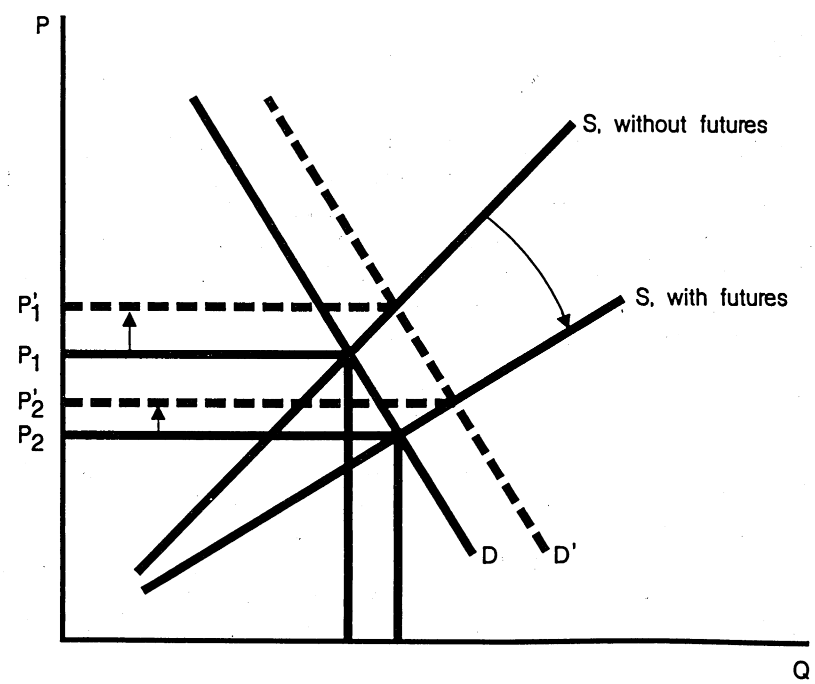
Intrayear prices may be affected as well. The introduction of a futures market should reduce the seasonal variability of spot prices around the annual average, because the constellation of spot and futures prices helps guide the allocation of inventories (42). Moreover, operational hedging by processors and exporters of farm commodities should reduce marketing margins. Futures often serve as a temporary, but important, substitute for cash purchases which merchants must make to meet contracted obligations and also provide for shifting price risk (31, pp. 17-19). Without futures, procurement costs would be larger. Hence, a good case can be made that farm prices would be lower and retail prices higher (5, 37).

Finally, the conceptual literature is more ambiguous about the potential effects of futures on short-term price behavior. But, the empirical evidence suggests that the introduction of a futures market does not increase and perhaps may decrease the variability of daily or weekly price changes (38). On balance, the aggregate market effects of futures trading seem to be beneficial to farmers, raising and stabilizing incomes. Or, at least the effects are not harmful.

<u>Individual firm effects</u>. Conditional on whatever market effects the introduction of organized futures trading may have, economic conditions determine prices. Returns to individual farmers from transactions in cash markets will

Figure 1

An effect of introducing a futures market



be distributed around market averages. Moreover, since futures trading provides zero additional returns in the aggregate, such trading could raise returns to farmers only if farmers as a group could consistently extract revenues from other traders. This would require farmers to be better forecasters than other traders. Although individuals can develop superior forecasting skills, no theoretical justification exists for arguing that farmers as a group can raise average returns through futures transactions themselves.

Similar arguments apply to farmers' use of options markets. For example, purchase of a put option places a floor under the sales price, and the purchaser can pick among floor (exercise) prices, thereby providing different risk-return alternatives (see Hauser and Andersen, 12). But, the price (premium) of the put reflects both expected price variability and the exercise price. Thus, if the farmer wishes to purchase a put with an exercise price above the current equilibrium level, this will be reflected in a relatively large premium. Even if the farmer purchases a put with an exercise price equal to the current equilibrium price each year, the expected value of the premium should essentially equal the expected benefit from holding the put (assuming, of course, that these values are determined in competitive markets). Whether or not the potential buyer of an option judges the premium to be "large" or "small" depends on the buyer's judgment about the future variability of prices relative to the market's judgment. The buyer can obtain an underpriced option only if his/her forecast of price volatility is better than the market's. In general, there is no free lunch.

Hedging, however, can have beneficial effects on farmer returns. The variability of returns can be reduced.3/ Moreover, if the constellation of prices indicates that an opportunity for profitable storage or production exists, these returns can be "locked in" through a hedge. But, the existence of futures and options markets does not guarantee that profitable opportunities will exist on a continuous basis. In competitive markets, prices can be below the cost of production. Forward markets do provide the flexibility to take advantage of profitable price relationships when they exist and to develop a variety of portfolios. These portfolios can include speculative positions, and in principle, the level and riskiness of returns can be altered to suit the individual's preferences.

Empirical Evidence

Research on farmer hedging has considered the effect of taking positions in futures on the variance of returns, on the mean of returns, and on the ability of hedges to assure the returns implied by relative prices. Early research simulated alternative marketing strategies, comparing various hedging programs with not hedging. Futures positions were typically assumed to be 100 percent (but be opposite in sign) of the cash position. Both routine and selective hedge programs were considered, where selective hedges involved some type of

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3/ In the optimal hedge framework, the effect of the futures position on the variance of returns depends, in part, on the covariance between futures and cash prices (or price changes). Measures of the parameters should pertain to the hedge interval. Thus, if a cattle producer held a hedge over a 5-month period, then the optimal hedge depends on variance and covariance parameters for this period. The variance of returns is reduced if the relevant covariance is not zero.

decision rule about whether or not to hedge. Such research usually showed that routine hedges could reduce the variance of farmers' returns and that selective hedges increase average returns in some cases. A typical result is shown in table 1.

Subsequent research has emphasized the use of optimal hedges in the context of portfolio concepts. Optima have been estimated for a variety of commodities and for different specifications of the riskiness of prices and yields [for example, 30 (eggs), 16 (grain and livestock), 17 (soybeans), 40 (wheat), and 24 (cattle)]. Such studies suggest that the optimal futures position is often a large percentage say, 75 to 100--of the expected cash position.4/ Thus, the implications for farmers' returns of optimal hedge positions are not much different than those studies that had assumed 100-percent hedges: namely, routine anticipatory hedges of production decisions will reduce the variability of income with little effect on average income.

The use of an objective function that involves explicit profit maximization, subject to a risk constraint, does imply, however, that the optimal futures position depends on expected price changes over the hedge interval. Thus, considerable research has considered whether price forecasts, through either technical or fundamental analysis, could improve hedging decisions (8). Research of this type often implies that farmers' incomes can be increased by selective hedges based on forecast price changes. It seems doubtful, however, that most individual farmers can consistently make profitable forecasts, thereby increasing incomes through futures transactions.

Producers of storable crops have a variety of marketing choices. Futures can assist in making these choices. The concept of arbitrage hedging emphasizes the use of futures to take advantage of expected (forecast) changes in relative prices rather than expected changes in price levels. Specifically, the change

4/ This result occurs because basis risk is often small relative to price-level risk and because these are the only risks considered in the analysis. For example, with harvest-time prices for soybeans in Decatur, Illinois, the standard deviation of the price level was $2.12 per bushel in the 1965-85 period, while the standard deviation of the basis was only $0.12.

Table 1--Net prices for corn in western New York, under simulated alternative marketing programs, 1975-80

Program	Mean	Standard deviation
	Dollars per bushel	
Cash sale	2.31	0.40
Routine hedge	2.27	.16
Selective hedge	2.37	.27

Source: (33, table 2).

in the cash price relative to the futures price over a storage interval can be forecast from the level of the initial basis (41 and 15).5/ This change in basis is a return to storage, and is assured through hedging. If a position in futures is taken when the initial basis (and the corresponding forecast of the return to storage) indicates that storage would be profitable, then a low risk, competitive profit is assured whether or not price levels rise or fall.

In table 2, these principles are applied to the storage of corn in western New York for 8 crop years. If a farmer had routinely stored corn at harvest each year and held the corn 24 weeks, the average gross return--the average seasonal rise in cash prices--would have been about 30 cents per bushel. However, these returns were highly variable. Routine hedging of the inventory would have reduced the variability of returns. But, more important, the harvest-time basis could have been used to forecast whether hedged storage would have been profitable or not. In 2 of the 8 years, this basis was small, indicating that corn should have been sold at harvest and not stored. If corn had been stored and hedged in the 6 years in which the initial basis seemed consistent with

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5/ Using the spot price and the current quote of a distant futures price relevant to the decision, the local basis (B) is defined. For example, at harvest, the difference between the current futures price for May corn and the local cash price defines a price of storage from harvest-time until May. The regression $dB = a + bB + e$ can then be fitted to historical data, where B is the basis at the beginning of the storage period and dB is the change in the basis over the intended storage interval. (The definition of dB depends on the storage interval being appraised.) The equation provides an estimate of the narrowing of the basis over the interval defined by dB, and dB can be forecast from B. This is a classic forecasting problem, since B is observable, and the standard deviation of forecast error is a measure of the basis risk.

Table 2--Gross returns to storing corn, western New York, 1978-85 crop years

Marketing strategy	Returns	
	Mean	Standard Deviation
	---Cents per bushel---	
Unhedged stocks	29.5	36.0
Routinely hedged stocks1/	32.1	21.6
Selective hedge2/	40.7	16.4

1/ Hedge placed about November 1 each year; corn is sold 24 weeks later (late April) and position in May futures removed; return to storage is change in basis. The return without hedging is based on the seasonal change in cash prices over the same interval.

2/ Returns from carrying inventory and futures positions in 6 of 8 years. In the other 2 years, the harvest-time basis was judged too small for hedging. The "zero" return from not carrying stocks in these years is not reflected in the calculations, but presumably the revenue from the harvest-time sale of corn would have earned a market rate of return in an alternative investment.

decision rule about whether or not to hedge. Such research usually showed that routine hedges could reduce the variance of farmers' returns and that selective hedges increase average returns in some cases. A typical result is shown in table 1.

Subsequent research has emphasized the use of optimal hedges in the context of portfolio concepts. Optima have been estimated for a variety of commodities and for different specifications of the riskiness of prices and yields [for example, 30 (eggs), 16 (grain and livestock), 17 (soybeans), 40 (wheat), and 24 (cattle)]. Such studies suggest that the optimal futures position is often a large percentage say, 75 to 100--of the expected cash position.4/ Thus, the implications for farmers' returns of optimal hedge positions are not much different than those studies that had assumed 100-percent hedges: namely, routine anticipatory hedges of production decisions will reduce the variability of income with little effect on average income.

The use of an objective function that involves explicit profit maximization, subject to a risk constraint, does imply, however, that the optimal futures position depends on expected price changes over the hedge interval. Thus, considerable research has considered whether price forecasts, through either technical or fundamental analysis, could improve hedging decisions (8). Research of this type often implies that farmers' incomes can be increased by selective hedges based on forecast price changes. It seems doubtful, however, that most individual farmers can consistently make profitable forecasts, thereby increasing incomes through futures transactions.

Producers of storable crops have a variety of marketing choices. Futures can assist in making these choices. The concept of arbitrage hedging emphasizes the use of futures to take advantage of expected (forecast) changes in relative prices rather than expected changes in price levels. Specifically, the change

4/ This result occurs because basis risk is often small relative to price-level risk and because these are the only risks considered in the analysis. For example, with harvest-time prices for soybeans in Decatur, Illinois, the standard deviation of the price level was $2.12 per bushel in the 1965-85 period, while the standard deviation of the basis was only $0.12.

Table 1--Net prices for corn in western New York, under simulated alternative marketing programs, 1975-80

Program	Mean	Standard deviation
	Dollars per bushel	
Cash sale	2.31	0.40
Routine hedge	2.27	.16
Selective hedge	2.37	.27

Source: (33, table 2).

in the cash price relative to the futures price over a storage interval can be forecast from the level of the initial basis (41 and 15).5/ This change in basis is a return to storage, and is assured through hedging. If a position in futures is taken when the initial basis (and the corresponding forecast of the return to storage) indicates that storage would be profitable, then a low risk, competitive profit is assured whether or not price levels rise or fall.

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profitable storage, returns to storage would have been raised 11 cents per bushel relative to routine, unhedged storage. Moreover, the standard deviation of returns would have been reduced.

An analogous concept exists for livestock: The producer can assure a return to "feedlot services" through the use of futures, when profitable relative prices occur (29). Of course, relative prices may not always permit profitable hedges; the returns to feedlot services (or to processing or storage) can be small or negative. But, profitable feeding of cattle or hogs often can be assured via the use of futures (14 and 20). The existence of futures markets for feeder cattle and corn as well as for fed cattle means that a profit margin could be established even before cattle are placed on feed (23).

Much less empirical research has been done on the effects of hedging in options on farmer incomes. But, options contracts should be a useful hedging tool, especially where the underlying risk itself has the character of an option (35, p. 227). In particular, at the beginning of a production period, farmers face both yield and price risk. Selling futures, of course, provides a hedge against price declines, but it exposes the hedger to a risk if the crop fails and prices rise. In contrast, the purchase of a put option provides a hedge against a price decline. And, if prices rise, the option will expire worthless. The farmer obtains the benefit of the higher price for whatever crop has been raised. An analysis of pricing soybeans through put options shows, for example, that options can place a secure floor under prices while having little effect on the net realized price (6).

In addition to simple hedges, options can be used for many, more complex transactions and portfolios that involve varying risks and returns (see 13 and references therein). The introduction of options expands the choice set, and advisory services often refer to all of the strategies as "hedges." But, clearly varying levels of speculation are involved and, as returns increase, risk increases. The precise levels of risk and return are constrained by the existing price distribution (13).

In sum, the use of futures or options can help shift risk. Moreover, arbitrage hedges can assure (approximately) competitive returns on storage and production decisions when such returns are reflected in market prices (not just when the farmer has a crop to sell). It is doubtful that farmers, as a group, can raise incomes via hedging. However, in principle, producers can tailor portfolios from spot, futures, and options positions to achieve risk-return objectives suited to their individual situations.

Actual Farmer Hedging

The limited evidence available suggests that few farmers use futures or options markets and that many take speculative positions when they do (18, 22). In contrast, commercial, nonfarm firms often make active hedging use of futures. It is well-documented that short open interest in the grains is highly correlated with inventory levels. Likewise, long hedging in the grains grew as exports (and the contemporaneous procurement risk) grew. Short and long positions in potato futures also were related to stock holding, on the one hand, and forward commitments of processors and seed merchants, on the other (27). Even though Peck and Nahmias (32) found that optimal hedge models were poor forecasts of actual hedge levels of flour millers, their hedge levels were large.

Thus, one is led to ask: Are farmers ignoring large potential benefits relative to the cost of hedging? Or, are there deterrents to hedging uses of organized markets not suggested by past research? The answers may be, to some degree, "yes" to both questions. Farmers perhaps are not well-informed about the use of futures and options markets. I shall also argue, however, that the objective functions specified for farmers have not fully characterized the costs of using futures and options markets. Thus, for many farmers, especially those of small or medium size, the direct use of futures and/or options markets may not be the low cost way to hedge.

Appraisal of Benefits

Objective Functions

Farmers' expected utility is commonly made a function of expected returns and risk; that is, hedging is appraised in a mean and variance framework based on a measure of returns, not profit. I will not review the issue about whether a mean-variance framework is an adequate characterization of farmers' utility. But, I will argue that the usual measures of returns omit important costs of hedging. Moreover, the parameters of the objective function are treated as constants over the entire sample period, while they undoubtedly should be viewed as changing from decision period to decision period.

Both theory and empirical evidence imply that the parameters of the distributions of prices are not constants, either within years or across years (for example, 2, 9, 21), while the conventional estimation of these parameters assumes that they are constants over the entire sample period. Using a model that allows the estimates of parameters of optimal hedge equations to vary from decision period to decision period can reduce the size of the optimal hedge (for example, 11).

The main reason for overestimating the size of optimal hedges, however, is probably related to the omission of important costs from most specifications of farmers' objective functions. These costs include yield risk, transactions costs including those associated with margin calls, costs of managing a position in futures, and the lumpiness of contracts. While options may help avoid margin calls and yield risk, they are probably viewed as even more sophisticated instruments than futures by the uninitiated. The options are, of course, on positions in futures, and thus are also lumpy (for a general discussion of forward commitments, see 28).

Costs of Using Futures

The liquidity and integrity of futures markets are especially important to large commercial users, while transactions costs and the lumpiness of contracts are relatively unimportant to such users. Thus, the discussion of costs and risks which follows is from the viewpoint of the small- or medium-sized farmer.

Heifner (17) in a pioneering study, demonstrated that yield risks can be relatively important in determining optimal hedges. His work used county yield data for soybeans. A subsequent analysis of three Illinois corn growers by Greenhall, and others (10) indicated that the minimum risk anticipatory hedge on May 1 was only eight to 20 percent of expected production.6/ While one must

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6/ As time passes, yield risk declines and the size of the optimal hedge increases.

be careful in generalizing from an analysis of three farms, such calculations suggest that optimal hedges for individual farms can be small indeed. If, in addition, other costs are considered, one might conclude that the optimal anticipatory hedge for many farmers is zero.

The cost of initial margin and the possible risk of margin calls are potentially important.7/ The correct treatment of the cost of initial margin is unclear. For large traders, treasury bills can be used for the initial margin deposit if arrangements are made for payment daily of variation margin. But a small trader, even a small hedger, is unlikely to be permitted to use treasury bills in this way. Moreover, the minimum-size bill is $10,000, which is likely to be larger than the minimum margin requirement. In any case, there is an opportunity cost of using a bill for margin. In my view, one simply cannot assume that the cost of the initial margin is zero.

If changes in futures prices are approximately a random walk, then the income or costs associated with changes in the value of the contract are about zero on average. Thus, it perhaps is not surprising that the few studies that have included margin costs have found them to be a small component of hedging costs (26, 1). Nonetheless, large margin calls can occur in particular years. For example, if the standard deviation of daily price changes for soybeans were 10 cents per day, a hedger would need a line of credit of about $14,000 per contract to have a 99-percent probability of meeting the cumulative sum of margin calls that could occur over a 100-day hedge interval. This amount contrasts with an initial margin of $2,500 or less per contract.

A prudent hedger would want to establish a line of credit for the major part of the margin risk exposure, not just for the initial margin. But, will bankers typically extend such a line of credit? At what cost? Margin calls on anticipatory hedges are most likely to occur as yield expectations decline (and prices rise). The appreciation in the spot price is meaningless if the farmer does not have a crop to sell. Thus, a lender has a good reason (lack of collateral) for not extending credit for margin calls. In such a situation, the farmer may want to offset the futures position. But, that is related to my point: What is the optimal size of the futures position, what is the cost of maintaining that position, and how should the position be managed?

Research by Nelson (26) indicates that the lumpiness of futures (or options) contracts can significantly influence the per bushel returns. In a simulation of a California wheat grower wishing to hedge 7,600 bushels, he found the difference in returns between a 7,000- and an 8,000-bushel position in futures ranged from less than 0.1 cent to 15 cents per bushel over an 8-year period.

Costs of Using Options

If the farmer is buying (rather than writing) options contracts, then no margin is required. But, a premium must be paid. An option's premium depends on the option's intrinsic value and its time value. The intrinsic value is determined by the size of the exercise price relative to the market price. The right to sell at above the market price can be obtained only by paying a large premium. For example, in early April 1987, when cash corn in Illinois was $1.42 per

7/ Adding storage costs to the objective function can alter the optimal hedge when storage and futures positions are jointly determined (4). Adding transactions costs to the objective function also will alter the optimal hedge.

bushel and July futures $1.62, the price of a put option on July futures with an exercise price $1.80 was 20 cents per bushel. That is, the right to a short position in July futures at $1.80 per bushel could have been obtained even though that futures was trading at only $1.62. But this right cost more than the difference in the two prices. The time value of the option depends on the length of time to maturity and the expected volatility of prices (as well as interest rates).

As indicated earlier, options are advantageous for anticipatory hedges because they need not be exercised and hence are a way to deal with yield risk. But options still have basis risk. Changes in option premia are not perfectly correlated with changes in the price of the underlying futures contract. And, since the option is on the futures contract, one still has the basis risk between the futures and cash markets.

There are also costs and perhaps unforeseen risks in taking advantage of the numerous alternatives provided by options markets. For example, this past winter, a respected farm magazine recommended that farmers create a synthetic call option in corn, by buying July futures and by buying a July put, rather than buying a July call directly (7). The underlying assumptions of the advice were that corn prices were at a bottom and that a synthetic call was cheaper and less risky than buying a call or carrying inventory. Thus, the advice related to a way to speculate on a possible increase in corn prices and not to a way to hedge inventory.8/ Although corn prices were low in December, they unfortunately declined still further over the next 4 months. The long position in July futures lost 24-1/4 cents by April 6; this was partly offset by a 12-3/4 cents gain in the premium of the July $1.80 put. If prices remain low, the call can ultimately be exercised, and the major cost limited to the premium. But, as the example suggests, costs can be incurred while the positions are held. And, in this case, the long position in futures was taken at a price somewhat above the strike price, thereby causing an additional loss from a price decline.

As it turned out, the premium on the call declined from 10 to 1-1/4 cents over the same period. Thus, the loss from speculating in the call through early April 1987 would have been less than the loss on the artificial call. My main point is, however, that the potential benefits of diverse portfolios provided by options have associated, potentially important management costs. These costs might be appraised in terms of professional management fees or in terms of opportunity cost of a farmer's time.

Since the option is on a futures contract, lumpiness of contract size remains an issue. Also, the volume of trading in most agricultural options, especially those with distant expiration dates, has been low. Thus, some markets may be sufficiently thin that individual transactions could have unexpected price effects. In sum, I suspect that there are major barriers to farmers' use of options, including the size of the premiums and the seeming complexity of using the instrument.

8/ An alternative piece of advice would have been to hold inventories and hedge these inventories in futures, a classic arbitrage hedge. The carrying charge reflected in market prices in the Fall of 1986 was quite large, and a hedge in futures could have "locked in" this return.

Conclusions

Hedging in organized futures or options markets has clear benefits in terms of shifting risk and of assuring competitive returns identified by existing price relationships. Forward markets, however, cannot provide above average returns for farmers as a whole. To imply, for example, that hedging in futures or options can provide above-equilibrium prices is to engage in a fiction.

The benefits of using organized markets come at some cost. These costs may be relatively large for individual farmers. Yield and basis risk are important issues at the farm level. Transactions costs, including margins, can be large. The lumpiness of the contracts may affect the returns from the hedge. And, farmers may perceive futures and options as complex instruments, which have high costs in terms of a scarce management resource.

In my opinion, these costs conspire against the direct use of futures and options contracts by many individual farmers. If this is true, then the benefits of futures and options markets for most farmers will come from their indirect use. As Johnson (19) has argued, opportunities exist for "wholesalers" to develop a wide range of services, contracts, and products, based on underlying futures markets, that can be "retailed" to a larger public.

For example, forward contracts and basis contracts are widely available to farmers from their local merchants with the merchant then undertaking the requisite transactions in futures. Options markets permit additional forward arrangements. Grain buyers can offer minimum price contracts to farmers, with prices based on those offered in the organized options markets (25). The minimum price contract provides the farmer with the benefit of the option: The establishment of a minimum sale price with the potential for taking advantage of price increases if they occur. The farmer also must pay the transactions costs, the option premium. But the farmer may see the contract as having a lower management cost and no basis risk and thus find it more attractive than the direct use of the options market.

In sum, for many farmers, the benefits of organized futures and options markets are most likely to come from their indirect, rather than direct, use. And, of course, these indirect uses can occur only if active, healthy futures and options markets exist.

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PART III: POLICIES THAT OPERATE THROUGH OR INCREASE FARMERS' AWARENESS OF FUTURES, OPTIONS, AND CASH FORWARD MARKETS

ALTERNATIVE PUBLIC PROGRAMS TO INCREASE FARMERS' AWARENESS AND POTENTIAL USE OF FORWARD MARKETS

Richard G. Heifner and Thomas L. Sporleder

Is it possible to design a new type of farm program that operates through or in conjunction with commodity futures and options markets, and offers significant advantages over existing programs? This is a challenging question to those familiar with the shortcomings of existing programs and the pricing and risk-shifting capabilities of forward markets. A little probing indicates that programs involving futures and options markets offer no quick and easy solutions to the current low-income problems of agriculture. Whether such programs offer other important advantages over existing farm programs is a complex question.

Farm programs and farmers' use of options and futures markets usually are discussed in separate forums. This separation is understandable in view of the fundamental differences between these two approaches to pricing farm products. Yet major farm programs and futures trading have coexisted since the 1930s. Exploring ways to make these two kinds of institutions work together more effectively seems worthwhile, even if it does not lead directly to a new type of farm program.

Our presentation focuses on possible full-scale, options-futures programs that might be offered to producers throughout the country. The pilot program called for by the 1985 farm act is viewed as a step in developing and testing such a nationwide program. The possibilities for such programs are many and varied. These include Government trading, educational programs, the backing of new types of forward contracts for farmers, and subsidizing farmer's use of existing contracts. Our objective in this presentation is to identify and categorize these alternative programs to facilitate discussion and analysis.

The process of categorizing program alternatives raises certain issues. For example, should the program be confined to options or options-like contracts, or should futures and cash forward contracts also be included? Thus, a secondary objective is to identify some of the major issues that arise in developing options-futures programs.

Finally, our work so far identifies numerous questions about program mechanics that call for answers. A sampling of these practical questions of implementation will be examined as we proceed.

Goals of Farm Programs

Before looking at alternative types of programs, we will consider what policymakers seek to accomplish through such programs. The goals of farm programs are often not well defined, partly because policymakers represent diverse interests

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and do not agree on goals. Thus, we proceed, not expecting full agreement on goals.

Raise or Support Farmers' Incomes

To raise farm incomes is probably the primary reason that the public and Congress support farm programs. Existing programs achieve considerable farm income enhancement largely through transfers in the form of deficiency payments and similar provisions. Price supports and farmer-owned reserves can raise farmers' prices and incomes temporarily by removing product from the market and subsidizing its storage. But, this is a short-term effect; stocks soon become burdensome. Prices and farmers' incomes cannot be raised over longer periods unless production is curtailed or part of the product is given away or disposed of in secondary markets where it would not otherwise be purchased. Programs operating through options and futures markets generally could not provide even the short-term market price enhancement that price supports provide since they would not remove supply from the market. Any major income transfer to farmers would have to come either from giving farmers arbitrarily high payments for participating or from other subsidy programs operating alongside the options-futures program.

Stabilize Farm Prices or Farmers' Revenues

Stabilization is a frequently cited but ill-defined goal of farm programs. Income stability and price and income certainty or predictability are probably more important than price stability as such. Indeed, price variability is not all bad. Some price changes are needed to reward storers for carrying inventories and to facilitate adjustments to changing technology and tastes. Since an options-futures program would have little effect on interyear stock-carrying, its stabilization potential is limited. It should help producers learn to anticipate more accurately prices and revenues and reduce risks. USDA is seeking to learn more about these effects through our modeling analyses.

Help Farmers Learn to Use Forward Markets More Effectively

The percentage of farmers who use commodity futures and options directly for hedging and the proportion of production covered are relatively low. Lack of greater use stems in part from lack of knowledge about what the markets offer. Perhaps this constitutes an information failure that calls for more public investment in educating farmers to use forward markets. Indeed, it can be argued that existing farm programs, by giving farmers an alternative way to limit risk, reduce their incentives to learn to use futures and options.

Limit Costs to Consumers and Taxpayers

Existing farm programs are costly. A prime reason for seeking alternatives is to lower this cost. Some people believe that a futures-options program might achieve some of the aforementioned goals at lower cost than existing programs.

Relationships Between Price Supports and Commodity Options

Selling forward, buying put options, and obtaining price support loans are alternative ways for a farmer to gain protection from unexpectedly low returns. Put options and price supports are similar in that both tend to establish a minimum price or floor price without fixing the maximum price, as does selling forward. The implied floor price for the farmer who has purchased a put option equals the put's strike price minus the option premium and expected closing basis (ignoring commissions and opportunity cost on commissions and premiums.) Thus, a farmer who holds a put option faces price risks much like those faced by a farmer who is eligible for price support. This similarity between put options and price supports suggests that the two might somehow be integrated.

Of course, price supports and commodity options differ in important ways. First, the farmer who buys a put option pays a premium for the risk protection obtained. With price supports, the risk protection is provided by the Government. Price supports are tools for redistributing income in favor of producers, whereas unsubsidized futures and options trading are neutral with respect to the distribution of income. The effectiveness of price supports for redistributing income is, of course, questionable, as noted previously.

Second, price supports are instruments by which Government influences the amounts of a commodity consumed and stored each year. Under price supports, carryover often depends not upon what storers think the commodity will be worth to consumers the next year, but on what the Government will pay. In contrast, futures and options markets facilitate individual decisionmaking about storage and utilization based upon market prospects.

Third, the time periods covered by put options and price supports differ. The support level is normally set before planting and holds through the marketing year. In contrast, new put options begin trading several times each year, but maturities more than about 6 to 8 months in advance are not actively traded. This limits how far ahead minimum prices can be set with put options. Moreover, put option premiums and the implied floor prices attainable by buying puts vary over time.

Fourth, options offer farmers several different strike prices and implied floor prices to choose from, whereas only one support price is available. Protection against extreme price declines can be acquired by buying an out-of-the-money put with a low strike price. Higher levels of price can be guaranteed by buying puts with higher strike prices for larger premiums.

Fifth, price floors obtained through options are subject to basis risk. If the closing basis is different from that expected, the actual floor or minimum price will also differ from expectations. Basis risk tends to increase with distance from the delivery point for the futures.

Finally, put options guarantee price for only the amount contracted, whereas price supports guarantee price for all that is produced on the qualifying acreage. The farmer using options, or minimum price cash forward contracts, must either contract for more than an average crop to assure that even a large crop will be covered, or be prepared to sell part of a large crop at a lower price if market prices fall below the strike price.

Relationships Between Options-Futures Programs and Other Farm Programs

An options-futures program could be designed as (1) a partial or complete replacement for existing programs, (2) an alternative operating alongside existing programs and available to farmers who select it, or (3) a complement or added benefit to existing programs. It could replace or substitute for price supports only, or for price supports and deficiency payments.

The first approach would call for eliminating existing programs as the options-futures program came on line. This is the only approach that involves moving toward a "free market." Under many possible scenarios, part of the existing programs would be retained alongside the options-futures program. For example, price supports might be dropped while retaining acreage controls and deficiency payments. Any income-raising effects of price supports could be either eliminated or provided through some new type of payment to participants.

The second approach would allow each farmer to participate in the options-futures program or the regular program, but not both. Options-futures program participants would probably be subject to the same acreage limitations and eligible for the same deficiency payments as regular program participants. Such a program would win participants only to the extent that its benefits exceeded those of the regular program. Pilot programs must generally operate in this fashion since barring regular program participation in pilot program counties would likely be considered unfair.

The third approach would make the options-futures program purely an added benefit above the regular program. Examples would be a purely educational program or a program to subsidize the purchase of call options for farmers who sell their crops at harvest.

Regardless of the approach taken, some type of pilot program is needed to develop and test administrative procedures. However, replacement of the existing program cannot be meaningfully tested at the pilot program stage since pilot program participation and results would be strongly affected by the regular program. Moreover, the act's requirement that pilot program participants be guaranteed returns at least equivalent to the price support level makes meaningful comparisons across programs difficult.

Types of Programs

Four possible types of futures-options programs are: (1) Government trading to influence price, (2) purely educational programs, (3) backing new types of forward contracts, and (4) subsidizing farmers' use of existing contracts. We will discuss each in turn and examine the last in some detail.

Government Trading to Influence Price

The Federal Government attempted to raise farm prices by trading in the agricultural futures markets under the Federal Farm Board in the 1920s. Results were very unsatisfactory, possibly due to economic conditions of the time. In the 1960s, Hendrick Houthakker proposed a scheme for Government trading solely for stabilization purposes, but there have been no recent attempts to implement such a program. Indeed, there seems to be little current interest in Government trading for the purpose of influencing prices. Such trading could dramatically change the character of the markets. Government trades might be large and lumpy, they could constitute a major proportion of the trades during many time periods, and Government traders would have different motives than commercial traders. Moreover, recent experience in the cocoa, tin, copper, and coffee markets suggests that buffer stock authorities are not particularly effective in stabilizing prices.

Purely Educational Programs

There are a number of educational programs offering widely different intensity of training in futures, options, and hedging. Many State agricultural extension specialists provide 2- to 4-hour county meetings on futures and options. There are some privately operated schools or week-long seminars offering hedging education at considerable cost to participants. In addition, the major exchanges and land-grant universities offer material and sometimes seminars to educate potential hedgers on futures and options.

Despite these efforts, relatively few potential hedgers are reached or effectively educated. Farmers may distrust brokers' efforts to disseminate information or provide education because of vested interests on the part of brokers. Various intermediaries, such as local merchants in cotton or producer cooperatives in hogs, may provide some education concerning the use of forward contract markets.

The current "delivery system" for education seminars and materials on commodity forward markets is fragmented and dispersed. The Federal Government could assist, in a complementary fashion, the current fragmented system by funding through the Federal Extension Service, Commodity Futures Trading Commission, or some other agency increased educational efforts in the use of forward markets. The advantage would be a central focus of activity. For example, sponsorship of 3-day to 1-week seminars in various parts of the country could be accomplished through such a center of responsibility.

Education is an important aspect of participation in forward markets. Much is in place, but additional public effort may be needed if broader participation is to occur.

Backing New Types of Contracts for Farmers

Existing futures and options contracts do not meet the needs of all farmers. Cash forward contracts with local buyers fill many of the gaps, especially where the farmer needs smaller or more flexible contracts, or wants to avoid basis risk. But cash forward contracting also has its limitations. Perhaps Government assistance is needed to help develop contracts that meet farmers' needs more closely. This might involve creating new types of Government-backed contracts and making them available to farmers, or subsidizing the development of new trading mechanisms.

One proposal for the futures-options pilot program would have the Government issue warrants that guarantee farmers the difference between a specified support price and the market price for a fixed amount of product. Once such contracts were issued, the Government could, if desired, transfer the price risk to the market by: (1) buying offsetting options contracts on the existing exchanges or (2) buying offsetting contracts from a dealer pool through a sealed-bid auction, somewhat similar to the auctions currently used to market Government securities.

Government might encourage the development and trading of contracts that set prices and quantities for delivery several years into the future. Such contracts might help farmers assure themselves of satisfactory returns on investments in land and equipment.

Another possibility is for the Government to help establish facilities to trade new standardized contracts where delivery is intended. For example, computerized or telephone exchanges might be developed to bring together farmers, first handlers, and/or processors for trading cash forward contracts. These "forward deliverable contract markets" should give individual farmers access to a larger number of buyers.

Subsidizing Farmers' Use of Existing Contracts

The fourth possibility is to subsidize farmers' purchases of approved options or futures contracts. Farmers' trades would be accomplished through existing exchanges and trading channels with timing decisions left to the individual farmer's discretion. The need to execute large numbers of trades over short periods should be less than with Government trading, although there could still be surges of farmer trading as farmers sought to meet deadlines imposed by program rules.

The types of contracts which might be eligible for subsidy include purchase of put options, purchase of call options, sale of futures, and fixed or minimum-price cash forward contracts.

Put options: Most of the ideas for options-futures programs start with put options. An illustration of how such a program might work is presented in the upper panel of table 1. In this illustration, we have assumed that the Government subsidizes the premium for an at-the-money put option which is 7 cents per bushel. Yield risk, basis risk, and commissions are disregarded and we have assumed that the market price is at the price support level. The farmer realizes the $1.80 minimum price even when the market price declines, and a higher price is realized when the market price rises. This year, of course, market prices have frequently run below support levels due to the certificate program and the market loan program for cotton and rice. This and basis and yield risk lead to complications that we will discuss subsequently.

Short futures positions: The 1985 Act calls for a study and pilot program dealing with futures as well as options. Futures offer features that some farmers may prefer. The workings of a program to subsidize short hedging in futures are illustrated in the lower part of the table. We have assumed that the Government pays the farmer 7 cents per bushel--the cost of an at-the-money put--for taking a short futures position. In this case, the farmer locks in a return of $1.87 per bushel, which is higher than the $1.80 minimum price obtained through put options, but forgoes the chance to get a higher return from a price increase during the life of the hedge.

For farmers, the opportunity to benefit from a price increase is a major advantage of hedging with put options compared with entering fixed-price contracts, such as selling futures. However, to gain this advantage, the farmer must generally accept a lower minimum price. The average revenue realized over a period of years, after paying option premiums, can be expected to be about the same as for hedging with futures.

Implementing a workable program appears more difficult for futures than for options. Futures involve exposure to margin calls. This might require some type of open-ended loan commitment by CCC to assure participants that they will not be forced out of positions at inopportune times. Administering such a program could be complicated.

Call options: Subsidizing farmers' use of call options has been suggested by some, particularly by persons associated with the cotton industry. Put options, like price supports, protect the farmer against downside price risk only until the product is sold. Sale of the product frees the farmer from downside price risk and eliminates any further need for such instruments, but also eliminates any possibility of gaining from a price rise. Thus, to subsidize the holding of put options beyond harvest is to subsidize storage and the holding of the product

Table 1--Example price and return outcomes for subsidized options and subsidized futures trading

Assumptions:

	Dollars
1. Current price for 1988 May futures	2.00
2. Expected local basis in May 1988	-.20
3. Expected local market price	1.80
4. Local loan rate	1.80

Panel A: Pay for at-the-money puts (Strike=$2.00):

	Possible outcomes		
		Dollars	
May futures price	1.80	2.00	2.20
Farmer's revenue--			
Return from cash sale	1.60	1.80	2.00
Return realized on put	.20	0	0
	----	----	----
Total	1.80	1.80	2.00
Government cost for option premiums	.07	.07	.07

Panel B: Pay farmers $0.07 for selling futures:

	Possible outcomes		
		Dollars	
May futures price	1.80	2.00	2.20
Farmer's revenue--			
Return from cash sale	1.60	1.80	2.00
Profit or loss from futures	.20	0	-.20
Incentive payment	.07	.07	.07
	----	----	----
Total	1.87	1.87	1.87
Government cost for incentive payment	.07	.07	.07

off the market. In some cases, Government may want farmers to move their products into market channels. By holding call options, farmers can speculate on price increases without holding the product and with limited exposure to downside price risks.

Cash forward contracts: Buyers of farm products offer farmers many types of cash forward contracts. An important distinction is between traditional fixed-price contracts and the newer minimum-price contracts. The former are close substitutes for futures contracts and the latter are close substitutes for exchange-traded options.

Cash forward contracts have been much more widely used by farmers than futures contracts. They offer several advantages to farmers over exchange-traded contracts. They can be sized to fit each farmer's specific needs instead of at multiples of 5,000 bushels (for grains and soybeans) or 50,000 pounds (for cotton) as with futures. For example, one standard soybean futures contract equals the output of 148 acres of soybeans yielding 35 bushels per acre.

A cash contract assures the farmer a place to deliver the crop and guarantees a supply to the local buyer. Basis risk is carried by the local buyer instead of the farmer. The farmer avoids margin calls and the need to establish an account with a futures commission merchant. Countering these advantages is a degree of risk that local buyers might default on their obligations. Local buyers typically take slightly higher margins to cover costs of hedging and absorbing basis risk.

Programs to subsidize farmers' use of cash forward contracts would encounter additional problems not present in subsidizing exchange-traded contracts. Cash forward contracts are more heterogeneous. Determining what constitutes subsidizable participation would be more difficult. Because of the differences between contracts offered by different buyers, guaranteeing farmers' revenues equivalent to specified support levels might be impractical. Concerns would arise as to whether local buyers were offering fair prices for forward contracts. These should be limited if farmers were allowed to use exchange-traded futures or options contracts as alternatives to cash forward contracts.

Related Considerations

The amount of subsidy to be offered to program participants is, of course, a big issue. The choice depends upon what the program seeks to accomplish. Modest subsidies should be sufficient to entice farmers to try new types of contracting if they continue to reap benefits from other programs. If, on the other hand, the program were to replace existing programs, then substantial subsidies could be required to provide farmers with comparable incomes.

Type of Subsidy

Farmers' use of forward contracts could be subsidized in at least four different ways: (1) cover specific expenses such as commissions and options premiums for pre-specified strike prices, (2) make special loans to provide farmers cash at harvest in lieu of price support loans or to cover margin deposits on futures, (3) make fixed payments per bushel or bale covered by approved types of contracts, or (4) pay farmers at the end of the year the difference between their realized return and some targeted return.

Cover specific expenses: Programs to cover specific expenses would be relatively easy to administer. Farmers would be required to present receipts showing the commissions or option premiums paid or the amount and duration of contracts entered.

Loans: Many farmers rely upon CCC nonrecourse loans at harvest-time to pay off production expenses. To make an options-futures program equally as attractive as the traditional nonrecourse loan program, some provision to make cash available at harvest may be needed. This might take the form of an ordinary recourse loan from CCC that would have to be paid back at maturity.

As noted previously, programs to subsidize futures trading may require some form of assured loan to help farmers meet margin calls.

Fixed payment per bushel or bale: Another possibility, and one that appears to be relatively easy to administer, would be to offer farmers a fixed payment per bushel or bale for entering approved types of contracts. For example, the Government might make a prescribed payment per bushel to farmers who either held put options, maintained a short futures position, or held cash forward contracts over some specified period. This would encourage farmers to avail themselves of price protection offered in the marketplace, but allow flexibility in the type of contract used. Determining what constitutes an eligible contract could be a problem.

Difference between realized return and support price: Finally, the Government could guarantee a specified level of return for those farmers who enter approved contracts by making year-end payments to cover any shortfalls. This would meet the 1985 Act's requirement that: "Participating producers shall be assured..... that the net return received.....is no less than the price support loan level." It could be relatively easy to administer, but may invite abuse. Farmers would be tempted to enter risky contracts since any losses would be covered by the Government.

Mechanics of Implementation

Many decisions that must be made about program implementation involve timing: When should contracts be entered? When should they mature? Will program participants be allowed to roll over one contract to a contract that expires later? Other decisions pertain to how many contracts a producer would be allowed to hold under the program.

Time of contract entry: Should the program apply over the growing season or only after harvest? Government can give growers price assurance at planting time either by subsidizing their entry into forward contracts then, or by announcing price levels and conditions for subsidizing contracts later. By getting farmers into forward contracts at planting time, the risks of guaranteeing prices over the growing season could be shifted from the Government to the market. Put options and minimum-price cash forward contracts are conceptually well suited for dealing with the yield risks involved. One problem is that put options with more distant maturities have not been actively traded in the past. Leaving the contracting until after harvest would be more like the existing loan program. Government would carry the price risks until the contracts were entered.

Contract maturities and minimum holding periods for contracts: To lower a farmer's risk, a forward contract must be held over some period of time. If participants were paid for buying option contracts and then allowed to sell the contracts immediately, then the program might offer them a quick profit without getting any significant risk shifting. On the other hand, the chance for participants to take advantage of a sudden unexpected price increase by selling their product and selling their put options or buying back the futures should not be denied. Some type of minimum holding period for contracts seems to be needed, but it should not be overly restrictive.

Roll-overs: If farmers are to obtain price guarantees over extended periods as with a loan program, then they need opportunities to enter and hold contracts for up to a year or more before their products are ready for sale. This may imply that roll-overs should be allowed. A roll-over involves getting out of one contract and replacing it with another contract that matures later. Allowing roll-overs would make the program more complex. Would you allow farmers only one or more than one roll-over for each crop year? What constraints would apply? Would the Government subsidize commissions for roll-overs? Maintaining the necessary records could be a burden to the farmers involved and to ASCS offices.

Number of contracts to subsidize for each farmer: What proportion of each farmer's expected or actual output should be eligible for coverage? When hedging or fixed-price contracting a crop subject to yield uncertainty, total revenue risk is typically minimized by selling forward no more than one-half to two-thirds of expected output. We presume the public would not want to subsidize the holding of larger positions than this. These risk-minimizing hedging levels vary among areas, depending upon the degree of yield uncertainty and how closely local prices are related to futures prices.

The issue is similar but perhaps more complex for options. Here the notion of minimizing revenue risk is more difficult to apply since the probability distributions for revenues are clearly asymmetrical. A one-to-one ratio between puts and expected output seems like an appropriate place to start, but this is not necessarily the best ratio for every farmer. A farmer who wants to be fully shielded from price declines might adapt a strategy to apply the delta (expected change in the option price corresponding to a one-unit change in the futures price) used by futures-options spreaders. For example, this could involve buying twice as many at-the-money puts as expected output. Other strategies also are available to hedgers of total revenue.

Price requirements: Subsidies for entering options, futures, or cash forward contracts might be made only for contracts that would be at least marginally advantageous to the farmer without subsidization. This could reflect the objective of helping farmers learn to use sound trading strategies that apply with and without the program. For example, suppose that the local support price for corn is $1.80 and the expected basis is 20 cents under. Then, payments might apply only for options with strike prices of $2.00 or higher since farmers would be better off to place the commodity under support than to depend upon options with lower strike prices.

Market Price Below the Loan

Under conditions like those of this year, with marketing certificates and/or marketing loans allowing market prices to fall below support levels for some commodities, a put option with a strike price equivalent to the loan could be deep in the money and exhibit little, if any, trading activity. How can a program be designed to utilize the more actively traded options contracts--those near the money--or futures contracts, and still attract participants? This may require compensatory payments.

Summary

We have sketched a number of possibilities for options-futures programs. The list is not exhaustive and many details remain to be examined. However, it is apparent that determining what, if any, type of program to implement is a complex task. Among the major issues to be resolved are:

What is the purpose and intent of such a program? Raise farmers' incomes? Stabilize prices? Free prices from Government control? Save taxpayers' money? Help farmers manage risks? Simply educate farmers about forward markets?

How will the options-futures program relate to other programs? Replace? Alternative for producers to choose? Supplement?

What kind of activities are to be included? Government trading? Pure education? Backing for new types of contracts? Subsidizing farmers' use of existing contracts?

What types of contracts are to be included? Puts? Short futures?

Calls? Fixed-price cash forward contracts? Minimum price cash forward contracts?

How much and what type of subsidy is to be provided?

Once these questions are answered, questions remain about the details of program mechanics.

Options-futures programs need to be viewed in the broader context of overall farm policy. Futures and options markets appear to be well suited to perform many of the pricing and risk-shifting functions provided by farm programs, but not suited for other functions such as redistributing income. The challenge is to design farm programs that complement and take advantage of, rather than conflict with, the pricing and risk-transfer functions of these markets.

DISCUSSION

Robert J. Hauser

Heifner and Sporleder note that farm programs and farmers' use of option and futures markets usually are discussed in separate forums. And, I may add, by separate groups of analysts. This independence between fields of study proves to be a nagging source of personal humiliation as I struggle with some very fundamental questions about the form and implementation of current farm programs, let alone the reasons for and consequences of the programs. So, as a self-proclaimed agricultural marketing economist who now has a better appreciation for what he does not know about agricultural policy, I decided to focus this discussion on identifying "market characteristics" of some current farm programs. I will particularly examine the options valuation characteristics of farm programs.

Heifner and Sporleder discuss the similarity between farm programs and option hedging. In short, both tend to set price floors to the producer while allowing that producer to capture favorable price changes. This similarity is perhaps the single most important reason why the pilot program was mandated in 1985 farm legislation, why this conference exists, and why the authors focus on alternative means to incorporate options into farm programs. Therefore, it seems worthwhile to take a closer look at the similarity issue. I will do so here by considering the values of farm programs in an option-pricing framework relative to values of options traded in the market.

Before examining specific programs, consider the general concept of farm programs as put options with a Government-set exercise price. Assume that the Government gives this option to the farmer about 6 months prior to harvest. Table 1 presents some hypothetical premium values that the market might determine for this type of an option when the exercise price is $1.80 per bushel of corn. Three different cases are illustrated in which the option is either out of the money, at the money, or in the money.

One view that has been taken (9) is that the economic value of this program could be measured by the market-determined premium.1/ In the case where the futures price is $1.60, this value is 30 cents per bushel or, when the futures price is $2.00, the value is 10 cents per bushel. Even when the market price is greater than the exercise price, the program has economic value perhaps not recognized. For instance, if the corn price stays above a price support level so that the price support is not effective, the program still provides economic value as reflected by the premium. Later, I will show that considerable care should be taken when applying this type of valuation because the option actually being offered (as a loan program or as a target program) may have a much different theoretical value than that imputed from its analog in today's option market. Now, however, I wish to consider the separation of the farm program premium into that which augments price versus that which helps manage price risk.

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

The option with an underlying commodity price of $1.60 in table 1 has an intrinsic value (exercise price minus futures price) of 20 cents. In a sense, this intrinsic value represents the price-enhancement portion of the option which is being given to the farmer. The remaining 10 cents of the premium (the time value) can be thought of as the risk-management (or price insurance or price stabilization) value. The other options in table 1 convey this risk-management separation perhaps more clearly. For example, assume the basis is zero and known (this assumption does not detract from the generalization being made). If the futures price is $2.00, the hedger can either "lock in" this price through hedging with futures, or buy an option with a strike of $1.80 for 10 cents, or forgo these forward market alternatives and maintain a naked position in the cash market. The simple but important point here is that the hedger <u>can</u> accept a price which is above the support (exercise price) level. This choice is a risk-management decision. An issue that becomes apparent when considering the incorporation of options into farm programs concerns the extent to which we want to influence this risk-management decision.

In the following three sections, three types of farm programs will be defined in a stylized form and then discussed as if the market were asked to value the programs as contingent claims or options. Each program considered is related to current programs for corn. The loan program that is in effect from the sign-up period (preplanting period) to harvest is considered first. The second program is defined as that part of the loan program which exists during the post-harvest period. The third program considered is the target or deficiency payment program.

A number of caveats concerning the following discussion on program valuation should be emphasized. First, each program is defined in a manner which ignores many interrelationships among programs. For example, the current target and loan (support) programs are inseparable parts of one package. Yet, I will treat them separately. Another obvious example is that the loan program is offered to the farmer once a year. Yet, I will treat it as if it were offered twice a year. These types of departures from current program definitions are made so that valuation characteristics can be conveyed easily. A second caveat is that each valuation issue will be discussed by itself, <u>ceteris paribus</u>. Finally, little attention will be given to some of the distributional effects on price

Table 1--Hypothetical premia for put options with an exercise price of $1.80 by underlying commodity price

December futures price in April (dollars)	Intrinsic value	Time value	Premium
		<u>Cents</u>	
1.60	20	10	30
1.80	0	20	20
2.00	0	10	10

and quantity that might result from the form and degree of coexisting programs or from characteristics such as stock manipulation that may be inherent in the program being analyzed. See Fackler (7) for a discussion on some of these potential effects. These caveats reflect what is and what is not the purpose of my discussion. Namely, I do hope to identify the option valuation factors implicit in farm programs as well as the directional effects of these factors relative to the value of exchange traded options. I will not attempt to assess the aggregate effect of these factors on program value. After identifying individual valuation factors in the next three sections, I will conclude with a brief discussion on research issues.

Planting to Harvest Loan Program

Under the current nonrecourse loan program for corn, farmers pay an inkind premium so they can have the right to sell corn at the loan price. For analytical purposes, I will assume that farmers can exercise this option immediately after harvest.2/ The exercise price applies to the quantity harvested. The premium now paid by farmers for this option is the cost associated with requirements for program eligibility, such as acreage diversion. The premium in which we are interested here, however, is that which would be determined by the market if it were asked to price this program as an option.

Initially, the market's premium estimate will be based on the valuation paradigm set forth by Cox and Ross (5). This premium is equal to the present value of the option's expected payoff when (1) the expected distribution of the underlying commodity (UC) price is lognormal, (2) the expected value of the UC price at expiration T, $E[F_T]$, is equal to $F_t e^{\rho(T-t)}$, where F_t is the current UC price at time t and ρ is a factor that depends on the holding cost and UC nonprice returns associated with the UC, and (3) the variance of the expected log-price distribution is known. The resulting model for valuing put options can be stated as:

$$(1)\ P_t = e^{-r(T-t)} Q \int_0^X (X-F_T) L'(F_T) dF_T$$

where P_t is the premium at current time t for Q units of the UC, r is the annualized risk-free interest rate, T-t is the time to option expiration in years, X is the exercise price per unit, F_T is the UC price per unit at expiration, and L' is a lognormal density function. The lognormal distribution is such that $E[F_T]=F_t e^{\rho(T-t)}$, where ρ is the annualized geometric mean return on the UC and is, by definition, equal to the expected return in a risk neutral world. Equation (1) yields the same solution as Black's (1) model for pricing options on futures when $\rho=0$. For more detail on expressing Black's futures option model as well as Black and Scholes' (2) physical option model in these risk-neutral terms, see Hauser (10).

Black's estimate will serve as a base from which the loan program value is analyzed. Adjustments to Black's model are considered that account for (1) production uncertainty, (2) the form of the underlying commodity, (3) the ability to hedge against the option, (4) exercise restrictions, and (5) other valuation factors.

2/ Though this harvest exercise assumption is made for analytical convenience, it does reflect reality to the extent that PIK certificates cover production.

Fixed Versus Variable Quantity

Consider the currently traded commodity option on corn price. This exchange option is on a price of a fixed quantity. In other words, if the UC price and exercise price (F_T and X) in equation 1 are on a per bushel basis and if Q is 5,000 bushels, then P_t is the premium for 5,000 bushels. In contrast, the loan program can be thought of as an option on a variable quantity, q_T, depending on production. The expected payoff calculation (equation 1) for the variable-quantity case will equal the fixed-quantity calculation for a given F_T lognormal if (but not only if) two conditions hold: (1) q_T is independent of F_T and (2) the expected value of q_T is Q.

One might expect, however, that F_T and expected q_T exhibit negative dependence insofar as this relationship is dominated by supply shocks during the planting-to-harvest period over which the option applies. If this negative relationship exists, then the program premium is larger than Black's premium for Q if (1) $E[F_T]=F_t$ under lognormality, (2) $E[q_T|F_T=F_t]=Q$, and (3) $X \leq F_t$. To see this, assume that the option is at the money; that is, $X=F_t$. Therefore, the integral in equation 1 is over $[0, F_t]$. For the variable quantity case, each of the $X-F_T$ differences is multiplied by $q_T|F_T$ instead of Q. All of these products are then aggregated to find the expected payoff at expiration. Since the entire distribution of q_T for a given F_T is multiplied by the $X-F_T$ difference, then each product is simply the mean of q_T, given F_T, times $X-F_T$. Since $E[q_T|F_T=F_t]$ is Q while $E[q_T|F_T<F_t]$ is greater than Q because of the negative correlation, then the program option value must be larger (in expected-payoff terms) than Black's premium. If $X<F_t$, this is also true because the integral is over $[0, X<F_t]$ and thus each $E[q_t|F_T<F_t]$ is greater than Q.

On the other hand, if $X>F_t$ (an out-of-the-money option), then the program value is not unambiguously greater than Black's value since some $E[q_T]$ values (when $F_T>F_t$) are less than Q. The extent to which these values offset the $F_T<F_t$ effect discussed above depends on such factors as the form of the dependency between F and q and the level of X/F_t. For example, if the negative dependency were similar to a kinked demand in which $E[q_T]$ decreases sharply as F_T increases beyond F_t, while the increase in $E[q_T]$ is relatively slight as F_T decreases below F_t, then there is a good chance that the program value is less than Black's value, particularly for deep out-of-the-money options.

UC Definition

As mentioned earlier, equation 1 is Black's solution for put options on futures when the expected lognormal is formed from a diffusion process that is characterized by a known variance and a drift in price, described by $E[F_T] = F_t e^{\rho(T-t)}$, in which $\rho = 0$. The value of ρ is equal to the equilibrium rate of return expected by a holder of the UC who does not consider the price variability or risk of holding the UC. For Black's futures option model, the cost of holding the UC is assumed zero and thus the equilibrium rate of return (ρ) is zero. Likewise, Thorp (18) shows that (European) options on forward contracts have the same value as Black's solution for futures contracts. Black and Scholes' (2) seminal model for physical (stock) options, however, yields a value that can be found in the expected-payoff framework by setting ρ equal to r. This model is for an option on a physical with no nonprice returns (such as dividends, convenience yields, etc.) and thus the expected equilibrium rate of return on this UC in a risk-neutral world is the risk-free interest rate r. If, conceptually, some type of continuous and proportional dividend payment on the UC is made (for example, Merton, 14, p. 171) at the annualized rate of d, then $\rho = r-d$.

Of interest here is the definition of the UC for the planting-to-harvest program option and the consequent level of ρ. A simple view on this issue is that the program is a forward contract and therefore ρ should be zero. The problem with this view is that it ignores the landownership or professional eligibility requirements. That is, the general public can hold a futures or forward contract traded in the market. However, only farmers may hold the forward-price promise that is available through the loan program. This eligibility requirement means that the program option changes the opportunity cost of production during the entire planting-to-harvest period. In this sense, the UC may be physical in nature in that it increases the opportunity cost of holding the land. However, one cannot sell the UC without selling the land. Thus, I do not know nor do I wish to hypothesize what the most appropriate perspective should be on this issue. I offer it as a factor that needs further thought and definition.

Discrete Trading

Most contemporary option valuation models are based on Black and Scholes' construct in which the UC and option can be continuously hedged against each other such that the resultant portfolio return replicates the return on a risk-free bond. This risk-free portfolio is why the expected-payoff model yields an equivalent solution for many cases. However, the UC and program option cannot be traded in an attempt to form this risk-free portfolio and thus the use of contemporary option-pricing models to value the program is suspect.

At least three different perspectives on this problem could be taken. One approach would be to value the program with models developed before Black and Scholes' work. See Smith (17, pp. 15-20) for a review of representative models from this period. These models focused on the valuation of contingent claims under various expectation and risk-preference assumptions. The second perspective is one that justifies the risk-neutrality assumption even though continuous hedging cannot occur. Examples of return processes and risk attitudes that lead to the same solution are found in Brennan (4), Merton (15), and Rubinstein (16). A third and perhaps most practical perspective is that Black's solution for the program represents the discounted expected cost to the government under reasonable assumptions about the terminal price distribution, even if the solution is not acceptable as a premium estimate. In other words, equation 1 is a present value of expected cost if one expects F_T to be F_t and if one's variance forecast is equal to the market's forecast. Thus, it may be useful to consider Black's solution from an expected-cost perspective if not from an economic-value perspective.

European Versus American

The planting-to-harvest program option under consideration is "European" in that the program participant must wait until expiration (harvest) to exercise the option. The premium estimate from equation 1 is appropriate with respect to this characteristic because Black's model is for European options. However, a valuation difference between the program option and its exchange option analog may stem from different exercise opportunities.

Commodity exchange options are "American" options that can be exercised any time before expiration. *Ceteris paribus*, an American option is worth at least as much as a European option (14). For example, assume that equation 1 is used to price a European put option under the following conditions: (1) Q=1 bushel, (2) X=\$2.30/bushel and F_t=\$1.80, (3) time to expiration is 6 months, (4) r=.08, and

(5) the annualized volatility percentage is 23. The resulting premium is 48.9 cents. The American option under these conditions would be worth at least 50 cents since one can exercise the option and receive $2.30 when the current market price is $1.80. A numerical technique that accounts for the possibility of pre-expiration exercise yields a premium of 50.3 cents.3/

The exercise characteristics of the planting-to-harvest program option versus the exchange option suggest that replacement of the program with options on a "one-to-one" basis would lead to increased costs to the Government. To a large extent, particularly for deep in the money options, this cost difference is caused by subsidization during the planting period with options as opposed to subsidization at harvest under the program. This is so because the "intrinsic values" of the program (European) option and exchange (American) option converge as expiration approaches.

Other Valuation Considerations

There are many reasons why the theoretical estimate of an exchange option value may differ from observed premia. A few of these reasons might involve (1) the effects of trading liquidity, (2) different volatility expectations among traders, (3) differences between borrowing and lending rates, (4) transaction costs, (5) noncontinuous UC price jumps, and (6) other distributional characteristics of the UC price that do not conform to the theoretical model. The general effect of these departures from the theoretical model on the evaluation of potential costs incurred when replacing aspects of a farm program with an exchange option is of interest here.

An example of this type of an evaluation is provided above where the exchange option premium is 50.3 cents when the program option premium is 48.9 cents. The 48.9-cent program value is relevant because it is an estimate of expected cost, regardless of its reliability as a premium estimate. Insofar as the cost of using options in lieu of this program is the estimated exchange premium, then the additional cost of using an option in this case is only about 1.5 cents per bushel. I hypothesize, however, that this type of cost comparison would generally underestimate the additional cost of using options. I'm inclined to believe this because violations of pricing model assumptions usually lead to an increase in premium. For example, many program options are fairly deep in the money. However, deep-in-the-money options receive relatively little attention by traders. The deep-in-the-money options that are traded often exhibit higher implied volatilities than, say, at-the-money options (for example, (11)), implying that different pricing models are being used since the market's forecast of UC price volatility is not conditional on the exercise price.

The point here is that many adjustments that the market makes to option valuation models do not have to be made when estimating the expected cost of a program option. Insofar as these adjustments cause an increase in the exchange option premium, an increase in the cost of incorporating options into farm programs can be expected.

Harvest to Expiration Loan Program

After harvest, the loan program allows the producer to place a fixed and known quantity of corn in reserve and receive a loan equal to the quantity times the

3/ This technique is a version of Cox, Ross, and Rubinstein's (6) binomial pricing model.

loan (support) price. Ignoring redemption with PIK certificates, the farmer has the option to forfeit the corn to the Government when the 9-month loan period expires. If the corn is forfeited (that is, the option is exercised at expiration), neither the principal nor interest is repaid. If the farmer redeems the loan before expiration, the principal and interest is repaid and the option is, in effect, given back to the Government.

The current loan program exhibits both American and European exercise properties, depending on the extent to which PIK certificates are issued. These certificates allow the producer to exercise the option for at least part of quantity before expiration. For the remaining quantity not covered by certificates, the option is European in that the corn cannot be "sold" to the Government at the loan price until expiration.

The UC for the program defined here is physical; that is, corn must be held. However, a payout or dividend accrues to the holder of the UC in the form of interest that is not repaid if the option is exercised. This interest can be viewed a continuous dividend and, as defined earlier, this means that ρ = r-d. Therefore, if r = d, the pricing formula for this physical option is the same as the formula for options on futures.4/

Other valuation considerations identified in the previous section on the planting-to-harvest program are also applicable for the harvest-to-expiration loan program. However, given only the two effects discussed here, the relative value of the program option could be greater or less than the exchange option. The exercise effect of the program implies that the program option is worth less than the exchange option because the program option is, in part, European. On the other hand, if d is sufficiently larger than r, then the program option value is larger than the exchange option value. These issues, like others identified earlier, need to be addressed empirically.

Another feature of this program that deserves particular emphasis is that the option is returned to the Government if the corn is sold before expiration. If a similar requirement were not made when replacing the program option with an exchange option, then the cost of subsidizing producers with exchange options could be considerably larger than the expected cost of the program option. This is reflected by the fact that if a producer is given an exchange option and then sells corn before expiration, that producer still has an option that can be sold. Under the current program, the producer cannot receive the option value when the corn is sold before expiration.

In terms of equation 1, this concept is reflected by adjustments to Q, where Q is defined here as the amount of corn placed under loan at time t (harvest). The expected cost of the harvest-to-expiration loan program depends on the proportion of Q expected to still be under loan at expiration T. Since this proportion is presumably less than one, the issuance of exchange options covering all of Q could very well increase Government costs.

Target Program

The current target or deficiency program allows the producer to accept deficiency payments equal to a Government-set quantity, C, (based on base acreage and past yields) times the difference between the target price, TP, and

4/ Hoag (12) implies that a positive convenience yield on a storable commodity also reduces ρ.

the average crop-year price, AP. Thus, this program option has an exercise to UC price ratio equal to (TP-AP)C/(F-AP)C.

The UC is similar to a futures option in that no physical commodity is held. In this sense, "ρ" is zero. However, the use of ρ is not strictly appropriate in this case because a lognormal diffusion process cannot exist in theory since a positive AP variate is subtracted from an assumed lognormal variate, F. This distributional effect, however, may be of little practical importance when compared with the effects discussed below of a random AP and of temporally dispersed deficiency payments.

The average market price, AP, that will be realized is uncertain, causing the exercise price of this target program option to be stochastic. In other words, the option guarantees that the producer will receive (TP-AP)C, but this payment depends on AP which is path dependent on F. Some examples of theoretical work on the effects of a stochastic exercise price include Boyle and Emanuel (3), Fischer (8), and Margrabe (13). Based on the case where the exercise price is the average of realized UC prices (Boyle and Emanuel) as well as on intuition, it seems safe to conclude that the premium value will decrease in response to increased randomness in the exercise price. Intuitively, this is plausible because once the exercise price exhibits randomness, the option's "usefulness" as a right to sell at a price level declines.

The final valuation factor considered for the target program is the timing of deficiency payments. If the Government provides the entire deficiency payment at expiration, then the option is European and thus priced less than an American counterpart traded in the market. However, diversion payments in recent years have been made throughout the year, causing the value of the option to increase.

Concluding Remarks

There are many differences between the option characteristics of farm programs and the characteristics of exchange options. Hypotheses about the effects of these characteristics on the valuation of programs were offered here. However, quantitative measurement of the effects is needed, particularly if the incorporation of exchange options into farm programs is pursued beyond the pilot stage. I wish to conclude this paper with some brief thoughts on this measurement task.

Two challenging problems in the measurement of program valuation were mentioned earlier as issues that this paper does not address. The first problem is that programs as well as option characteristics of individual programs must be combined and analyzed together. The second, which is another related aggregation problem, involves the price and production effects of moving toward an option-oriented farm program. As illustrated by Fackler, these price/production effects are extremely difficult to model in both conceptual and empirical terms.

Among the program valuation factors identified in this paper, I believe that the research effort required for appropriate analysis of four factors would be considerable. This is not to imply that these four factors are expected to have the largest effect on value. I suspect, however, that they would pose the largest research challenge.

The first factor concerns the production uncertainty effect associated with the planting-to-harvest program scenario. Discussed earlier were possible valuation effects when the expected relationship between price and quantity is negative. This relationship could alternatively be assumed positive due to a domination of demand shocks. I am not aware of empirical evidence indicating how this expected relationship should be viewed.

The second issue involves the separation of option market trading realities from theoretical pricing models. When evaluating program costs, one must first find a base situation in the market for which a theoretical pricing model performs well. Adjustments made by the market to this base model should then be considered when cost comparisons of farm programs with and without exchange options are estimated. Given our limited knowledge about how and why these market adjust- ments are made, this is a formidable task.

The third "large" problem is related to the current target program's requirement that the program option be returned to the Government if the corn is sold before expiration. The estimated value of this type of a program depends, I suspect, on one's analysis of the expected Q (quantity under loan) distribution at expiration given conditions during harvest and/or the sign-up period.

The fourth and final problem is in developing models to analyze the random exercise-price properties of the target program. These models could perhaps follow along the same lines as previous work in this area. However, I doubt that existing models could be adapted readily for this target program valuation.

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DISCUSSION

Patrick J. Catania

These comments are my own and not necessarily representative of any farm policy position that the Chicago Board of Trade might have. Overall, I think the Heifner-Sporleder paper does a good job of presenting possible alternatives for achieving a more market-oriented farm program through the recognition or incorporation of futures and options into that program. The potential flaw in carrying out the legislated pilot program is that the results could be meaningless in the long run and for long-term planning because such a program would originate and would operate under the existing farm policy. I don't know that there is a fair chance to evaluate a program in that realm.

Over the last 16 years, I have been directly involved in educating farmers as an account executive handling their hedging business, as a sales officer for several different brokerage firms, and now with the Chicago Board of Trade. You who are academics can especially appreciate my one conclusion after this 16 years of trying to educate farmers: That is, very simply, farmers as students are no different from the rest of the human race as students. There are some "A" students, there are some "C" students, and there are some "F" students. To assume that we educate to the degree that all farmers are going to perform as "A" students is a problem from the outset. You simply cannot "legislate" into existence a whole crop of "A" students.

Heifner touched on a very important point, in fact, the most important point as far as I'm concerned. And that is, what are the goals of such a program? The question comes up again and again as I work with the people who are taking a stab at how we approach this program. What are the goals that we are trying to achieve? In this legislation, we have created or enacted a response to a question which is yet to determined.

The goals should be to look at farmers, look at producers, and to teach to encourage them to develop something very basic to any business activity. That, very simply, is a marketing plan. Until we can establish within the realm of the farmers' perception that it is necessary to operate under the auspices of being in business, and until they develop marketing plans which then may incorporate something such as this proposed pilot program or legislated pilot program into those marketing plans, I don't think we are really accomplishing anything.

If a farm program, and that includes the legislated pilot program using options and futures, is designed so that farmers are no worse off by using the options and futures under the pilot than they would be if they stayed within the existing farm program, what is the incentive to learn? Why would they be involved in any further activity in teaching themselves more about the marketplace and how to exist within that marketplace? We are inviting them under this proposal to learn about and use this exchange traded option or a futures contract. But, by the same token if it turns out that they lose 10 cents a bushel, we will make that up. We will cover it. We will make you whole.

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I often wonder, when asked to be a discussant on a program such as this, is the discussant supposed to answer questions or ask questions? Today I've opted to raise the questions. I think there are some very basic questions that we really have not yet addressed. How do you get someone to sign up for such a program? How do you entice farmers to become a part of the pilot: To give a shot at taking the route where you use exchange traded options or futures contracts, build a marketing plan, develop strategies, and enact those strategies? How do you interest them in doing that if their neighbors opt not to take the plan and the neighbors will be supported at full value and the farmers who become part of the program are not made whole?

Specific segments of the paper that concern me, especially in my capacity with the Chicago Board of Trade, dealt with the concepts centering around education. Under the listing of the types of programs that they might envision (which included Government trading, educational programs, new types of contracts for farmers, etc.), the part that interests me the most is the purely educational program segment.

The paper may be a little misleading in this realm, especially with regard to the discussion of existing educational programs. I would agree with the statement within the paper that efforts thus far have been fragmented and that they need to be better coordinated. A lot of activity has taken place in recent years to do just that. Many of the exchanges have worked directly with the producers trade associations. The Chicago Board of Trade, the Minneapolis Grain Exchange, and the Kansas City Board of Trade all have very tight working relationships with the national associations. So there is a very concerted effort taking place, albeit in recent times, to put together an ongoing program to be delivered to farmers directly or under the auspices of the national trade associations.

This concerted educational effort has taken place under one banner. That is the banner of marketing alternatives. We have presented across the country the same concept, the same type of program: Marketing alternatives. Our goal as an exchange is to see farmers take more action and more interest in the marketing of their products.

All of this is fine and dandy in terms of theory. In practice, we still have the farm legislation and the farm programs hanging over us. I bring up the same question again. What is the farmers' incentive to avail themselves of this information, this knowledge, these potential tools when in fact there is a farm program that can make them whole?

I also found another interesting point in the paper. I want to basically bring it up as a point of reference. The comment was made that, in terms of educational efforts, sometimes farmers feel pressured when that educational effort comes through a sales network of a brokerage firm.

Some years ago, I think it was 1982, the Chicago Board of Trade conducted a survey among brokerage house accounts through which we asked all kinds of questions. Basically, we attempted to find out who is using the marketplace and what types of clients are out there. Are they doctors from Des Moines? Dentists from Des Moines? Or, farmers?

Something stood out very clearly in the results of that study. Of those respondents who classified themselves as agricultural producers, most also classified themselves as regularly receiving two to three brokerage house newsletters or research reports. So, while I understand the hesitation a producer might possibly have in dealing directly with the sales force in terms of an educational effort, they do realize the potential of that sales firm as a research and information source.

One final comment on this whole concept of educational effort and activity. The paper made a point that perhaps "The Federal Government could assist, in a complementary fashion, the current fragmented system by funding through the Federal Extension Service, the Commodity Futures Trading Commission, or some other agency, increased educational efforts in the use of forward markets." I again quote from the paper: "... the major exchanges and land-grant universities offer material and sometimes seminars to educate potential hedgers on futures and options." In fact, when the agricultural options first began several years ago, the Chicago Board of Trade at its expense brought in 500 county agents, 50 at a time, and gave them a 2- to 3-day training course and overview on agricultural options.

The theory at the time was to prepare this group to go out and be fruitful and multiply and fill the earth with options users. It never happened that way. But, in some isolated instances, it was very successful. Some individuals took a very strong interest in it. But I think we lacked the followthrough by the Federal Government in prioritizing options education as an activity of those extension agents. Therefore, without that oomph, that extra kick or support in terms of prioritizing that activity, we did not get the followthrough. It's not to say we would not attempt something again if in fact we were assured of the type of support mentioned in the paper. We need some kind of backup and some kind of additional support from the Federal Government to make this a standing program as opposed to a one-sided effort by the exchanges.

In conclusion, I would simply say that the one potential flaw is the fact that results of any type of program instituted under the existing farm program, or while the existing farm program is in effect, may cause distorted perceptions or distorted views for the long-term efficiencies or effectiveness of using the futures and futures options markets. We should take Heifner's point to heart, that we look at the <u>goals</u> and the <u>objectives</u> of this entire effort, and that we state these goals and objectives so succinctly that there is no chance for error or misconception on the part of the producer or the USDA.

FUTURES AND OPTIONS PILOT PROGRAM

Larry Walker

I will discuss the following four topics related to the pilot program:

1. A summary of what is known relative to program provisions.
2. Responsibilities of the advisory panel.
3. My expectations relative to program provisions.
4. Questions that I have for this symposium.

First

Section 1743 of the Food Security Act of 1985 states that the pilot program shall be conducted in at least 40 counties. The commodities to be included are wheat, feed grains, soybeans, and cotton. However, the section also states that the commodities must be traded on both the futures and options markets. Thus, corn is the only eligible feed grain.

Section 1743 also states that the Secretary shall use the services of an advisory panel consisting of producers, processors, exporters, and futures and options traders in formulating the program. On December 24, 1986, a Departmental regulation was published that stated the advisory panel will consist of not fewer than 11 members, appointed by the Secretary.

Yesterday, Under Secretary Amstutz stated that the initial list of representatives to serve on the panel will be finalized in around 1 month. He also stated that the program will be conducted over a 16- to 18-month period to cover preplanting through most of the marketing year.

Second

The advisory panel will be responsible for determining (1) the number of counties that may participate, (2) actual county designation, and (3) administrative provisions of the program.

Third

I expect that the earliest that the advisory panel could meet would be during late 1987. This expectation is based on the following schedule of events:

(1) July--finalization of initial list of representatives to serve on the panel.

(2) August-October--security clearance of advisory panel members. (Legislation did not exempt panel members from security clearance requirements, 1- to 3-month process.)

(3) September-December--1 to 2 months for arranging a meeting date that will accommodate all panel members' business schedules.

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Thus, I would expect that the pilot program will begin during the February-April 1988 time period.

Further, I would expect that any of the four eligible commodities--wheat, corn, soybeans, and cotton--would be covered by the program in each participating county. That is, program coverage would not be limited to one commodity per county.

I am troubled by the wide use of the word "subsidization" and the context in which it has been used during this symposium. Even the phrase "hand out money" has been used. Federally sponsored programs typically involve some form of subsidy. But, I do not believe that Congress intended for this pilot program to require significant Government outlays. During the development of Section 1743, the pilot program was touted as a means of guaranteeing producers at least as much, if not more, net income at no additional taxpayer expense. If, during the time that pilot program provisions are being developed, significant Government outlays appear likely under the administration of such a program, I would recommend that Congress be consulted to ensure that such a program would not be contrary to the intent of Section 1743.

Fourth

I pose the following questions to you:

1. Can one expect that the education efforts under the pilot program will be more successful than past and present education efforts conducted by public and private sector organizations?

2. Should minimum strike prices and futures contract positions be required?

3. How and what interest expenses, or time value of money, should be considered in calculating producer net returns?

PART IV: RESEARCH FINDINGS

A SIMULATION ANALYSIS OF COMMODITY OPTIONS AS A POLICY ALTERNATIVE

Scott H. Irwin, Anne E. Peck, Otto C. Doering III, and B. Wade Brorsen

Price support programs have been the foundation of U.S. agricultural policies since the Agricultural Adjustment Act (AAA) of 1933. The basic price support programs begun under the AAA, while changing mechanically, have not changed in intent in 54 years. The programs have historically been criticized by some agricultural economists (28, 26, 14).1/ However, changes in the farm sector and greater awareness of the economic effects of the programs have led an increasing number of agricultural economists to criticize price supports.2/ For example, Bonnen (4, p. 99) has argued "... the original goals now often are obsolete, confused, or have been politically subverted in operation so that the programs clearly fail to address today's problems." Penn (21) noted that such criticism permeated the debate surrounding the Food Security Act of 1985 and led many observers to believe that the act would incorporate commensurate changes in policy.

While the 1985 Act ended up being sharply at odds with most earlier expectations, it did mandate study of alternative policies. It specifically stated that "... there is a need for investigation and development of alternative price support programs carried out by the Department of Agriculture; that agricultural producers and others have insufficient knowledge concerning the nature and extent of price stabilization in the private sector; and that more information is needed to accurately assess the Federal budgetary impact of producer participation in such private sector risk avoidance services" (27, p. 591). Private sector alternatives include producer hedging in commodity futures and options markets. Gardner (9) and Petzel (22) have argued that producers may stabilize their incomes in a desirable manner by hedging in commodity options markets. For example, the purchase of a put option allows a grain producer to establish a price floor, yet also benefit from possible subsequent price appreciation. Petzel suggests this skewed distribution of outcomes is an important reason why producers may prefer options to futures hedging.

Government price support programs set a price floor and allow producers to benefit from higher prices. This suggests, from a producer's perspective, a symmetry between the distribution of outcomes generated by price support programs and put options hedging. Gardner (9) has argued that a Government price support program can thus be viewed as a program of put option hedges

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

2/ See Paarlberg (19), Cochrane (5), Gardner (8), and Schuh (25) for a comprehensive review of the criticism of price support programs.

where producers do not have to pay the premium.3/ Under a price support program, producers gain the added benefit of having a minimum price guaranteed for realized production, whereas a minimum price is guaranteed only for expected production with options hedging. Marcus and Modest (17) have demonstrated that this feature of Government price support programs can be thought of as the provision of a random number of put options to producers. Given the premium subsidy and provision of a random number of puts, the distribution of producer revenue generated through market options hedging will be dominated by the distribution generated through participation in a Government price support program. Thus, the suggestion that options hedging in private markets can replace existing price support programs, and not reduce producer revenues in the process, is simply untrue.

While producers would prefer existing Government price support programs to unsubsidized options hedging, it is less certain whether producers would prefer existing price support programs to a program where the Government subsidized the full premium costs incurred through options hedging. The answer depends on the magnitude of yield risk faced by producers and individual program parameters, that is, the release price for Government-owned stocks under a nonrecourse loan program. Gardner and Petzel have argued that a subsidized options hedging program would be more efficient than existing programs, where efficiency refers to the net effect on producers, consumers, and taxpayers. These issues need to be investigated in light of the mandate expressed in the Food Security Act of 1985. Therefore, the purpose of this study is to simulate the effects of existing and options hedging programs on producer revenue, consumer costs, and taxpayer costs in the U.S. corn market.

Alternative Programs

Five alternative programs will be simulated: (1) a free market, (2) an unsubsidized options hedging program, (3) a subsidized options hedging program, (4) a target price program, and (5) a nonrecourse loan program. The programs are formulated for the corn market because neither the soybean nor animal product markets have been the subject of direct and extensive Government intervention. None of the programs include acreage diversion or set-aside options.

The free market simulation assumes no Government intervention through direct payments, stock management, or other means, and no hedging in the options market by farmers. The free market will serve as the base for comparing the other alternative policies.

The second alternative is a routine options hedging program, where all producers are assumed to hedge their expected production previous to planting. Put options are assumed to be purchased during April and offset during November. The strike price is assumed to be constant from year-to-year. The

3/ Schertz (24) argues that the government does require farmers to pay for the put option in price support programs by diverting acreage. However, acreage is not required to be diverted for all supported crops, and for those that are supported, acreage is not required to be diverted in all years. Furthermore, the effect of acreage reduction programs is lessened due to "slippage," which occurs when harvested acreage changes by less than the change in idled acres. Ericksen and Collins (6) concluded that, as a result of slippage, acreage reduction programs are only 47-86 percent effective.

supply of put options contracts is assumed perfectly elastic at the desired strike price. Finally, since the options are assumed to be purchased in a private market, private traders bear the risks of providing price support to farmers. If the options market is fair, in an actuarial sense, then premium revenue should on average be equal to the losses incurred through writing options.

The third alternative is a subsidized options program. This program is identical to the routine options hedging program except the Government is assumed to subsidize the full premium costs paid by farmers. The Government is assumed to subsidize the options premium only. The liability associated with the put options contracts continues to be borne by private market traders.

The fourth alternative is a target price program where the Government transfers income directly to farmers in years where the season average cash price is below a specified level. The amount of the transfer is equal to the difference between the cash and target prices, times a producer's actual production. No transfer occurs in years when the cash price exceeds the target price.

The fifth alternative is a simplified version of a nonrecourse loan program. The specified commodity is assumed to be purchased directly by a Government agency whenever the market price is below the loan rate. The Government stocks can be released only after market prices exceed the release price, which is set at 115 percent of the loan rate. It is also assumed that the Government agency can purchase enough stocks in any year such that the season average cash price does not fall below the loan rate.

Simulation Model and Assumptions

A modified version of the FEEDSIM model (12) will be used to simulate the U.S. feed grain sector. The FEEDSIM model has proven to be unique in its ability to incorporate alternative policies. FEEDSIM is a "synthetic" model, not built upon a system of equations estimated either jointly or in blocks. Rather, coefficient estimates were obtained from various studies and melded together by the judgment of the analysts constructing the model. The FEEDSIM model is also stochastic. That is, random variables are used to represent random (such as, weather) shocks in United States and rest-of-the-world supplies of corn and soybeans. For the United States, there are two random yield shocks, one for corn and one for soybeans. Production shocks in the rest-of-the-world are modelled by adding random shocks to the demand for U.S. exports of corn, soybeans, soybean meal, and soybean oil.

The FEEDSIM model was modified to incorporate corn futures and options pricing equations.4/ Futures prices are used in three parts of the simulation. First, futures prices are used in calculating expected prices for supply response decisions of farmers. Gardner (10) has shown futures prices to yield reasonable results in soybean and cotton supply equations. Second, futures prices are used to determine the price of corn options. Third, futures prices are used to determine the profits or losses from the options hedging positions. All prices are assumed to be specific to the December corn contract.

Following Kenyon and Cooper (16), the preplanting futures price equation was specified as a function of the one-period, lagged season-average cash price,

4/ See Irwin (13) for a detailed description of the modified FEEDSIM model.

ending stocks, and exports. The harvest-time futures price was specified as a function of the contemporaneous season-average cash price, which was assumed to be forecast without error at this stage in the marketing year. All equations were specified in linear form and estimated via ordinary least squares.

Black's (3) model was used to value put options. The studies of Jordan and others (15), Hauser and Neff (11), and Shastri and Tandon (23) suggest the Black model is an accurate predictor of options premiums in the absence of price-support related volatility distortions.5/ None of the simulations assume a private options market and a loan program operate simultaneously. A problem is observed, however, when the premium cost of producers is subsidized. The Black model assumes that the underlying commodity price is exogenous to option valuation. This assumption is violated under a subsidized options program. That is, the underlying futures price becomes endogenous due to the output-expanding effects of the subsidy. Determining a closed-form valuation model under this circumstance is intractable, if not impossible. Rather than simply ignoring this serious source of bias, we adopted an ad hoc procedure in an effort to account for the bias. First, uncorrected simulations were conducted. The average amount of the premium bias was estimated as the difference between actual put options buyers' gains and zero. This average gain was then added to each options premium in a subsequent simulation.

Corn and soybean production are modeled in FEEDSIM as Cobb-Douglas functions of expected prices, whose formulation varies by program alternative. All domestic and export demands are expressed as constant elasticity functions, which results in a more realistic simulation of prices for abnormal supply-demand situations (12). The demand function coefficients are shown in table 1 and are appropriately considered shortrun elasticities.

5/ The Black model is derived assuming futures price changes are normally distributed. A price support truncates the distribution from below, thus invalidating the normality assumption.

Table 1--FEEDSIM model: domestic and export demand coefficients

Demand coefficients	Intercept	Corn price	Soybean price	Soybean meal price	Soybean oil price
Domestic:					
Corn feed	149.0	-0.3	0	0.2	0
Corn other domestic	42.5	-0.1	0	0	0
Soybean other domestic	2.4	0	0	0	0
Soybean meal	18.1	0.2	0	-0.2	0
Soybean oil	16.0	0	0	0	-0.2
Export:					
Corn	107.0	-0.5	0.3	0	0
Soybean	5262.0	0	-1.0	0	0
Soybean meal	43.3	0.2	0	-0.6	0
Soybean oil	259078.0	0	0	0	-2.0

Sources: (18, 2, 12)

The simulations are best thought of as "experiments" whose purpose is the comparison and evaluation of alternative corn policies. Moreover, the simulations were not designed for forecasting purposes. A number of assumptions need to be stated: (1) The inflation rate is assumed to be zero, both for input and output prices. Thus, all reported prices and revenues will be in real terms. (2) The short-term interest rate is assumed to be a constant 8 percent for all simulations. The rate is used in determining options prices and the total cost of holding stocks. (3) The volatility of futures prices varies endogenously with the level of futures prices. The relationship is positive. (4) Annual storage costs are assumed to be 32 cents per bushel of corn. (5) Time-dependent intercept-shifters for yields and export demands are assumed to be equal to zero. (6) Starting values for exogenous variables were set equal to levels from 1984/1985. These were found to have less effect on outcomes than 10-year average values. (7) Demand and supply coefficients are assumed to be constant across all simulations. (8) The support-price was fixed at $2.60 per bushel in all simulations.6/ This was equal to the longrun equilibrium price established in the base free-market simulation. A basis adjusted support level, corresponding to the previous cash level, was used to specify the futures strike price for the options programs.

Simulation Results

To reiterate, five alternative programs were simulated using a modified version of the FEEDSIM model: (1) a free market, (2) an unsubsidized options hedging, (3) a fully subsidized options hedging, (4) a target price, and (5) a loan program. The simulations consisted of 500 iterations of a 7-year sequence. All simulations were begun with the same initial starting values for exogenous variables and seed values for random shocks.7/

The simulated results with respect to producer revenue, consumer costs, and taxpayer costs under the alternative policies are presented in table 2.8/

Relative to the free market, mean annual revenue of corn producers was essentially unaffected through unsubsidized options hedging. As expected, this was not true of the subsidized programs. The mean of producer revenue under these programs was an average of 11.8 percent higher than under the free market. The largest difference in mean producer revenue across the subsidized programs was less than 2.5 percent.9/ Thus, producers would likely be indifferent between the fully-subsidized options, target price, and loan programs based on mean comparisons. However, producers may still prefer the target price and loan

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6/ Simulations were also conducted at support prices of $2.30 and $2.90 per bushel. The results did not differ qualitatively and are presented in Irwin (13).

7/ Evaluation of the base free market results yielded two conclusions. First, the model was stable when simulated both deterministically and stochastically. All variables tended to converge to stable values reasonably quickly, typically by the third or fourth year of the 7-year simulation period. Both annual means and standard deviations were stable for the stochastic simulations. Second, the stochastic properties of the free market simulation were similar to that generated by the 1973-79 period, which represents the closest approximation to actual free market conditions of any recent period.

8/ The effects of the alternative programs on the revenues and costs of soybean producers and consumers, were also determined. The effects were minimal until the corn support rate was set above the longrun equilibrium price.

9/ Statistical tests were not conducted due to the highly nonnormal revenue distributions generated under all but the free market simulations.

programs if yield risk is substantial, which will result in a greater variability in returns.

Variability of producer revenue was in fact sharply reduced under all alternatives to the free market. The reduction in the standard deviation under the unsubsidized options program was $1.5 billion, or 31.9 percent. The average reduction was $2.3 billion, or 48.2 percent, under the three subsidized alternatives. Differences in the distributions of revenue become more apparent between the subsidized options, target price, and loan programs based on variability comparisons. This can be seen more clearly with the aid of figure 1, which shows the frequency distribution of producer revenue under the free market and the three subsidized programs. First, though, all three of the subsidized programs create a substantial degree of right skewness in the distributions relative to the free market. In this general sense, the programs are quite similar. Furthermore, comparison of the fully subsidized options and target price distributions reveal no meaningful economic differences, thus suggesting that yield risk is not significant on an aggregate basis. This, of course, may not be true for an individual producer.

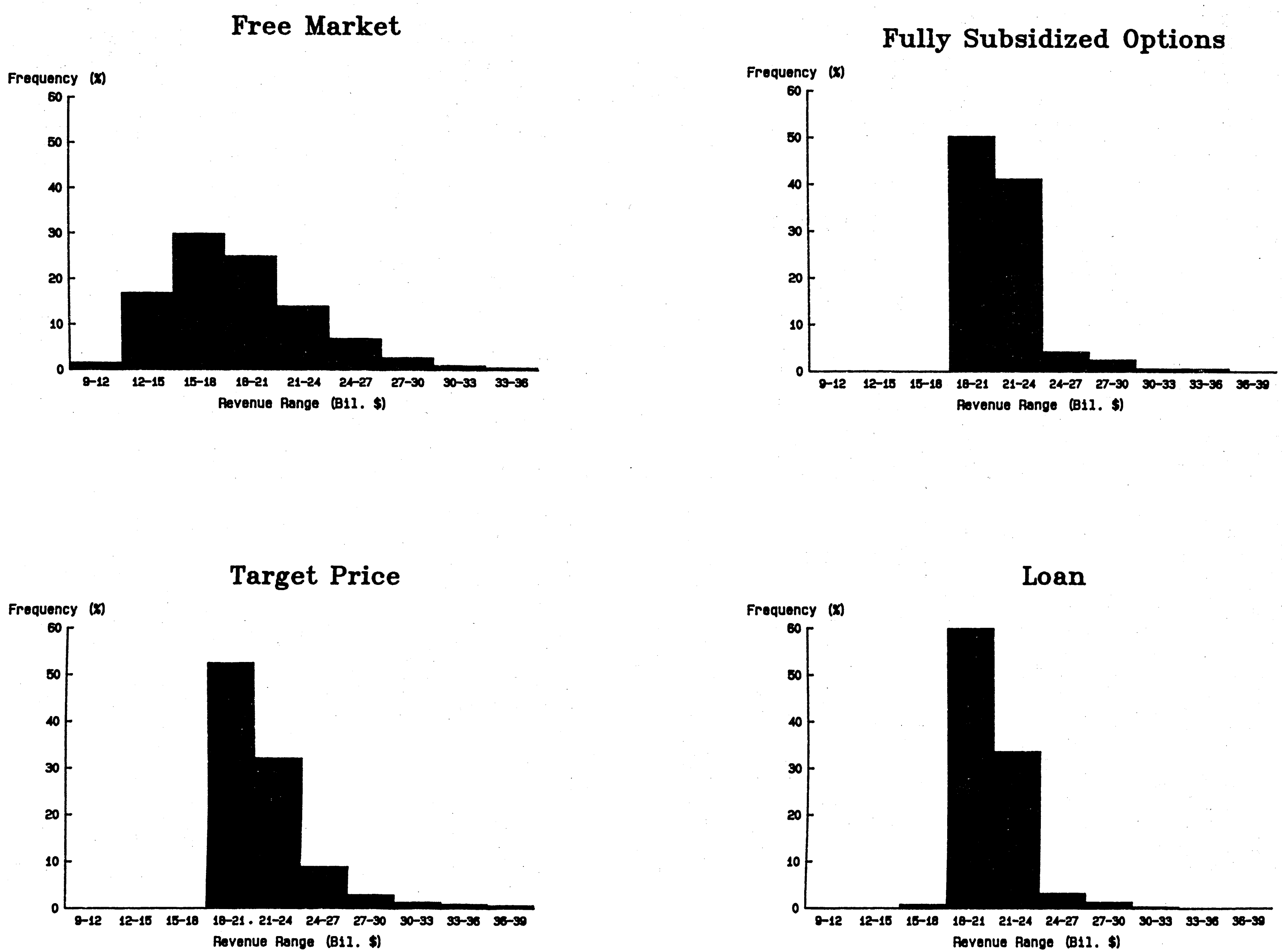
The distribution under the loan program is "tighter" than under the other two subsidized alternatives. This is most evident in the $18-21 billion revenue class, which contained 60.1 percent of the observations under the loan program, compared with 50.4 and 52.6 percent under the fully subsidized options and target price programs. Furthermore, the proportion of outcomes in the high revenue classes ($27 billion or more) was approximately 60 percent lower under the loan program. The explanation for the tighter revenue distribution under the loan program is simply that stocks are sold back into the market at higher prices, thus limiting further price rises.

The alternative programs differed sharply with respect to their effects on the annual costs of domestic corn consumers (table 2). Under the fully subsidized

Table 2--Simulated annual producer revenue, consumer costs, and taxpayer costs

Program	Revenue of corn producers		Costs of domestic corn consumers		Taxpayer costs	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
			Billion dollars			
Free market	18.9	4.7	13.2	3.3	0	0
Unsubsidized options	18.8	3.2	13.2	3.3	0	0
Fully subsidized options	21.4	2.4	12.2	3.1	3.5	1.1
Target price	21.1	2.7	12.2	3.1	3.1	3.2
Loan	20.9	2.2	14.1	1.7	1.6	1.9

Figure 1. Frequency Distribution of Producer Corn Revenues.



options and target price programs, costs are reduced $1.0 billion, or 7.6 percent, with only a small reduction in variability. In contrast, costs are raised $0.9 billion, or 6.8 percent, under the loan program. The standard deviation of consumer costs is reduced substantially, 48 percent. However, the form of the reduction is not favorable to consumers' interests. This is shown graphically in figure 2, which presents the distributions of domestic corn consumers' costs under a free market and a loan program. Costs less than $12 billion are truncated by the loan program and essentially "piled up" at the loan-rate. The truncation is substantial in that 39.9 percent of the costs under the free market are less than $12 billion. Thus, the right-skewness in prices and hence producer revenues generated under the loan program are clearly antithetical to consumers' interests.

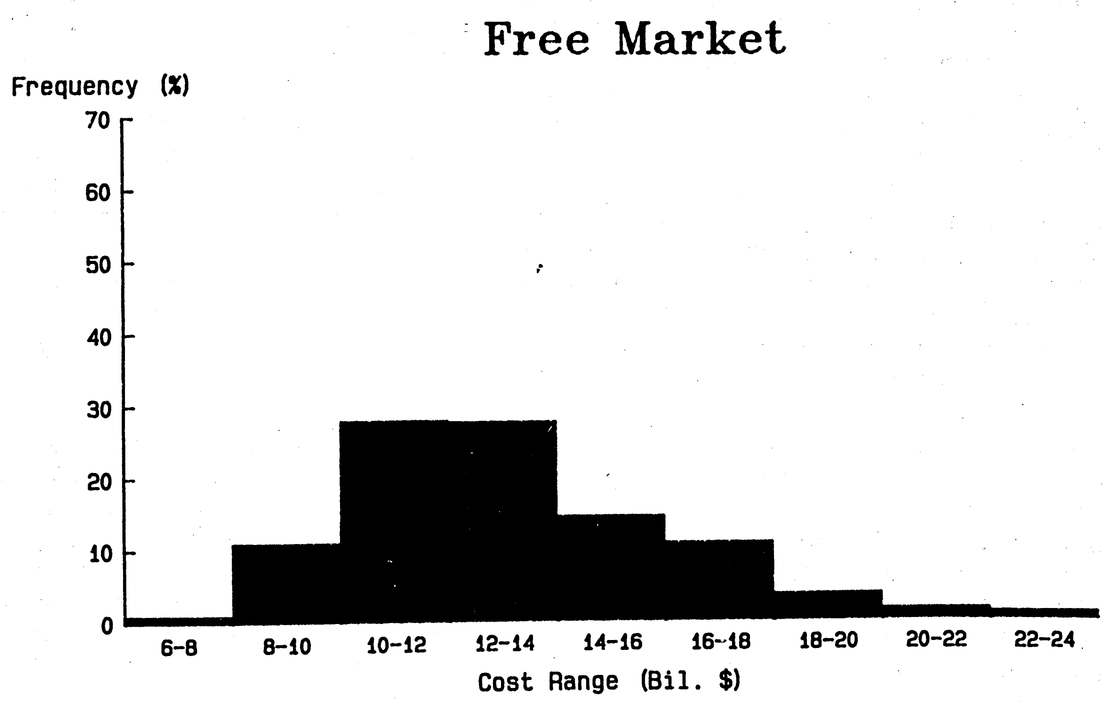
Taxpayers, the final group considered in table 2, are affected only by the three subsidized program alternatives. Three observations are relevant. First, the mean cost to taxpayers is not substantially different between the fully subsidized options and target price programs. Moreover, the reported difference is likely overstated due to the procedure used to adjust premiums for the subsidy bias. Second, the standard deviation of costs under the target price program is nearly three times that under the options program, suggesting taxpayers may prefer the options program even with the slightly higher mean costs. The difference in the standard deviations is due to the timing of the subsidy payments.

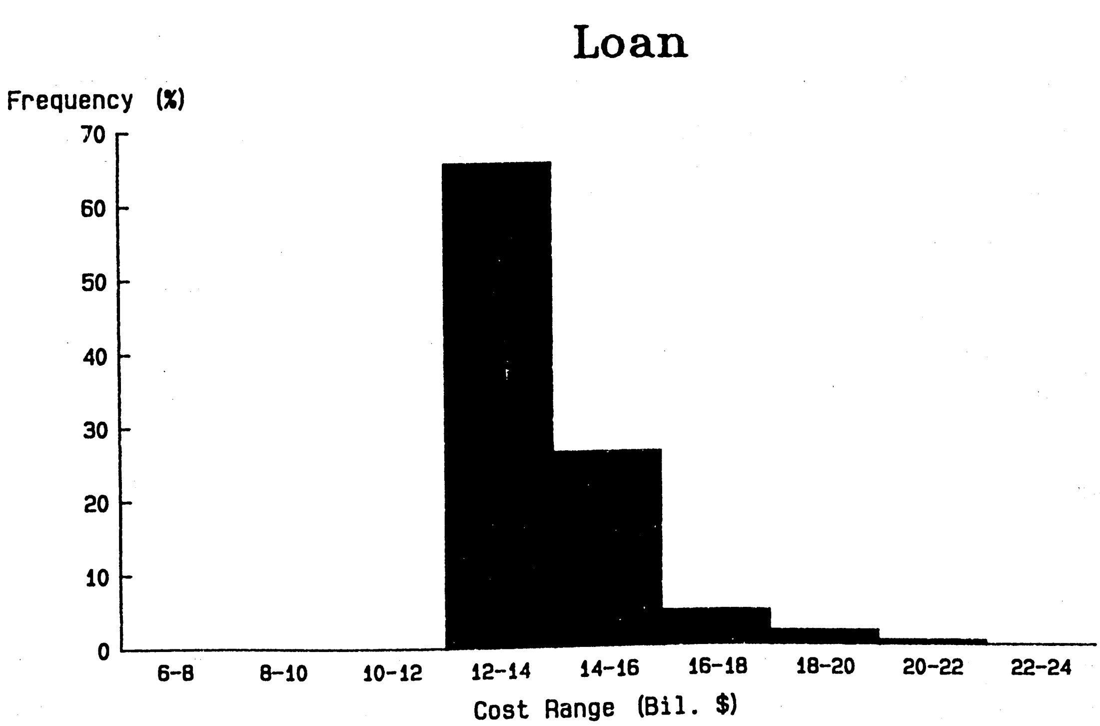
The payment under an options program is an <u>ex ante</u> subsidy. That is, the premium subsidy is paid previous to planting when the options contract is written. Note that the option value (equal to the subsidy) is a weighted average of all possible positive differences between the strike price and futures price at the option's expiration, where the weights are the probabilities of the differences occurring. The payment under a target price program is an <u>ex post</u> subsidy. That is, the subsidy is paid after or at harvest. Thus, the subsidy is equal to the difference between the target price and realized cash price. This difference is the realization of the expected difference under a fully subsidized options program. In any given year, the expected difference may not equal the realized difference due to random demand or supply shocks. Therefore, since the expected difference, or options value, is a weighted average of all possible positive differences, the distribution of government costs will be less variable under a fully subsidized options program.

The third observation with respect to taxpayer costs is that they are substantially lower under the loan program. The reductions, approximately 50 percent, are due to the direct intervention in the market to support prices. The total economic cost is higher due to the previously noted rise in consumer costs.

A simple analysis of the net costs is presented in table 3, where changes in average outcomes relative to the free market are weighted equally. While producer revenue is raised a similar magnitude under the three programs, the net cost is $0.5 billion per year under the loan program compared with no net cost under the fully subsidized options and target price programs. This result is due to the increased consumer costs under the loan program which, when added to the increase in taxpayer costs, more than outweigh the gains in producer revenue. Nevertheless, the absolute magnitude of the costs under the loan program are relatively low. These results are consistent with the net costs calculated by Babcock and Schmitz (<u>1</u>) for the actual 1984 corn program.

Figure 2. Frequency Distribution of the Costs of Domestic Corn Consumers





Summary and Conclusions

This study simulated the effects of target price, loan, and options hedging programs on producer revenue, consumer costs, and taxpayer costs in the U.S. corn market. The results can be summarized qualitatively as follows. First, a fully subsidized options program generated a distribution of producer revenue at least as preferable as an equivalent target price or loan program. Second, the distribution of domestic consumer costs under the loan program was substantially truncated on the left, thereby raising consumer costs. In contrast, costs were lowered under the fully subsidized options and target price programs. Third, the variation of taxpayer costs was approximately two-thirds smaller under the fully subsidized options program compared with the target price program, even though mean costs were similar. The reason cited for the difference was the smoothing inherent in subsidizing premiums rather than the realized difference between the support and cash prices. Fourth, net costs were relatively small or negligible for all programs simulated.

These results suggest that a fully subsidized options program may be an attractive candidate for replacing existing programs. However, two significant problems were assumed away in the analysis. First, it is highly unlikely that options prices would remain constant at the volume of trading necessary under an options program. For example, hedging an expected corn crop of 8 billion bushels would imply a volume of 1.6 million contracts in the pre-planting period. The total volume of corn options traded throughout 1986 was only 575,634 contracts. Thus, it is likely that options writers would require a substantial risk premium to write such a volume of contracts, thereby increasing the cost of subsidizing premiums.

Table 3--Simulated annual net costs of alternative corn programs

Program	Change in producer revenue	Change in consumer costs	Change in taxpayer costs	Net costs1/
		Billion dollars		
Fully subsidized options	+2.5	-1.0	+3.5	0
Target price	+2.2	-1.0	+3.1	0
Loan	+2.0	+.9	+1.6	0.5

1/ Net costs = (Change in producer revenue) - (Change in consumer costs) - (Change in taxpayer costs)

The second problem is that options strike prices are actually set by exchanges as a "band" around market prices. Thus, producers are likely to be able to manage only short- or intermediate-run price risks with options hedging. Long-term risks due to structural changes in fiscal, monetary, or trade policies can be addressed only through stability of such policies or a price-support program with support levels fixed for a period of years.

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SUBSIDIZED PUT OPTIONS AS ALTERNATIVES TO PRICE SUPPORTS

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Section 1742 of the Food Security Act of 1985 requires that the Secretary of Agriculture conduct a study of how producers of agricultural commodities can use futures and options markets to gain price stability and income protection. In addition, the 1985 Act requires that the Federal budget effect of using futures and options be examined in comparison with existing price support programs. This paper gives a brief overview of the modelling effort underway at USDA to estimate the market effects and costs and benefits of the use of futures and options, and it presents some preliminary estimates for a subsidized put option program for soybeans.

We examine here the use of subsidized put options as an alternative to price supports. Under such a program, producers would purchase put options at harvest to cover their production. The Government would agree to reimburse producers the amount of the premium for a put option where the strike price equals the loan rate. Announcement of the loan-rate-equivalent strike price would be made prior to planting. The options would expire after 6 months. (To date, volume for option contracts traded further away than 6 months has been negligible.) At the end of 6 months, producers would either exercise the option if the cash price were below the strike price or let the option expire if the cash price were above the strike price.

Estimating the costs of using subsidized put options as alternatives to price supports poses a number of analytical problems. Full-scale implementation of the program would likely have profound effects on agricultural markets. The removal of price supports from agricultural markets would free Government stocks for consumption purposes, thus affecting the level and volatility of prices for these commodities. These changes would affect option prices and, as a consequence, the level of Government expenditures.

Thus, the use of current options markets to predict the costs of replacing price supports with subsidized put options could lead to substantial errors in the estimates (8).1/ Our research shows costs are likely to be underestimated unless changes in the underlying price distributions are taken into account.

Secondly, the removal of price supports would affect the price expectations of market participants. If we assume that producers, consumers, and private inventory holders form rational price expectations, such policy changes could affect supply and demand decisions. A model is needed that accounts for how price expectations would change with the implementation of new price support policies.

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

The approach taken here draws on the recent storage literature (1,4,7,9,10,11,12,13). In particular, emphasis is given to the stochastic and dynamic aspects of production, the formulation of price expectations, and the role of private and Government storage.

The paper is organized as follows. In the first section, we present a model of a market for an annually produced storable commodity. In the second section, we show how full-scale implementation of a program which subsidizes the purchase of put options would affect market prices and option premiums. The third section compares such a program with a conventional price support program. In the final section, we discuss policy recommendations based on preliminary results of our research and outline avenues of future research.

The Market Model

Our market model for an annually produced, storable agricultural commodity comprises consumers, producers, private arbitrageurs, and the Government. Consumers base their decisions on current market price, producers on expected harvest price, and arbitrageurs on the difference between the current and expected future market prices. The Government manages a public buffer stock to stabilize market price and provides subsidized put options to producers to guarantee they receive a set minimum price for their product.

A typical year t begins with a given supply s_t' held by private market participants and a given amount y_t' held by the Government. Initial private supply s_t' is composed of private carryover from the preceding year x_{t-1} and new production, which equals the acreage planted the preceding year a_{t-1} times a random per-acre yield, $\tilde{w}_t$:

(1) $$s_t' = x_{t-1} + a_{t-1} \cdot \tilde{w}_t.$$

Pipeline stocks are assumed constant from one year to the next and hence are not modeled explicitly. Initial Government stocks y_t' are composed of Government carryout from the preceding year y_{t-1}:

(2) $$y_t' = y_{t-1}.$$

The Government administers a buffer stock stabilization program in which it attempts to contain market price between two specified prices through open market operations. At the support price p_S, the Government offers to buy and store unlimited quantities of the commodity. At the release price p_R, it offers to sell any quantities in its possession.

Government purchases and sales alter the distribution of total supply between Government and private hands. Denoting by g_t the net amount purchased by the Government on the open market in year t, final available private supply in year t is:

(3) $$s_t = s_t' - g_t$$

and the final level of Government stocks in year t is

(4) $$y_t = y_t' + g_t.$$

The Government does not purchase stocks if the market price exceeds the support level and does not sell if the market price lies below the release level:

(5) $p_t > p_S \Rightarrow g_t \leq 0,$

(6) $p_t < p_R \Rightarrow g_t \geq 0.$

Since the Government is willing to acquire unlimited stocks at the support price, the market price never falls below this level:

(7) $p_t \geq p_S.$

On the other hand, the Government can release only as much as it initally holds in the stockpile:

(8) $g_t \geq -y'_t.$

Thus, the market price can rise above the release level if the Government stockpile is depleted:

(9) $p_t > p_R \Rightarrow g_t = -y'_t.$

The Government also administers a program which provides farmers with free put options with the strike price set equal to the loan rate. Whenever the market price falls below the strike price p_T, farmers may exercise the put option and receive the strike price for the amount of their production. Under this policy, the effective farm price, f_t, equals the maximum of the market price and the strike price:

(10) $f_t = \max \{p_t, p_T\}.$

Arbitrageurs store an amount x_t of the final private supply s_t. Consumers purchase the remainder, $s_t - x_t$, at the market clearing price

(11) $p_t = \pi(s_t - x_t).$

Competition among private, risk-neutral arbitrageurs eliminates expected speculative profit opportunities. This yields the familiar complementarity conditions:

(12) $p_t \geq (1+r)^{-1}p^e_{t+1} - k_t; \quad x_t \geq 0,$

$x_t\ [(1+r)^{-1}p^e_{t+1} - p_t - k_t] = 0,$

where $(1+r)^{-1}p^e_{t+1} - k_t$, the discounted harvest price minus the constant unit cost of storage, is the expected marginal revenue from storing the commodity. Arbitrageurs will not store if speculative losses are expected.

The acreage planted by producers depends on the price they expect for their product next year at harvest time2/:

(13) $a_t = a(f^e_{t+1}).$

Arbitrageurs and producers rationally form their price expectations:

2/ We assume that producers form acreage planting decisions based on expected price. This assumes that the covariance between the expected price and the yield of firm i is zero. This is reasonable for crops grown under diverse weather conditions with wide geographic dispersion.

$$(14) \qquad p^e_{t+1} = E_t p_{t+1}$$

$$(15) \qquad f^e_{t+1} = E_t f_{t+1}$$

We make the following additional assumptions: The random yields $\tilde{w}_t$ are independently and identically distributed. The discount factor is less than one and the unit storage cost k is positive. The inverse consumption demand function is strictly decreasing in quantity demanded and the acreage supply function is increasing in expected price.3/ The demand and supply functions, the distribution of random yields, and all other market parameters are time-stationary.

Market equilibrium in period t is determined by the conditions prevailing at the beginning of the period.4/ Thus, equilbrium market price p_t and farm price f_t are functions of initial private supply s'_t and initial Government stocks y'_t:

$$(16) \qquad p_t = \hat{p}(s'_t, y'_t)$$

$$(17) \qquad f_t = \hat{f}(s'_t, y'_t).$$

The expected future market and farm prices, p^e_{t+1} and f^e_{t+1}, are functions of private carryout x_t, Government carryout y_t, and acreage planted a_t:

$$(18) \qquad p^e_{t+1} = E_t \hat{p}(x_t + a_t \cdot \tilde{w},\ y_t) = \phi_p(x_t, a_t, y_t)$$

$$(19) \qquad f^e_{t+1} = E_t \hat{f}(x_t + a_t \cdot \tilde{w},\ y_t) = \phi_f(x_t, a_t, y_t).$$

Derivation of the equilibrium price and expected price functions is not a trivial matter. To derive the price functions p and f we must solve, for all levels of initial private supply and Government stocks, the system of equations (3)-(15) that characterizes market equilibrium. This requires that we know the expected price functions ϕ_p and ϕ_f, which must be substituted into (14) and (15) to close the system. Conversely, as follows from (18) and (19), derivation of the expected price functions requires that we know the equilibrium price functions $\hat{p}$ and $\hat{f}$. This creates an apparent dilemma that is further complicated by the presence of the complementarity condition (12), which defies simple algebraic solution.

Although market equilibria cannot be expressed algebraically, Miranda has shown that the equilibrium price and expected price functions exist, are unique, and can be approximated to an arbitrary degree of accuracy through the use of iterative computational methods (6). Because the functions are conditional on the underlying market parameters, we must reestimate them for each policy considered. While costly, the methods allow us to derive rational price expectations functions that fully reflect the new policy environment.

3/ The market model can easily be generalized to include random consumption demand and acreage shocks; see Miranda (6). Preliminary simulation experiments by the authors, however, indicated that the effects of these random shocks are negligible in comparison with the effects of yield variability.

4/ The simulation experiments assume that producers and arbitrageurs do not anticipate the introduction of the program. Miranda (6) performs a similar analysis using the same model but under the alternative scenario that the Government announces the program a year prior to implementing it. On comparison of the two sets of results, it is apparent that the conclusions of our paper are robust to the assumption regarding the timing of announcement of the program.

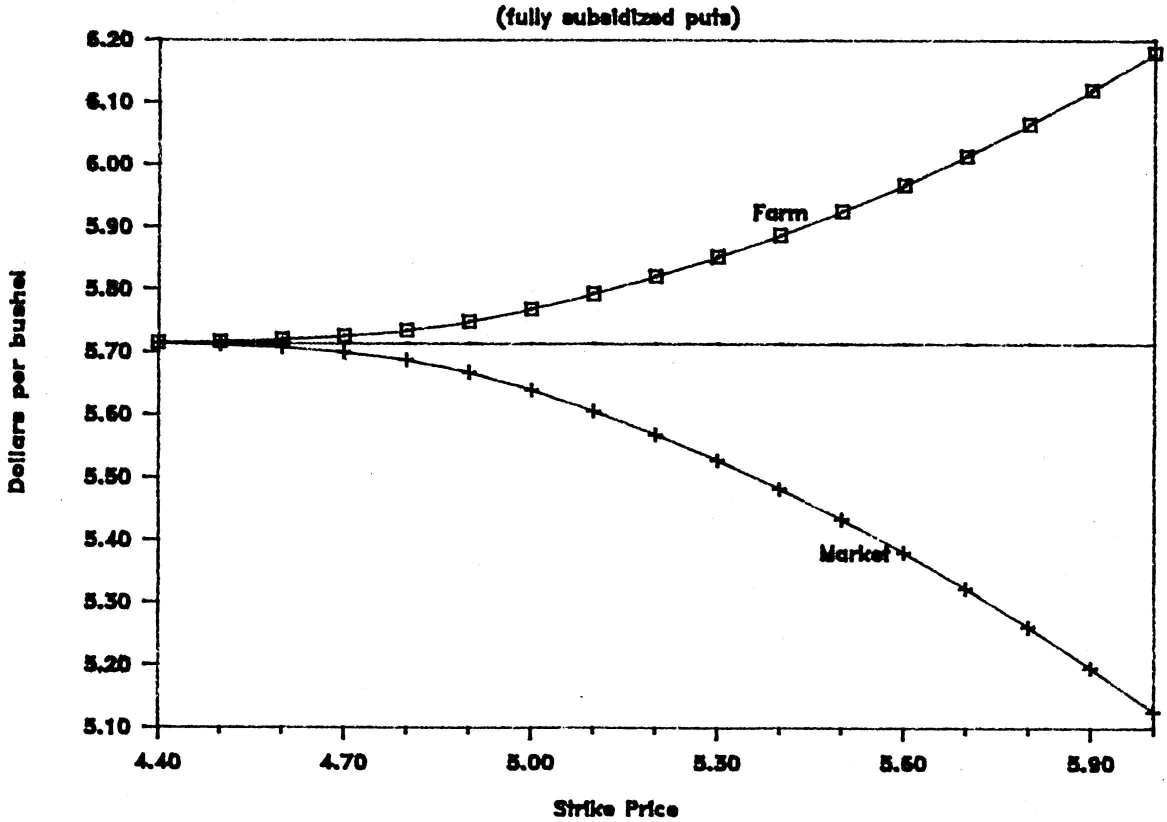
The Market Effects of Subsidizing Put Options

The analysis of an options subsidy program is based on the demand and supply relationships for the U.S. soybean market estimated by Glauber (2).5/ For selected strike prices we derived approximations of the rational expected price functions given in (14) and (15) using numerical methods outlined in Miranda. Having estimated the rational expected price functions, we performed Monte Carlo simulations to estimate the steady-state means and coefficients of variation for selected market variables.

In the absence of Government programs, the mean competitive price is $5.71. Under a subsidized put option program, the Government ensures that farmers receive at least the strike price p_T. But this encourages farmers to plant more since the loan-rate-equivalent strike price is announced prior to planting and since there are no production controls. Market prices fall as a result (fig. 1). As the strike price increases, mean annual farm price increases while mean annual market price decreases.

5/ The model includes a log-linear demand function with a price elasticity of -0.6133, a log-linear acreage supply function with a price elasticity of 0.8859. In addition, it was assumed that yield satisfied log w = log 29.4 + μ, where μ is normally distributed with mean 0 and variance 0.1729. We assumed a storage cost of $0.36 per bushel and an annual discount factor of 0.916.

Figure 1 Price Effects
(fully subsidized puts)



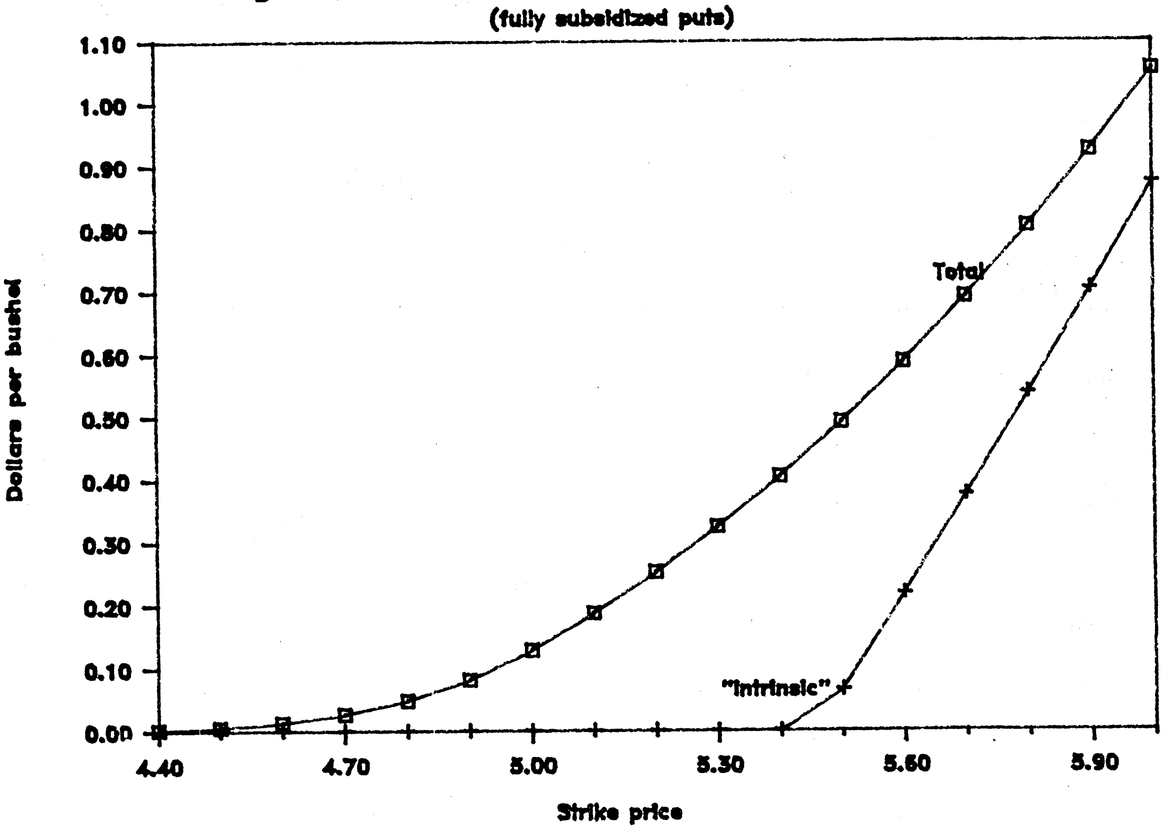
The difference between the expected market and farm price represents the expected per-unit Government outlay for a subsidized put option program. This is equivalent to the price of the option, or the option premium. As the strike price increases, the level of the premium increases (fig. 2). The option's intrinsic value (defined as the difference between the strike price and expected price at planting) is zero over most of the range. Note that intrinsic value is positive at a $5.50 strike price, well below the competitive mean price in absence of subsidies. The difference between the total premium and the intrinsic value is defined as the time value of the subsidized option. Time value falls proportionately as the intrinsic value rises. This reflects the fact that, as the strike price increases, expected market prices fall and the probability that producers will exercise the option increases.

Figure 3 compares the value of put options in a purely competitive market with no subsidies to that of fully subsidized options. As the strike price increases, the values of the put options increase, but the value of the fully subsidized put increases more rapidly. For example, at a strike price of $5.70, the value of a put option in a competitive market is 44 cents, all of which reflects time value. For a fully subsidized put, a strike price of $5.70 shifts the expected market price to $5.32. Total value of the option is 69 cents, almost 57 percent more than the value of an option in a market with no subsidies.

This demonstrates why it is potentially misleading to use current options markets to estimate the costs of full-scale implementation of a subsidized option program (8). Full-scale implementation of an options subsidy program, in the absence of

Figure 2 Ex Ante Government Costs

(fully subsidized puts)



production controls, would likely shift the distribution of market prices downward, thus increasing the value of the option.

Because subsidizing the use of put options guarantees producers a return no less than the strike price, participation in the program would likely be high. A concern with an options subsidy program is whether there is currently adequate volume on organized options markets to absorb this volume. Assuming that put options were purchased for all harvested production, a fully subsidized put at a strike price of $5.30 would result in an additional volume of 370,000 5,000-bushel contracts. Current open interests for all puts for soybeans traded at the Chicago Board of Trade is approximately 7.5 percent of this figure.

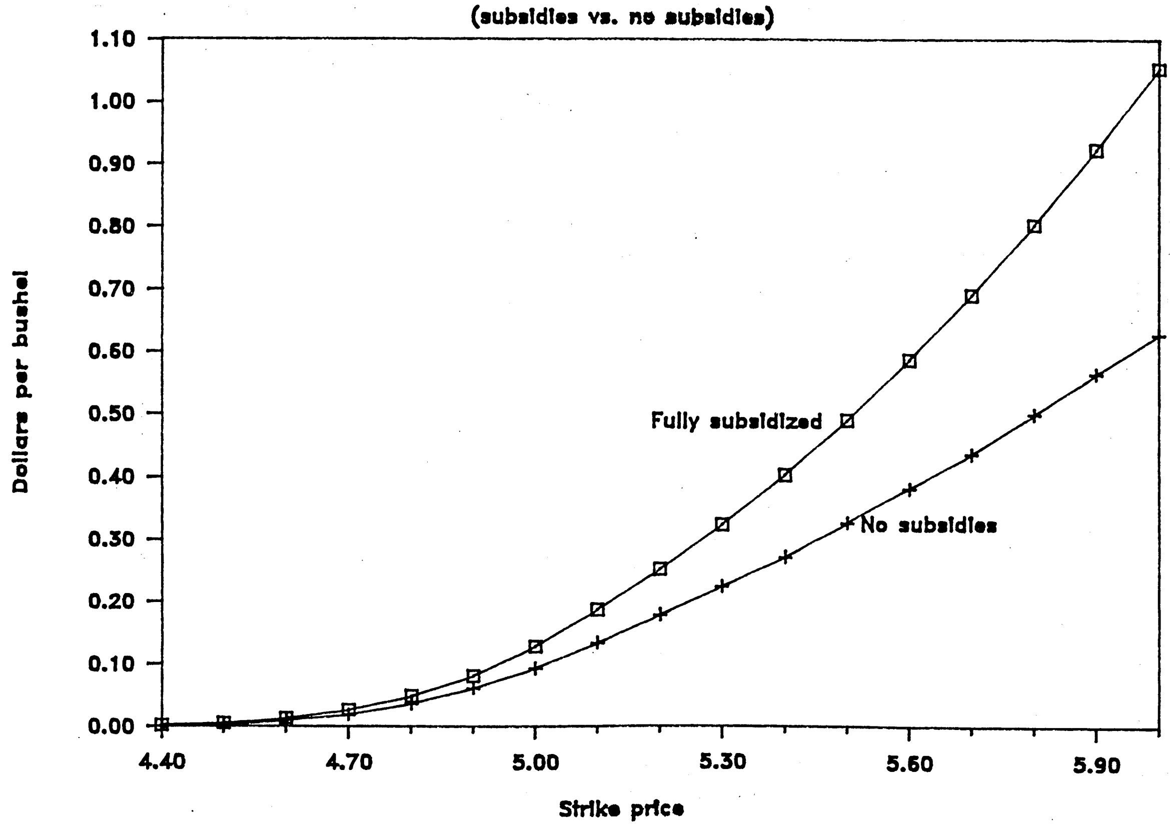
The Welfare Effects of Subsidizing Put Options

In the analysis that follows we compare subsidized put options to price support programs. We fix the release price for all price support simulations at 120 percent of the support price. The size of the band is similar to that used in Government buffer stock programs such as the farmer-owned reserve. A full description of the economics of buffer stock program is given in (9).

In comparing programs, price variability, producer and consumer gains, and total welfare gains were plotted versus average annual Government expenditures. Price variabilty was calculated using the steady-state coefficient of variation of price. We measure consumer gain as the mean change in Marshallian consumer

Figure 3 Value of put options

(subsidies vs. no subsidies)



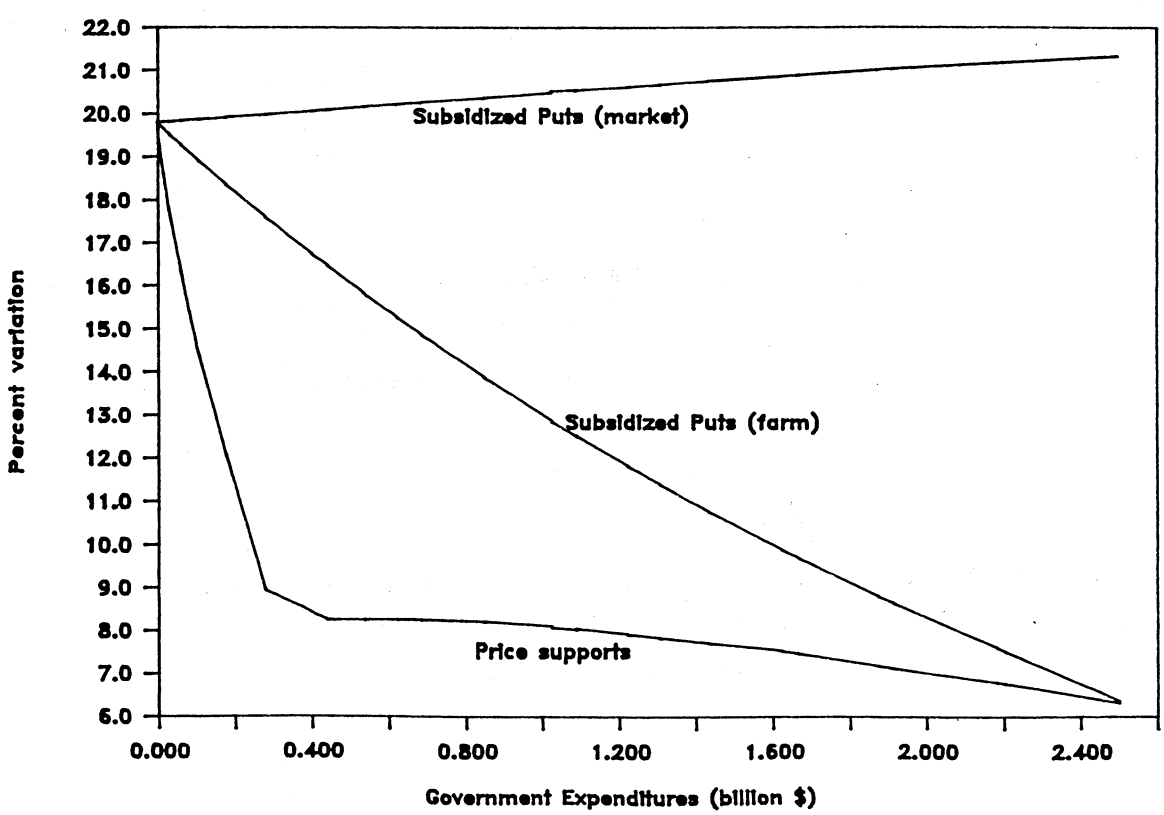
surplus caused by the introduction of a farm program into a competitive market. Producer gain is measured as the mean change in producer quasi-rent. Quasi-rent is measured as producer revenue minus the compounded costs of production (the area under the expected acreage supply equation times expected yield). Government expenditures for price supports include open market outlays and storage payments.

The dynamic effects of Government intervention are very important. For example, in the early years of program operation, a buffer stock tends to remove output from the market. Mean annual prices rise well above competitive levels, benefiting producers and hurting consumers and taxpayers. In contrast, the adjustment to steady state for a program which subsidizes the purchase of put options is much more rapid since the Government does not intervene directly in the market. To capture these dynamic effects, we estimate the discounted sum of mean annual gains (losses) over the first 50 years of program operation and calculate the amortized average gains (losses) per year.

Price supports were generally more effective than subsidizing the purchase of puts in reducing price variability (fig. 4). Price support programs reduce price peaks and provide floors below which prices will not fall. (Under a price support program the price received by the producer and the market price are the same.) The ability of price supports to reduce price variability depends primarily on whether there are ample stocks available to release upon the market in the event of high prices. Previous studies have shown that price supports are ineffective over low levels of price supports because the Government does not accumulate enough stocks to effectively contain price within the band (7,10).

Put options provide producers with a floor on producer returns, but do not entail the building up of Government stocks. However, subsidizing the purchase of put

Figure 4 Price Variability



options encourages production which can help buffer high prices caused through low yields or unexpected demand shocks. As strike prices are increased, mean production increases which causes market prices to fall. Thus, the probability that the producer exercises the option to sell at the strike price increases. At high levels of Government expenditures (in excess of $2.4 billion), subsidized put options are as effective as price supports in reducing farm price variability.

In addition, our results suggest that an options subsidy program would have little effect on the stability of market prices and could potentially destabilize prices if price supports were removed. While producers would be insulated from market price variability, increased variability may affect decisions of processors and handlers further downstream in the marketing chain.

How do price support and subsidized put options programs affect consumers, producers, and taxpayers? Figures 5-7 give the estimates of average annual consumer and producer gains (losses) and average deadweight loss. For annual outlays less than $400 million, price support programs are marginally more efficient in transfering benefits from taxpayers to producers (fig. 5); for outlays in excess of $400 million, subsidized put options are more efficient.

Under a subsidized put option program, producers sell their crops on the market rather than forfeit them to the Government. Consumers benefit as strike prices are increased because additional supplies are made available to the market. In contrast, price support programs raise market price and consumers lose as a result (fig. 6).

Figure 5 Producer Gains

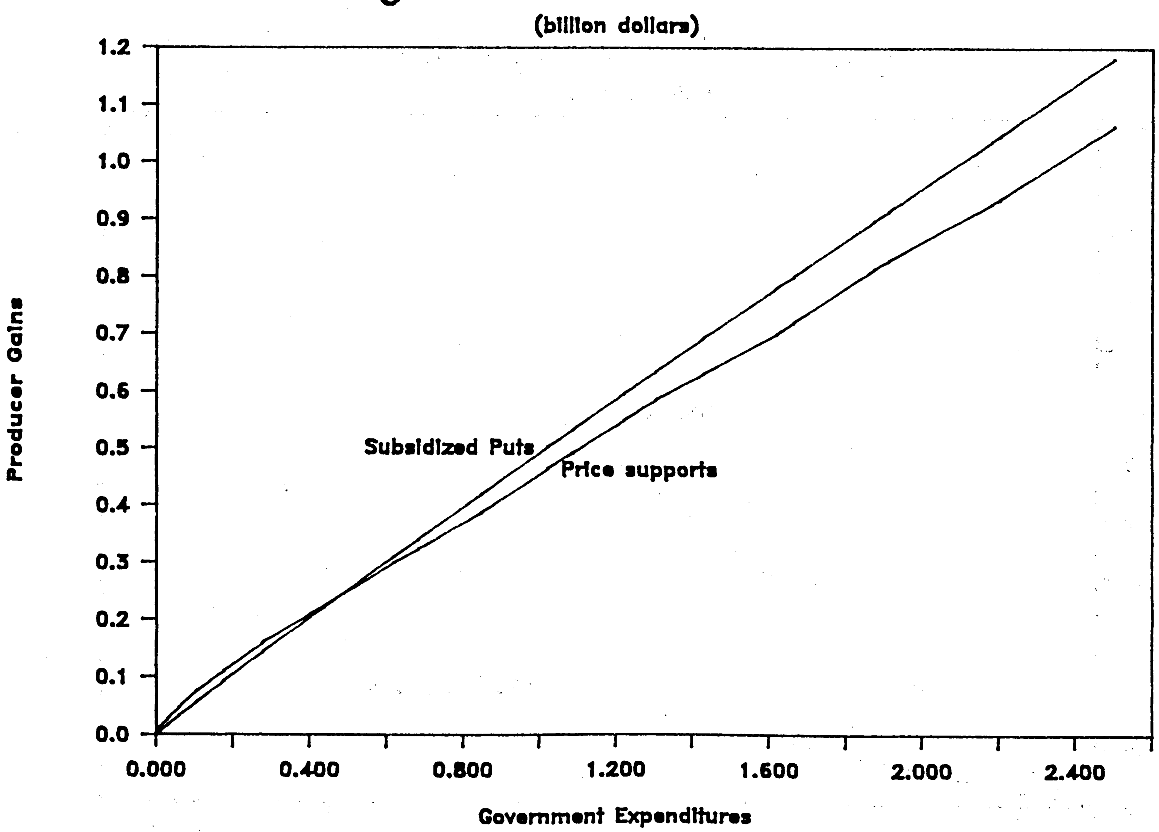


Figure 6 Consumer Gains

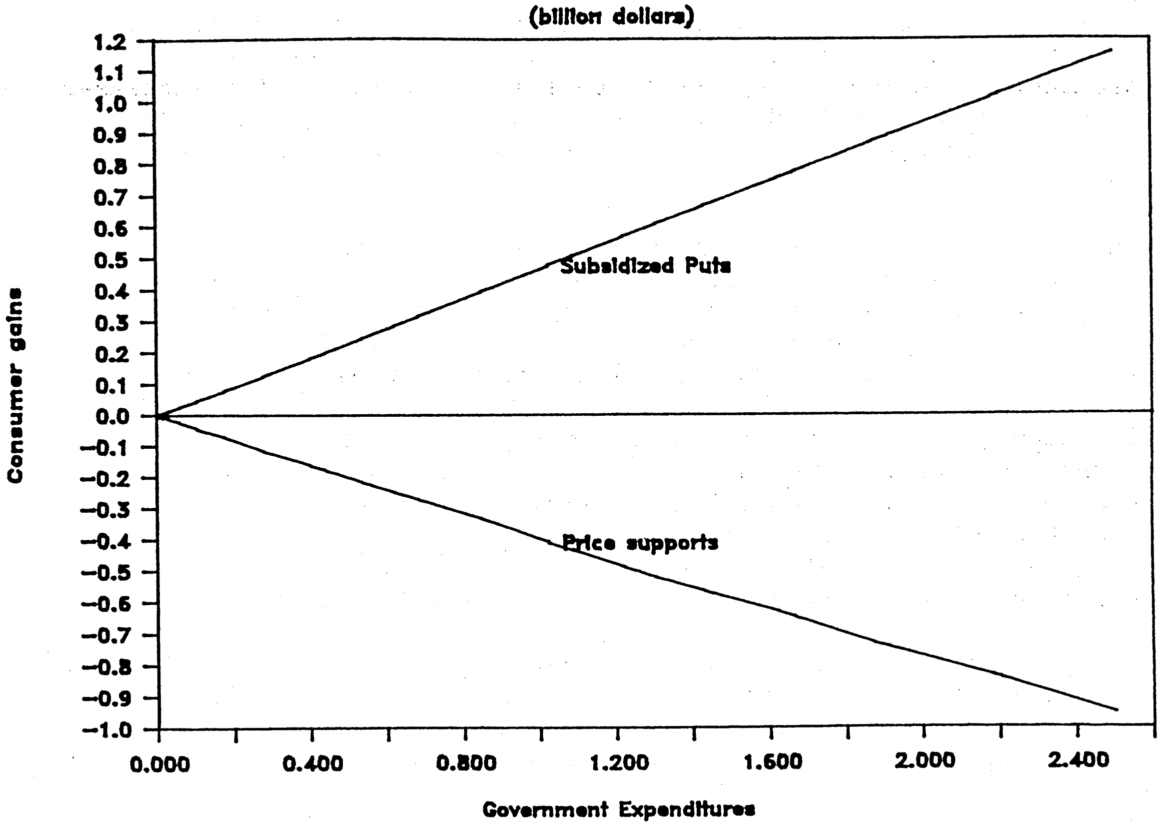
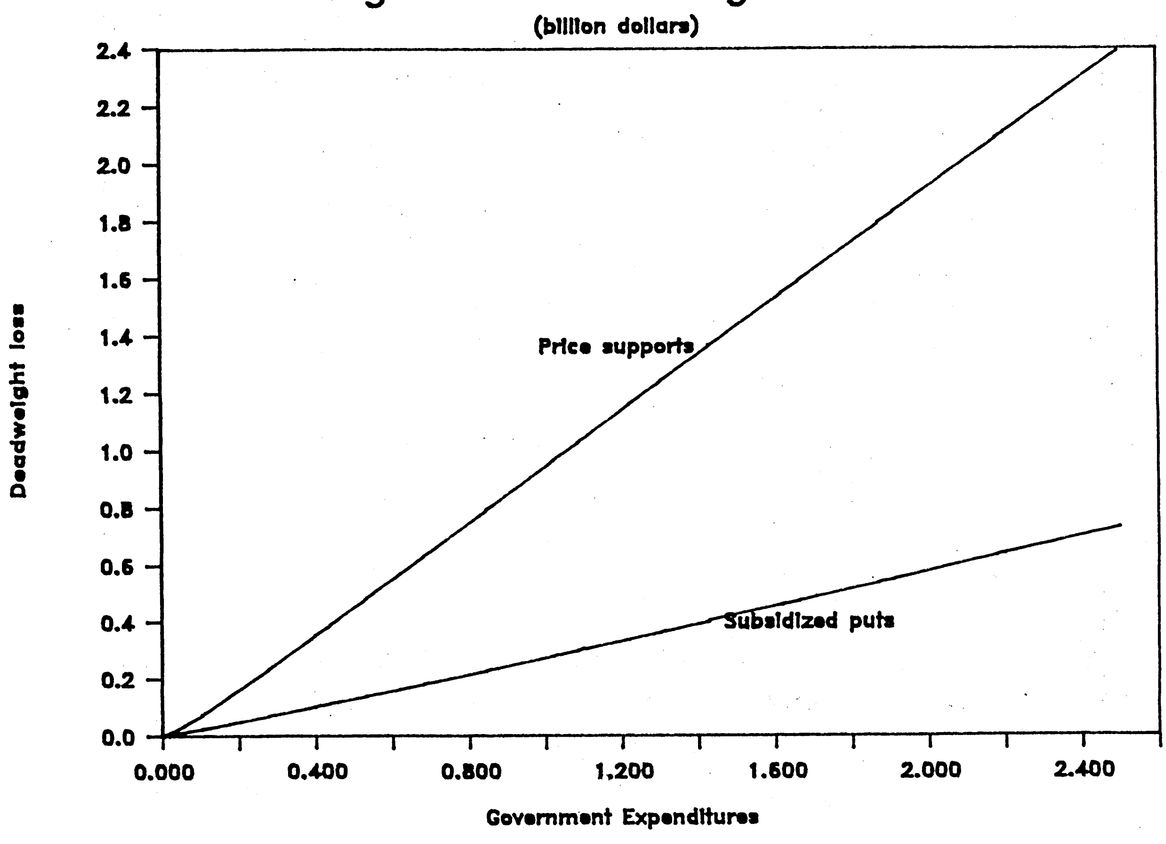


Figure 7 Deadweight Loss



If we define deadweight loss as total Government expenditures minus total producer and domestic consumer gains (ignoring foreign consumer surplus), subsidized put options are clearly more efficient than price supports (fig. 7). However, total deadweight loss is positive for both types of intervention. In the absence of risk considerations, either type of Government intervention is Pareto-inferior to the purely competitive market.

Conclusions

The analysis presented here is only a first step in understanding how futures and options markets may serve as alternatives to price supports. Future research will extend the analyses to include estimates for corn, soybeans, wheat, and cotton through the 1990/91 crop years. Other programs to be analyzed include partial subsidies for put options and call options subsidies in conjunction with marketing loans. These results will be compared with baseline estimates under the current farm legislation.

While the results are only preliminary, a few tentative conclusions can be drawn. Subsidizing the purchase of put options will provide producers with roughly the same amount of income protection as currently provided by price supports. If consumers are considered, however, subsidizing put options may be preferable to price supports. Price supports are a more efficient policy tool if the aim is to stabilize farm prices. Indeed, subsidizing the purchase of put options may potentially destabilize market prices.

Further extensions of the model include acreage controls, incorporation of risk variables in the acreage supply and private inventory holding equations, and an analysis of the variability of Government costs. Acreage controls in conjunction with subsidized options would place an upper limit on Government expenditures but reduce the beneficial effect on consumers. Incorporating risk could potentially affect the welfare analysis presented above. However, recent research suggests that policies that stabilize prices may not necessarily stabilize incomes (4). Lastly, with the enactment of the Gramm-Rudman-Hollings Deficit Reduction Act, there is considerable interest in stabilizing Government outlays. Offsetting commitments to producers at planting with the purchase of put options may offer the Government a means to stabilize budget outlays, but the costs of doing so may be substantial.

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EFFECTIVENESS OF FUTURES AND OPTIONS IN REDUCING FARMER REVENUE RISK

Gerald E. Plato

The special study and pilot project on futures trading mandated by the Food Security Act of 1985 requires an examination of the following two questions concerning farmer use of futures and options markets. What is the manner in which farmers might use these markets to provide price and revenue protection? What is the extent of price and revenue protection that farmers might reasonably expect to receive from such participation?

An evaluation of the Federal budget impacts of alternative commodity programs, including programs based on options and/or futures, and the widespread farmer use of futures and options are also to be included in the special study. Instruction of farmers in the use of futures and options is to be included in a related pilot project. The pilot project is to also include selected farmer participation in a commodity program based on futures and options. Farmers who produce corn, cotton, soybeans, and wheat are to be included in this part of the pilot project. The special study will also include those four commodities.

The manner in which farmers might use futures and options in marketing soybeans and the extent of expected revenue protection are examined in this paper. Five marketing strategies are considered in this examination. These are (1) selling in the cash market (base case), (2) selling futures contracts, (3) buying put options (at and deep in the money), (4) selling futures in combination with crop insurance, and (5) buying puts in combination with crop insurance. Crop insurance is considered because it can be used to reduce the yield risk associated with using futures and options to hedge the price outcome over the growing season. Yield risk reduces the effectiveness of futures and options in providing revenue protection, particularly when yield and price are negatively correlated. The marketing strategies specify that futures and options positions are established at planting and maintained until harvest and that the crop is sold in the cash market immediately after harvest.

Gross revenue per acre for each of the five marketing strategies is the revenue measure used in this analysis. This revenue measure equals the cash price at harvest times yield per acre adjusted for the cost and returns to futures, options, and crop insurance, where appropriate. The results for this revenue measure reflect production and marketing conditions in four Iowa counties: Dallas, Madison, Polk, and Warren. Additional revenue measures for representative farms will be used when price and yield estimates become available for the other three commodities in the special study.

This analysis concentrates on examining the effectiveness of futures and options in providing revenue protection over a series of 9 years. The annual gross revenues per acre over this period for cash sales provided the base case for examining the effectiveness of futures and options. Most hedging studies have either examined effectiveness over a single growing season or over part or

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all of a single storage season. A comparison of the effectiveness of futures in providing revenue protection over the 9-year period with its effectiveness over a single growing season is also made.

First, the data are described and general procedures used in this analysis are explained. Then procedures specific to individual marketing strategies and results are presented for soybeans in the four Iowa counties. Finally, implications of the results and further work planned under the section of the special study for examining the farmer use of futures and options are discussed.

Data and General Procedures

The estimates of farmer revenue per acre are based on 500 replications of U.S. average farm prices in 1977 dollars and U.S. average yields over a 9-year period. These average prices and yields were provided by a quarterly dynamic programming and simulation model of the U.S. soybean market (6)1/. The U.S. average prices and yields were used in estimating farm-level cash prices and yields in the four Iowa counties. The estimated farm-level prices and yields were then used in estimating gross revenues per acre over the 9-year period for the five marketing strategies.

An essential feature of the prices from this quarterly model for examining the effectiveness of farmer marketing strategies that use futures and options is that they reflect expectations that imitate those of futures markets. The price expectations provided by the quarterly model include all the currently available information that influences both the current price and expected prices on later dates. Such price expectations are known as rational in the economics literature and efficient in the finance literature. Futures market prices are considered to closely approximate rational or efficient prices. Gordon (4) has provided a detailed analysis of the efficiency of agricultural futures markets. The prices in the quarterly model reflect the current inventory level and the expected levels of future production, demand, and inventories.

A futures price is estimated for each of the U.S. average farm prices from the quarterly model using an estimated basis with an average of 30 cents per bushel and a standard deviation of 9 cents per bushel. Basis is a futures price minus a cash price. A farm-level cash price was estimated for each futures price using an estimated basis of 41 cents per bushel and a standard deviation of 12 cents per bushel.

Table 1 shows a frequency distribution of soybean stocks at planting for the 500 replications of the 9-year period. The average of the estimated futures price levels at planting for each interval in the frequency distribution is also shown. In addition, the standard deviation of the futures price over the growing season for each interval of stocks is shown. Each observation used in calculating the standard deviations is the natural logarithm of the ratio of the futures price at harvest to its level at planting. This specification for the standard deviation of price is commonly used in option pricing models.

The futures price decreases as the planting-time stock level increases, reflecting anticipation of larger supplies at harvest. These results emphasize

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

that planting-time price expectations are not constant over the 9 years. The change in these price expectations is a major factor in influencing the estimates of revenue protection offered by futures and options. Tomek and Gray (8) found that price expectations at planting, as indicated by the futures market, change considerably from year to year for crops such as soybeans that can be stored between successive harvests. They recognized that these changes reduce the effectiveness of futures in providing longrun revenue protection.

Table 1 also shows that the standard deviation of the futures price over the growing season decreases as more stocks are available to cushion demand and supply shocks. These standard deviations were used in estimating the option premiums for the option marketing strategy and the combined option and crop insurance marketing strategy.

A farm yield was estimated for each U.S. average yield provided by the quarterly model. Both farm and U.S. average yields were assumed to be lognormally distributed. The U.S. average yields had an estimated average of 30 bushels per acre and a standard deviation of 4.6 bushels per acre. County average yields for the four counties were used to represent yields that farmers might expect. The county average yields had an estimated average of 35 bushels per acre and a standard deviation of 7.7 bushels per acre. The estimated farm yields maintained this average and standard deviation and also maintained the estimated +0.29 correlation between the U.S. and county yields. The +0.29 correlation reflects the positive but less than perfect correlation of growing conditions, particularly rainfall and temperature, in the four-county area with the growing conditions over the total U.S. soybean acreage.

Larger (smaller) than expected U.S. average soybean yields frequently correspond with smaller (larger) than expected U.S. average soybean prices. This correspondence results in a large negative correlation between these two variables. The level of correlation between these two variables from the quarterly model was -0.8. If U.S. average yields and yields in the four-county area were uncorrelated, then the prices and yields in the four-county area

Table 1--Frequency distribution of soybean stocks at planting and corresponding levels of expected futures price and their standard deviation

Class Interval	Frequency	Futures price	
		Level	Standard deviation1/
Million bushels		Dollars per bushel	
Under 40	1,385	6.03	0.151
40 - 45	1,544	6.00	.144
45 - 50	665	5.94	.130
50 - 55	259	5.85	.119
55 - 60	331	5.75	.109
60 - 65	250	5.68	.107
Over 65	66	5.60	.106

1/ The standard deviation is computed from the national logrithm of the ratio of the futures price at harvest to its level at planting.

would also be uncorrelated even though U.S. average yields and prices are highly negatively correlated. The +0.29 correlation between the U.S. average yields and the estimated farmer yields maintained a negative correlation between the estimated farmer prices and yields but at a lower level than between U.S. average yields and prices. The correlation between the estimated farmer prices and yields is -0.22 which is approximately equal to the correlation estimated using the actual prices and yields in the four-county area.

Specific Procedures and Results

The reduction in the standard deviation of revenue from using futures and options is the primary measure of effectiveness. Comparisons between futures and options in providing revenue protection is also based on the standardized measure of skewness, the third sample moment divided by the standard deviation cubed. Preliminary results from considering the entire distribution of revenues provided by futures are presented. First, results for the effects of the correlation between the estimated farmer prices and yields on the distribution of revenue are presented.

Natural Hedge

The negative correlation between farmer yield and price produces what is known as a natural hedge. The term natural hedge stems from the effect of this correlation in reducing revenue variability. The effects of this natural hedge were estimated by examining the revenues for cash sales under the estimated -0.22 and under a zero correlation between yield and price. There is no natural hedge when yield and price are uncorrelated. Revenue variability as measured by its standard deviation was $50.08 and $43.24 per acre, under the zero and -0.22 correlations, respectively, over the 9-year period. This is a 13.6-percent reduction and is larger than the reductions estimated for either futures or options. The standard deviation of revenue is reduced since combinations of both large as well as both small prices and yields occur less frequently when they are negatively correlated. This large reduction in the standard deviation of revenue emphasizes the importance of correctly estimating and modelling the correlation between yield and price in establishing the cash-sales base case. In addition, as shown later, the correlation between price and yield influences the amount to sell forward with futures and options over the growing season.

Average revenue was reduced from $193.20 to $191.05 per acre by the negative correlation. Average revenue equals the product of average price and average yield plus the covariance between these two variables. The covariance has the same sign as the correlation and is zero when the correlation is zero. Neither the average price nor average yield is affected by the correlation. Skewness is also reduced slightly by the negative correlation because of the large reductions in the extremely large revenue outcomes.

Futures

Table 2 shows the estimated effects of selling futures on revenue. Average revenue was specified to be unaffected by specifying the futures price at planting to be equal to the average of its outcomes at harvest. However, average revenue from selling the entire expected production forward with futures was 18 cents per acre (approximately 0.01 percent) larger than from cash sales. This small increase is due to inaccuracies in estimating the basis outcomes. It does not influence the interpretation of the effect of futures in reducing revenue variability.

The standard deviation of revenue is at a minimum when the futures position is about 80 percent of the average soybean yield of 35 bushels per acre; that is, when 28 bushels are sold forward with futures for every 35 bushels of expected production. Minimizing the standard deviation of revenue when prices and yields are negatively correlated by selling less than 100 percent of expected production forward with futures is consistent with other hedging studies (for example, 3 and 2). The standard deviation of revenue was only slightly influenced by altering the futures position around the 80-percent level. This result was also found by Grant (2) and suggests that a precise estimate of the futures position that minimizes the standard deviation of revenue is not required.

Hedging effectiveness as measured by the maximum reduction in the standard deviation of revenue was 11.4 percent. This is less than the effect of the natural hedge. Also, the skewness of the revenue distribution was reduced by 22.2 percent when 80 percent of the expected production was sold forward with futures. This large reduction in skewness significantly reduces opportunities for large revenues.

The optimal hedge position is approximately 80 percent if only the mean and standard deviation of revenue are considered. The mean measures the level of expected reward and the standard deviation measures the level of risk in this situation. Since average revenue is for practical purposes constant regardless of the quantity sold forward with futures, the obvious choice is to sell the quantity forward that minimizes the risk. There is no trade-off between risk and return in this example. Therefore, there is no need to consider a farmer's utility function in determining the optimal hedge position.

The figure shows the cumulative revenue distributions for futures and cash sales. The futures position is 80 percent of expected yield. Cumulative

Table 2--Effects of selling futures contracts on the cash sales revenue distribution

Futures position as percentage of average yield	Revenue		
	Average	Standard deviation	Skewness 1/
Percent	---Dollars per acre---		
0	191.05	43.25	0.72
50	191.14	38.57	.69
80	191.19	38.30	.56
90	191.21	38.67	.49
100	191.23	39.25	.43

1/ Skewness is the third sample moment divided by the standard deviation cubed.

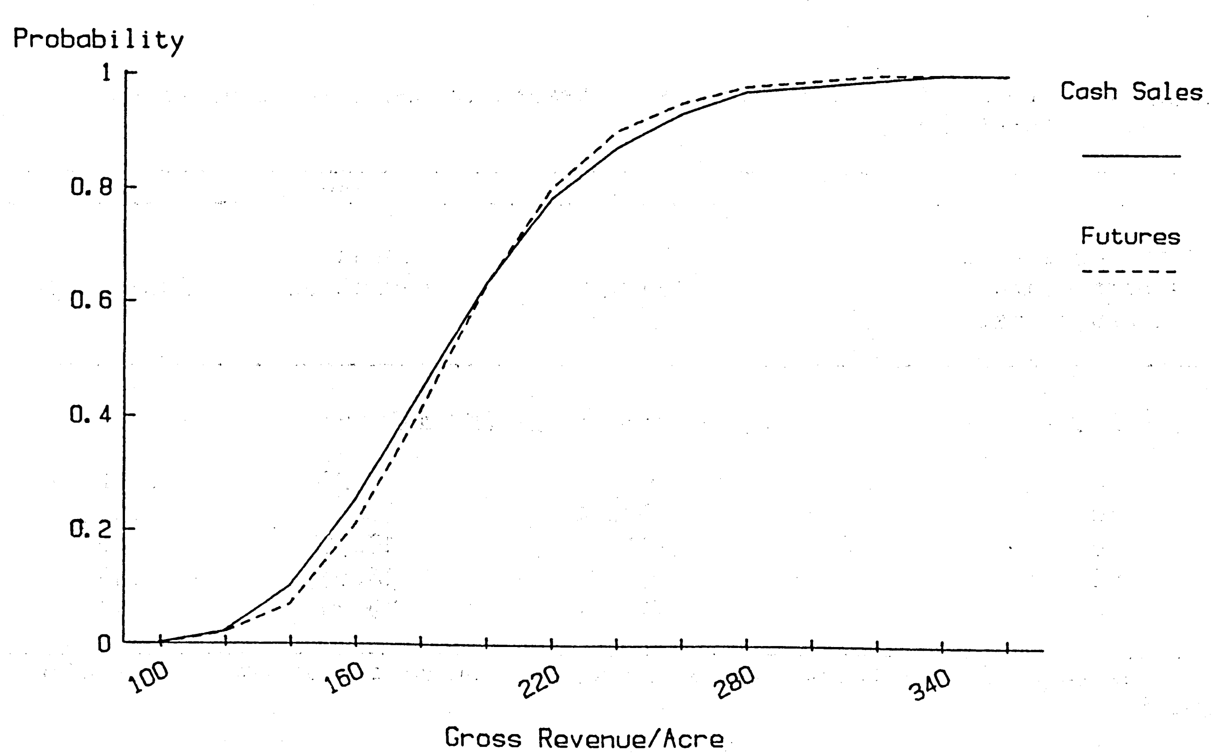
revenue distributions consider the entire distribution of revenues. They show the probabilities of receiving revenues less than or equal to given levels. The mean and variance (standard deviation) and all the higher moments influence cumulative revenue distributions. The figure shows that futures reduces the probability of receiving revenues between $120 and $200 per acre but at the expense of decreasing the probabilities of receiving revenues between $200 and $330 per acre. Information about a farmer's utility function is required to determine if the estimated cumulative revenue distribution for futures is preferred to that estimated for cash sales.

If the only information about a farmer's utility function is that more revenue is preferred to less (that is, has an increasing utility function for revenue), then it is not possible to know which distribution is preferred. For futures (cash sales) to be preferred based on this information, its cumulative revenue distribution would have to lie entirely to the right and below that of the cash sales (futures) distribution.

If it is also known that a farmer's utility function exhibits risk aversion, then the area between the two curves from $120 and $200 would have to be larger than the area between the two curves from $200 and $330 for futures to be preferred. If, in addition, bounds on the level of a farmer's risk aversion are determined then futures may be preferred even if the area between the two curves from $120 to $200 is less then the area between the curves from $200 to $330 (5,7). An examination is needed using alternative risk-aversion bounds to determine the influence of farmers' risk aversion on the preference between selling futures and cash.

Planting-time price expectations as measured by the average of the estimated futures prices for the intervals of soybeans stocks in table 1 varied from $5.53 to $6.04 per bushel. The average soybean price was $5.94 per bushel.

CASH SALES VS FUTURES



Varying planting-time price expectations over a series of years prevents farmers from selling forward at a constant futures price. The inability to sell forward at a constant futures price at each planting reduces the effectiveness of futures in controlling revenue risk. An analysis of the effectiveness of futures was made under the assumption that planting-time price expectations each year over the 9-year period were constant at $5.94 per bushel. The -0.22 correlation between the estimated farmer prices and yields was maintained. Under these conditions, futures reduced the standard deviation of revenue by 50 percent. This compares with approximately 11 percent under the varying planting-time price expectations.

Options

Put options provide the opportunity to sell a futures contract at a predetermined strike price when the futures price outcome is less than the strike price. Two sets of strike prices are considered in the analysis. Strike prices for at-the-money put options were specified to equal the expected futures price at harvest. Strike prices for deep-in-the-money put options were specified to be 25 percent higher than the expected futures price at harvest.

Put option premiums for over the growing season were estimated using Black's option pricing model (1). The standard deviations of the futures price shown in table 1 were used in estimating the option premiums. Premiums for the at-the-money options ranged from $0.23 to $0.36 per bushel and for the deep-in-money options ranged from $1.38 to $1.51 per bushel.

Average returns from buying at and deep-in-the money put options were 3 and 2 cents per bushel. Black's option pricing model implies zero average returns to buying options when, as in this analysis, the expected futures price at harvest equals its observed value at planting. Average returns to futures in this situation are also zero. The nonzero returns are due in part to departures of the price outcomes provided by the quarterly model from the assumed lognormal distribution in Black's option pricing model. A second factor contributing to the nonzero option returns was the use of the standard deviation of the futures price over intervals of planting-time stocks. A standard deviation estimate for each level of planting-time stocks should be used.

The nonzero average returns from buying put options do not present a problem in the analysis. Average revenue per acre was increased by only 0.7 percent and 0.4 percent for at and deep-in-the-money put options when the entire expected production per acre was sold forward.

Table 3 shows the standard deviation of revenue for alternative positions of at-the-money put options. The standard deviation of revenue was reduced by 8 percent when the entire expected production per acre was sold forward. Futures reduced the standard deviation of revenue by a maximum of 11.4 percent. The standard deviation of revenue was less sensitive to changes in the level of forward selling with the at-the-money put options than with futures. The minimum standard deviation occurred when the options position was more than 100 percent of expected yield. However, the additional reduction in the standard deviation of revenue from positions greater than 100 percent was insignificant. The major advantage over futures was the preservation of revenue skewness.

The standard deviation of revenue per acre was reduced by a maximum of 11.4 percent by the-deep-in-the-money put options. This reduction is identical to that provided by futures and also, as with futures, occurred when 80 percent of the expected production was sold forward, as shown in table 4. Skewness of revenue provided by the deep-in-the-money puts is almost identical to that from futures. As with futures, the standard deviation of revenue decreased and then increased as the amount sold forward increased from 0 to 100 percent of expected yield.

The price of a put option moves in the opposite direction to the price of its underlying financial instrument or asset since the buyer of a put option is entitled to sell the financial instrument or asset at the strike price. In addition, the absolute value of a price move for a deep-in-the-money put option is either close to or equal to the absolute value of the corresponding price move for the underlying financial instrument or asset. The value of a deep-in-the-money put option on a futures contract, therefore, changes by about the same amount as a short (sell) futures position and consequently provides similar hedging results to futures as previously demonstrated.

Crop Insurance

Crop insurance offers a means to control yield risk while hedging price risk with futures or options. Loses on futures and options when yields are low and prices are high are offset, at least partially, by crop insurance indemnity payments. Therefore, the effectiveness of futures and options in reducing revenue variability should increase when crop insurance is also used.

Futures and options can be viewed as a means of controlling price risk when using crop insurance to reduce yield risk. Loses on crop insurance when yields are high and prices are low are at least partially offset by gains on futures or options.

Loses can occur on the futures-crop insurance combination and on the options-crop insurance combination when both prices and yields are high. However, the frequency of this outcome is reduced by the negative correlation between price and yield.

Table 3--Effects of buying at the money put options on the cash sales revenue distribution

Options position as percentage of average yield	Revenue		
	Average	Standard deviation	Skewness1/
Percent	---- Dollars per acre ----		
0	191.05	43.25	0.72
50	191.69	40.93	.75
80	192.07	40.11	.73
90	192.20	38.93	.72
100	192.33	39.80	.70
130	192.71	39.74	.63
200	193.61	41.40	.46

1/ Skewness is the third sample moment divided by the standard deviation cubed.

A crop insurance premium was estimated using the estimated farmer yield probability distribution and the expected harvest-time cash price at planting. A yield guarantee of 31 bushels per acre from crop insurance was used. An indemnity payment was made whenever the yield outcome was less than this level. The indemnity payment equals the bushels below the yield guarantee times the expected farmer cash price at harvest. Yields are expected to be lower than 31 bushels per acre for 35 percent of the outcomes from the estimated farmer yield probability distribution.

The crop insurance premium equals the expected yield loss of 1.35 bushels per acre times the expected cash price at harvest. The expected yield loss is the average number of bushels below the yield guarantee for the estimated farmer yield probability distribution. The expected farmer cash price equals the expected futures price at harvest minus the expected basis of 41 cents per acre. Premiums change from year to year reflecting the changing price expectations.

Crop insurance in combination with futures reduced the standard deviation of revenue per acre by 29 percent and, in combination with options, reduced the standard deviation of revenue per acre by 24 percent. These percentage reductions are more than two times as large as for futures and options individually.

Average revenue was essentially unchanged because the average returns to futures was approximately zero and the average returns to options and crop insurance were almost equal to their premiums. Skewness increased because the combination of crop insurance with futures and with options were effective in truncating the lower part of the cash-sales revenue distribution. As expected, skewness was larger for the options-crop insurance combination.

Implications and Plans for Further Work

The results imply that futures and options are not effective in reducing long-term revenue risk for gross revenue per acre. However, the results do imply that futures is effective in reducing risk for this revenue measure over a

Table 4--Effects of buying deep-in-the-money put options on the cash sales revenue distribution

Options position as percentage of average yield	Revenue		
	Average	Standard deviation	Skewness 1/
Percent	----- Dollars per acre -----		
0	191.05	43.25	0.72
50	191.45	38.65	.69
80	191.68	38.30	.57
100	191.84	39.15	.45
130	192.09	41.90	.25

1/ Skewness is the third sample moment divided by the standard deviation cubed.

single growing season. This discrepancy is due to the changes in price expectations at planting from one year to the next. A major determinant of price expectations at planting is the level of stocks.

The results also imply that the effectiveness of futures and options in reducing long-term revenue risk is significantly improved when used in combination with crop insurance. The results may somewhat overstate the influence of combining crop insurance with futures or options because the yield expectations at planting were assumed constant in the analysis. This assumption may be inappropriate for growing areas with limited rainfall.

The relatively small estimated reductions in the standard deviation of revenue per acre from using futures and options may be sufficient to significantly improve the probability that expenses, including family living expenses, are covered thus protecting farmer equity and the ability to remain in business. A key factor affecting the ability of futures and options to protect equity may be a farmer's debt/equity ratio. The use of crop insurance in combination with futures and options may further improve the probability that expenses are covered and that farmer equity is protected. Further analysis using farm specifications with alternative debt/equity ratios will examine the ability of futures and options individually and each in combination with crop insurance to protect farmer equity. Corn, cotton, soybeans, and wheat will be included in this analysis.

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PART V: CURRENT REGULATORY ENVIRONMENT FOR FUTURES AND OPTIONS TRADING

FORWARD PRICING INSTRUMENTS AND COMMODITY MARKET REGULATION

Kalo A. Hineman

I appreciate the opportunity to share with you some ideas about relationships among currently existing commodity forward pricing instruments and the commodity market regulatory environment.

Overview of Futures and Options Regulatory Framework

An effective regulatory system is in place and doing its job. There has been steady improvement in the self-regulatory programs set up and administered by the exchanges. In addition, an industry-wide self-regulatory body, the National Futures Association, is operating. This organization has taken on some direct regulatory duties; for example, in the areas of registration and auditing. These factors have enabled the Commodity Futures Trading Commission (CFTC) to move into more of an oversight role. We at CFTC conduct periodic rule enforcement reviews. The results which we make public are viewed as a "report card." The adverse publicity that goes with a "bad grade" is a powerful incentive for the exchange to implement our recommendations for improvement.

I would like to mention three specific examples of the improving ability to regulate these markets. One is the changes in financial rules that followed the "Volume Investors incident" (in which overextended positions in gold options caused the failure of a clearing member of Comex, the New York metals exchange). This has further strengthened the financial "safety net" provided by exchange rules and underlying regulatory machinery. Another is the improvements in exchange self-regulation. Consistent with the recommendations of CFTC rule enforcement reviews, exchanges have expanded their enforcement staffs and they are bringing more cases and assessing bigger penalties. The third is the recently enacted amendments to the CFTC's audit trail rules to require greatly improved time-sequenced audit trails. This will result in much more thorough market surveillance and, as a side benefit, improved exchange computer information systems that will ultimately result in a more effective and a more efficient oversight function for the CFTC.

Even with these advances, there is still room for improvement. Some deficiencies remain. This conference represents, in part, an effort to help identify and remedy them.

Adequate information and advice about the use of various risk shifting instruments is not generally available to many farmers. More specifically, many brokers in the futures/options area need to provide a higher degree to professionalism and better hedging advice with the services they furnish. Hedging programs too often become speculative programs and it takes only one "horror story" to poison the well.

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Forward Contracts and Minimum Price Guarantee Contracts

Many farmers have used forward price contracts and more are becoming acquainted with minimum price guarantee (MPG) contracts. These secondary instruments have features that may cause them to remain the prevalent way for farmers to participate (although indirectly) in the benefits offered by futures and options markets. For example, the secondary instruments are more easily understood by farmers and their bankers. Furthermore, farmers will be dealing with local merchants that they and their bankers know and trust. The merchants should, in turn, execute the associated futures or options transactions to hedge the risks they have assumed in making a pricing commitment to farmers. Still, farmers and their bankers must assess reliability of the local merchants and recognize that secondary instruments may not have the financial "safety net" support of the exchange-traded instruments.

Secondary instruments for the agricultural sector will by law virtually always be mandatory delivery instruments. This helps to minimize the temptation to slip over the line and become a speculator as all too often happens with futures. Temptation to speculate may exist for exchange traded options as well but it is lessened if they are properly viewed as "price insurance."

Two other characteristics of secondary instruments pertain to the psychology as well as the economics of marketing. Farmers have less need (at least they tend to feel less need) for constantly monitoring price changes when using secondary instruments as opposed to direct use of exchange traded instruments. Also, secondary instruments such as MPG contracts--unlike futures--have predictable up-front costs and no margin calls. Of course, exchange-traded options also have no margin calls for the purchaser and the same predictable up-front cost. Predictability is a comfort to farmers and their bankers, but it is not free. A premium must be paid, either directly, as the cost of purchasing the option, or indirectly as built into the price of the MPG contract.

Regulation of Forward Contracts and Minimum Price Guarantee Contracts

Forward contracts have been exempt from Federal regulatory jurisdiction since the basic regulatory authorizations were put in place by Congress more than 50 years ago. Under an opinion of the CFTC's Office of General Counsel, MPG contracts are within this exemption if they include mandatory delivery provisions (as they normally do). Minimum price guarantee (MPG) contracts that do not contain such mandatory delivery, instead allowing producers to "walk away" from the contract, are considered "trade options." "Trade options" for agricultural commodities continue to be banned. MPG contracts, like other forward contracts, are of course, subject to State laws pertaining to things like fraud, contracts, and commercial transactions.

Concluding Thoughts

1. Proper use of futures and options can offer individual price risk management for farmers.

2. Secondary instruments will continue to be an important element in farmers' price risk management for the foreseeable future.

3. Firms offering minimum price guarantee contracts to farmers should consider adopting more comprehensive financial safeguards if they have not already done so. Users of such contracts must ascertain that those offering them give adequate assurance of their ability to perform on those contracts.

4. Price protection cannot be achieved through a futures or option contract at a level higher than would be available in the marketplace during the life of the contract. Therefore, futures or options cannot put a macro economic "floor" under cash prices as has been done with traditional price support programs. Thus, the role of futures and options in income stabilization programs (as compared with current Government programs) needs to be carefully delineated in terms of realistic expectations.

5. Agricultural producers need to become better informed about markets and about various alternatives for marketing their products. This includes a good understanding of the various price risk shifting alternatives, so that the individual farmers can make the marketing choices best fitting their needs. The 40-county pilot program may help in this regard.

6. Any education effort (including one associated with the pilot program) needs to be prepared to deal with prejudices about futures and options. A common and important misconception identifies speculation, and the volume and liquidity that flow from speculation, as enemies. Really, the enemy is thin markets. In other words, markets characterized by low volume and illiquidity are more likely to be subject to unexpected price changes.

PART VI: REPORTS ON RESEARCH UNDERWAY

USE OF MINIMUM PRICE CONTRACTS BY FARMERS AND GRAIN ELEVATORS IN ILLINOIS

Rick Whitacre and Craig Olmstead

In 1982, Congress authorized the Commodity Futures Trading Commission (CFTC) to establish a pilot program for the trading of options on agricultural futures contracts. Actual trading of these options began in the latter part on 1984. With the advent of options trading on grain and soybean futures, the marketing tools became available for commercial grain firms to offer producers the opportunity to set a minimum price for their crop while retaining the opportunity to take advantage of price increases. A 1985 CFTC interpretive statement indicated that contracts between commercial grain interests and producers which set a minimum price guarantee and require delivery of the grain are cash contracts and forward contracts or cash forward contracts. Thus, they are exempt from the CFTC's jurisdiction.

Minimum price contracts (MPCs) are cash forward contracts between commercial interests and farmers which allow producers to set a minimum floor price for their crop. At the same time, the contract specifies a predetermined pricing formula which gives farmers the opportunity to sell their product at a higher price to the elevator if prices increase between the contract signing and delivery of the cash grain.

Specifics of MPCs vary from firm to firm. The cash basis, administrative expenses, and exchange-traded option premiums are all used to establish a minimum price guarantee.

This paper determines the availability and current level of use of these new contracts by grain and soybean producers in Illinois. Three general questions are addressed: (1) to what extent are they being offered by country elevators in Illinois, (2) to what extent are grain and soybean producers using this new marketing tool, and (3) what are the factors that may be impeding their adoption by producers.

Data

An 11-question survey was sent to a random sample of 250 managers of country elevators within of Illinois. This sample is approximately one quarter of the grain elevators in the State. The sample was generated from the membership list of the National Grain and Feed Association.

The elevator managers were queried concerning their offering of minimum price contracts, the characteristics of their elevators, and their customers' use of such contracts. Eighty-nine usable surveys were returned, for a response rate of 36 percent.

Forty-two percent of the respondents identified themselves as managers of cooperatives, 17 percent were managers of single proprietorships, 16 percent

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managed small corporations, 16 percent were mangers of line elevators for large corporations, and 8 percent managed an elevator for a partnership.

The survey respondents were evenly distributed in terms of capacity. The average storage capacity of the facilities managed was slightly over 1 million bushels (table 1).

Results

Forty-five percent of the managers responding indicated that they were currently offering minimum price contracts. Six percent indicated that they had offered these contracts at some time but had since discontinued offering them: 49 percent said that they had never offered them.

Sixty-eight percent of the cooperatives responding offered minimum price contracts (table 2). Forty-three percent of the elevators associated with large corporations offered them.

Results of the survey indicate that larger elevators are more likely to offer MPCs than are smaller elevators (table 3). Eighty-five percent of the elevators with at least 4 million bushels storage capacity offered MPCs, while only 16 percent of elevators with storage capacity of less than 500,000 bushels offered them.

Although 45 percent of the elevator managers responding indicated that they offered MPCs, 98 percent indicated that they were purchasing less than 5 percent their grain under such agreements and 96 percent said that less than 5 percent of their farmer customers used these contracts.

Although country elevator managers perceive that more of their customers use futures contracts and options on futures to price their grain and soybeans than

Table 1--Storage capacity of firms in sample

Storage capacity	Respondents
Million Bushels	Percent
Under 0.5	14
1.5 - 1.0	21
1.0 - 2.0	24
2.0 - 3.0	19
3.0 - 4.0	7
Over 4.0	15
Total	100

use MPCs, most feel that only a small percentage of producers are using futures and options as pricing tools. Forty-two percent of the managers indicated that less than 5 percent of the farmers in their area used futures contracts to price

Table 2--Offering of Minimum Price Contracts by type of organizational structure

Type of organization	Currently offer	Do not offer	Discontinued Offering
		Percent	
Cooperative	68	30	2
Single proprietorship	7	53	20
Partnership	29	71	0
Small corporation	21	50	29
Large corporation	43	50	7
All firms	45	49	6

Table 3--Offering of Minimum Price Contracts by storage capacity

Storage capacity	Currently offer	Do not offer	Discontinued Offering
Million bushels		Percent	
Under 0.5	16	84	0
1.5 - 1.0	44	56	0
1.0 - 2.0	40	55	5
2.0 - 3.0	50	38	12
3.0 - 4.0	50	50	0
Over 4.0	85	0	15
All firms	45	49	6

any portion of their production. Thirty-three percent indicated 6-10 percent of the farmers in their area used futures as a pricing tool. Elevator mangers feel that farmers use options even less than futures contracts as a pricing tool (table 4).

Sixty-nine percent indicated that the major reason for low use of minimum price contracts was a lack of knowledge about their mechanics and application. Twenty-two percent indicated the No. 1 inhibitor was farmers' beliefs that they can do a better job of marketing by using other tools such as forward contracts, futures contracts, or options. The remaining responses were divided between excessive cost and a failure of MPCs to meet producer needs.

Conclusions

Data collected from 89 country elevator managers in Illinois indicate that approximately half of those surveyed offered minimum price contracts to their farmer customers. Elevators associated with large corporations and firms organized as cooperatives were most likely to offer MPCs, while small corporations and single proprietorships were least likely to offer them. The data also indicate that firms with larger storage capacity were more likely to offer MPCs than were smaller firms.

Ninety-eight percent of the managers of elevators offering minimum price contracts said that less than 5 percent of their grain was purchased with them and 96 percent indicated that less than 5 percent of their farmer customers had used them. A majority of elevator managers said that the No. 1 reason for the low level of use by farmers was a lack of familiarity of the mechanics and application of this marketing tool.

The survey of elevator managers suggests that farm organizations, the commodity industry, and university/extension personnel must increase their efforts to improve farmer awareness of both the commodity futures option market and the use of minimum price contracts.

Table 4--Country elevator managers' perception of farmer use of futures and options

Percentage of farmers using futures and options	Percentage of managers reporting farmers' use of-- Futures	Options
	Percent	
0 - 5	42	66
6 - 10	33	23
11 - 15	8	3
16 - 20	3	3
More than 20	10	5

EFFECT OF THE COTTON MARKETING LOAN PROGRAM ON SPOT MARKET AND FUTURES PRICE MOVEMENT

Dean T. Chen and Carl G. Anderson

The Food Security Act of 1985 authorizes the Secretary of Agriculture to implement a marketing loan repayment program for cotton. The marketing loan program became effective August 1, 1986, allowing producers to repay nonrecourse Commodity Credit Corporation (CCC) loans at rates below the base loan rate. Prior to this new program, the base loan rates had set the de facto price floor for the U.S. cotton market. Under the new program, formula-based world adjusted prices have become an effective price floor, making U. S. cotton price sensitive to changes in both domestic and international markets.

This new farm legislation has substantially altered the process of price determination in the cotton market, particularly during the 12-month period prior to its implementation and the first 6 months of the program. A drastic change in the intertemporal price spreads between Memphis spot and futures prices has occurred due to a shift in the price support program from a rigid domestic loan to market-oriented world adjusted prices. This seems to be a unique time period for testing the market behavior in cash and futures price relationships. Considerable interest currently prevails in extending the marketing loan provisions to the other commodities, such as wheat, feed grains, and soybeans. The experience with cotton, therefore, needs to be carefully evaluated in order to understand the marketing loan effect on crop production, domestic and export demand, inventory stock adjustment, price, income, and Government program costs.

This paper designs and implements an impact simulation study of the marketing loan program on cash and futures price movements. We attempt to explore three major questions: (1) how and how much the new policy instrument affects spot market price variations during an 18-month period influenced by program implementation as compared with the past, (2) the program effects on the price interactions between cash markets in Memphis, Liverpool, and futures contracts of nearby and distant periods, and (3) the policy effects on cotton production, export sales, and producers' prices and returns over the transitional and initial periods of the program and thereafter.

A Period of Unusual Price Movement

The 12 months from August 1985 to July 1986 are defined as the transitional period before the new program, while the 6 months immediately after August 1, 1986, represent the initial period of the program. Throughout the timespan, the Liverpool "A" Index dropped from 57 cents per pound in August 1985 to about 37 cents in July a year later, and rose to around 60 cents in December 1986 (fig. 1). In contrast, the U.S. Memphis price increased from 57 cents in August

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1985 to 65.5 cents in July 1986, dropped 39 cents to the world price level in August, and then climbed up to about 52 cents by December 1986.

Due to the price support program, U.S. cotton prices held up well above the world prices by 20-30 cents per pound with little fluctuation before the marketing loan program. Although the nearby futures prices were running closely with U.S. spot market prices at relatively high levels, the distant futures of the December 1986 contract dropped sharply lower in anticipation of a decline to the world price level under the new marketing loan. In August 1985, the December 1986 futures began dropping from 58 cents per pound to a low point of 30.5 in July a year later, and recovered strongly to a high of 54.4 before the December expiration date. The effect of the marketing loan program is particularly visible for the month of August 1986, when Memphis spot price registered a record drop of 39 cents per pound from the July average of 66 cents to 27 cents.

Theoretical Considerations and Procedures

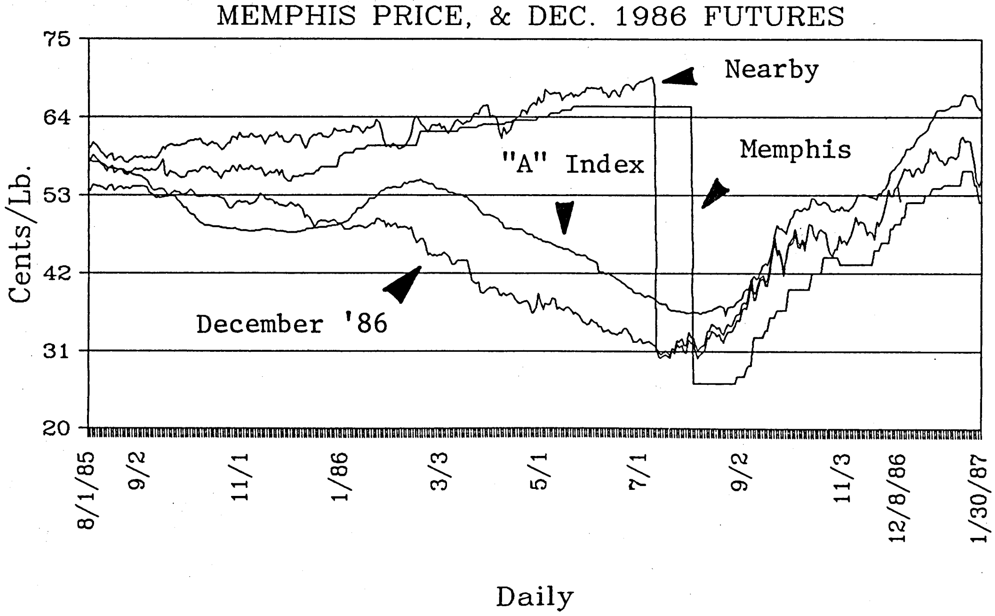
Intertemporal Price Spread

The intertemporal price relationships between cash-futures and nearby-distant futures have received much attention in economic literature. Previous theoretical and empirical research has concentrated upon explanations of the price spreads by either a static theory of storage (14) to reflect current stock conditions, or a rational expectation hypothesis (13) to relate expected stocks to the price differences.1/

Available empirical evidence on the relevance of Working's static framework versus the rational expectation formulation remains unclear, however (8). Some other studies (12,11) suggest the interperiod price difference or "basis" relation between cash and futures prices is determined substantially by factors other than the expectation variables.

1/ Underscored numerals in parentheses indicate items in References at end of paper.

FIGURE 1. "A" INDEX, NEARBY FUTURES, MEMPHIS PRICE, & DEC. 1986 FUTURES



In this study, a theoretical hypothesis is formulated to discriminate basis determination in a normal period from one of policy shock. In a normal time period, Working's theory of storage is found to be particularly useful to explain cash-futures price spread. For the marketing loan impact period, however, a dynamic representation of price expectation is essential in analyzing futures price determination, particularly the effects of the latest changes in policies on the actual and expected inventory stock levels and the world market price reactions.

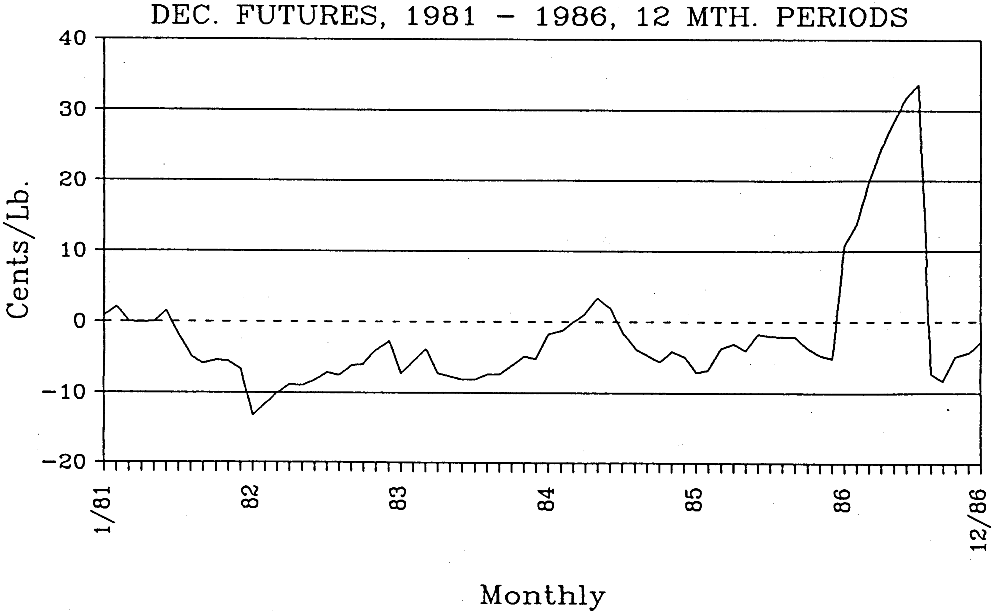
For Memphis cotton, at delivery point, the closing basis is normally around 4.5 cents per pound. The exact basis movement during the life of a contract vacillates due to many market forces (2,6). Basis is affected by (1) storage and interest costs, (2) transportation costs, (3) local supply-demand forces versus those driving the futures market, (4) quality differences between cash and those specified in futures contracts, (5) supply-demand and price factors of substitutable commodities, and (6) price expectations. In the marketing loan impact period, the importance of price expectations induced by policy changes needs to be particularly emphasized; for example, the process of the 1985 farm legislation, the timing of program announcements, and the procedures for program implementation.

Dynamics of Basis-Narrowing Trend

In considering the dynamic features of "basis" for storable crop commodities, most observers recognize that the basis tends to narrow over the storage season (9). In theory, the different market forces influencing the spot and futures markets react differently at times. However, basis has a normal time pattern largely based on storage and interest costs. During the nonharvest season, cotton is stored for later use. As monthly storage and interests costs occur, they add to the price and become part of the spot quotation. Thus, under normal supply-demand conditions and stable farm policy, the basis narrows as the futures contract nears expiration.

A historical review of monthly average spot quotations of Memphis and December New York cotton futures, same qualities, from January to December for 1981-86, reflects wide and erratic basis movements (fig. 2). The December futures

FIGURE 2. BASIS: MEMPHIS SPOT MINUS
DEC. FUTURES, 1981 - 1986, 12 MTH. PERIODS



contract responds to new crop market expectations and is actively traded. The normal relationship of Memphis spot under December futures moving from a wide to narrowing basis was dramatically altered from expectations in 1986. Prior to that, the small positive basis in early 1981 resulted from tight supplies pushing spot prices upward following poor yields in 1980. The 1983 payment-in-kind program and dry weather contributed to a short crop and a strong market in the second quarter of 1984.

For the purpose of policy impact analysis, the dynamic relationships of seasonal basis movement for two different time periods are considered. Two daily time series data of the basis between Memphis spot and December futures for the contract life of 1985 and 1986 are used for our analysis. The former represents a more normal period of cash-futures price relationship, while the latter is chosen to study the unusual basis relationship of the policy shock period induced by cotton marketing loan program.

Causality Tests and Impact Simulations

The marketing loan effect on spot-futures price relationships is analyzed by two major approaches: a causality test of the lead-lag relationship and an impact simulation analysis with the econometric model.

Various causality testing procedures have been developed for empirical investigation of the dynamic properties of time series data. Two prominent examples are the Sims (10) procedure for testing the causality between money and income and the Bessler and Brandt (3) procedure on causality tests in livestock markets. In this paper, a system identification procedure proposed by Hsiao (7) is used for causality testing the spot and futures prices relationships. Based upon Akaike's FPE-criteria and the technique in search of minimum Final Prediction Error (FPE) statistics, Hsiao's procedure has the advantage of providing additional insights into the order of the autoregressive process which generates time series data. The method does not require prior knowledge in the selection of lag length. Hsiao causality tests choose the order of lags according to minimum FPE criterion, and the method is equivalent to applying F-test with varying significance levels.

Hsiao's sequential procedure for system identification is adopted in this study. We use daily data series for the spot prices of Memphis and Liverpool markets and daily settlement prices of December futures of 1985 and 1986 for our analysis. To differentiate the effect of a normal time period from one of policy shock, two years of December futures data covering the contract life of 1985 and 1986 are used. The 1985 contract contains a total of 371 daily observations while the 1986 contract has 372 observations.

To follow Hsiao's procedure, we test the unidirectional autoregressive process of a maximum lag of five periods. Our initial hypothesis is that spot-futures and nearby-distant futures relationships are simultaneously determined by market forces at home and abroad. A maximum time lag of 5 trading days is used in our causality tests. With the December contract data of 1985 and 1986, a total of six bivariate relations are specified and tested. Our prior expectation is that all causality directions for the spot-futures price relationships are instantaneous and bidirectional. The following bivariate models were formulated and tested:

(1) Memphis Spot vs. "A" Index 367 obs. for 1985 contract

(2) Memphis Spot vs. Dec. Futures 371 obs. for 1985 contract

(3) "A" Index vs. Dec. Futures 366 obs. for 1985 contract

(4) Memphis Spot vs. "A" Index 370 obs. for 1986 contract

(5) Memphis Spot vs. Dec. Futures 372 obs. for 1986 contract

(6) "A" Index vs. Dec. Futures 368 obs. for 1986 contract

The second approach for our marketing loan study is impact simulations with an econometric model. The cotton model used is a 67-equation system with 15 behavioral equations and 52 identities. It is a fully integrated monthly model with a domestic market block, a Farm Program Simulator, and a block of world market equations (4).

The Farm Program Simulator is by far the largest block with 58 variables. The domestic market variables include monthly equations of domestic mill consumption, ginning, and export sales. Memphis spot prices, average price received by farmers, cash receipts, and other income components are also determined endogenously.

In the world market, the model includes annual equations for total world cotton import demand and U.S. export market share, and monthly equations for U.S. cotton exports. The key variables in export equations are U.S. cotton prices at Memphis and world prices at Liverpool and the weighted average exchange rates of six major trading countries. Total mill consumption, harvest acreage, and production for rest-of-world totals are also determined endogenously in the model. This model emphasizes "forward-looking" rather than "backward-looking" expectation formulations.

The cotton marketing loan program links the U.S. cotton price to the world market through loan repayment provisions (1). A formula-based U.S. adjusted world price is calculated by using the Northern European Liverpool cotton price for U.S. growths as representing the world market and adjusting it to the U.S. price by considering average transportation and handling costs, quality, and location adjustments from the United States to overseas.

The model is particularly useful for impact simulation of substantial policy changes. For the marketing loan study, implications from this policy action can be analyzed through a shift of the effective price floor from the domestic loan rate to adjusted world prices because the price equation has properties suitable for forecasting these types of policy changes (5).

As the Memphis price equation is estimated by a deviation term relating Memphis price to the effective price floor, changes in the effective price floor from domestic loan rates to adjusted world prices can be determined through an identity relation of the model:

Identity for Memphis Cotton Price

COLPMME116 = COLPMDPLL + (COLPFLLD1 * COLPLE + COLPFLLD2 * COLAWP)

where COLPMME116 is the cotton market price, cents per pound, Memphis Strict Low Middling (SLM) 1-1/16 inch; COLPMDPLL is the deviation of Memphis price from effective price floor; COLPLE is the effective loan rate, cents per pound, using base loan rate adjusted by interest charge and storage costs through the crop season; COLAWP is the adjusted world prices, cents per pound, Liverpool market, the "A" Index series, adjusted by transportation costs and quality differences between the U.S. and Liverpool markets; COLPFLLD1 and COLPFLLD2 are two dummy variables used to represent policy changes, implementation of the 1985 farm act provision of marketing loan August 1, 1986; COLPFLLD1 equals one prior to August 1986 and zero otherwise; and COLPFLLD2 equals one after August 1986 and zero otherwise.

In addition, the price equation for Memphis spot market is constructed on the theory of inventory demand with stock/use ratio and the expected stock/use ratio as the key explanatory variables. The model has a comprehensive set of simulation instruments for analyzing supply-demand projections of domestic and international markets.

Empirical Results

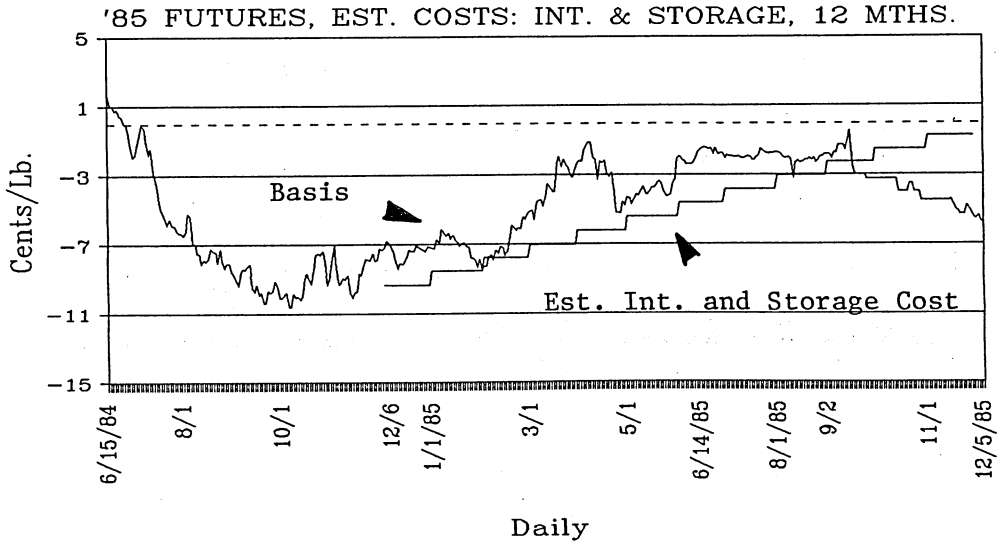
This section reports the empirical results from testing basis behavior under a normal market condition in comparison with the period of policy shock. Also, the results from causality tests between spot and futures prices and model simulation results of marketing loan program are discussed.

Basis Behavior

Understanding basis behavior or difference between cash and future prices over time is essential for successful use of the futures market in hedging cotton sales and purchases. Basis is defined in this paper as the difference in cents per pound for a specified cash spot price at a given location and a specific futures price. The Memphis spot quotation for SLM grade, 1-1/16 inch staple quality, relative to the specified New York futures contract is the cash-futures relationship analyzed. This is the base quality for deliverable cotton at Memphis location against the New York Number 2 futures contract.

The Memphis basis for the December 1985 futures contract represents a normal pattern (fig. 3). The basis was almost 11 cents per pound under in late 1984, more than a year in advance of the 1985 crop. By January 1985, when most of the crop was in storage, the basis remained wide and began a steady path of narrow-

FIGURE 3. BASIS: MEMPHIS SPOT MINUS DEC. '85 FUTURES, EST. COSTS: INT. & STORAGE, 12 MTHS.



ing, reflecting cumulative storage and interest costs until about September when the new harvest season began. Then, as the December future expiration date neared, the basis widened to account for normal delivery costs.

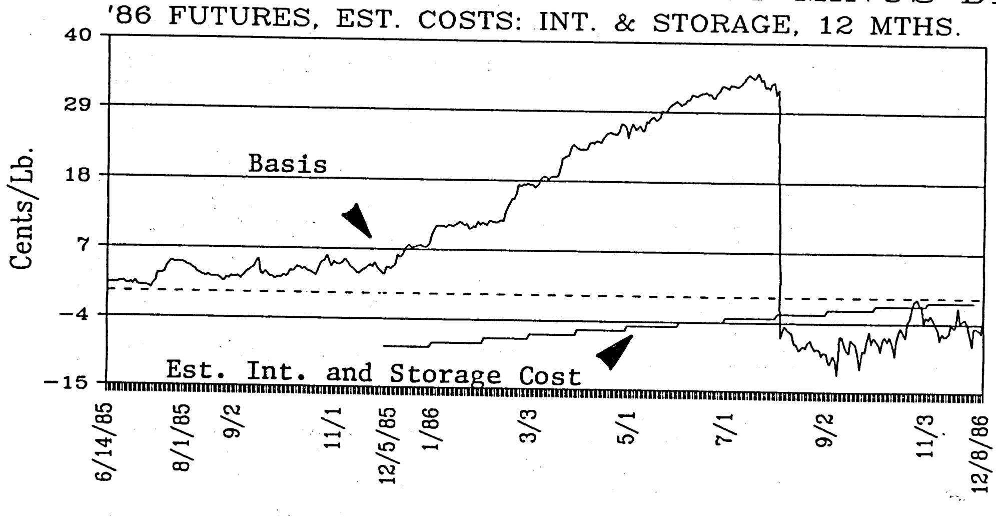
In contrast, the Memphis spot to December 1986 basis pattern sharply deviates from the expected narrowing pattern (fig. 4). The basis started with Memphis over December futures 18 months in advance, and by January 1986 began soaring to more than 32 cents above in July, widening the gap between U.S. effective loan price and foreign price level. But, following implementation of the marketing loan, spot dropped to the world price level, returning to a normal pattern under December futures.

The most dramatic, positive December basis developed in 1986 because of the marketing loan. While the 1985 farm legislation was signed late that year, the procedures for implementation were not provided until Spring, 1986. Then, provisions were announced with an August 1 implementation date. As a result, expectations of a market glut and large foreign sales drove the foreign price and New York December futures down sharply.

In anticipation of the tremendous downward pressure on U.S. prices that might lead to "dumping" in both spot and futures markets, the marketing loan program included inventory protection payments for cotton not under CCC loan. Inventory protection payments were made to anyone holding "free" cotton stocks on August 1, 1986. Payments took into account the difference between the 57.3 cents per pound 1985 base loan plus regional carrying charges and the adjusted world price announced weekly. Payments were made in first handler certificates redeemable in only CCC cotton for 9 months.

The effective loan rate held the May and July nearby futures up above Memphis spot. In contrast, because December 1986 futures were reflecting world price expectations, Memphis spot stood almost 10 cents per pound over December 1986 futures in January. By June, the positive difference was 32 cents. The base loan rate plus storage and interest was clearly setting an effective floor for domestic price movement. The forthcoming marketing loan sent the December futures downward.

FIGURE 4. BASIS: MEMPHIS SPOT MINUS DEC. '86 FUTURES, EST. COSTS: INT. & STORAGE, 12 MTHS.



Causality Tests

The causality tests do not provide strong and uniform results in supporting our a priori beliefs on instantaneous and bidirectional spot-futures prices interrelationships. In both the normal time period of 1985 and the policy shock period of 1986, Memphis spot and Liverpool "A" Index demonstrate the expected strong feedback relationships. Although their causal relationships are bidirectional and instantaneous with a short lag length of 1-2 days, the Akaike's statistics show substantially different FPE for these two testing periods. The FPE statistics for the policy shock period of 1986 (4.4) are nearly 14 times larger than the normal time period of 1985 (0.3). The results clearly confirm the disruption of the normal U.S. and world price relationship during the marketing loan period.

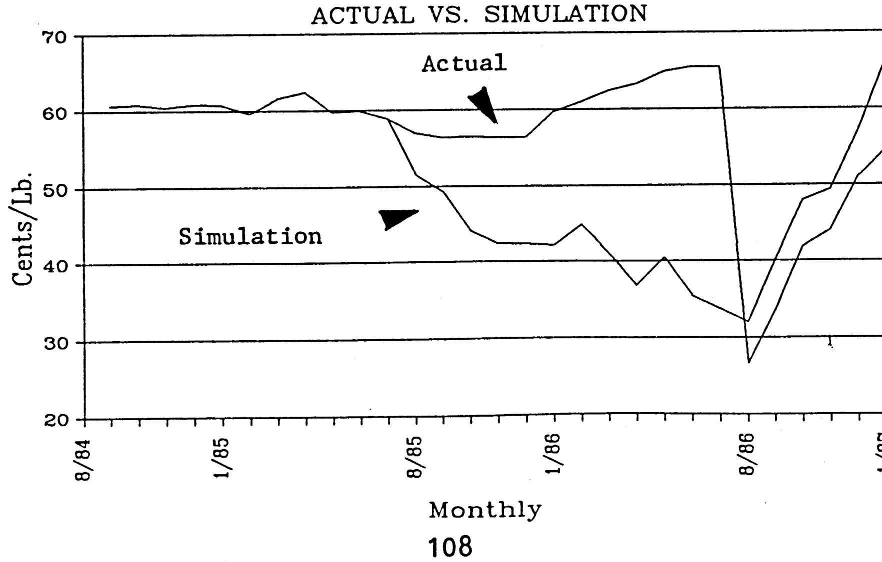
This study also provides evidence on an unidirectional causality relationship between spot market and futures prices in 1985. Strong causal relationships were found running from December futures prices to spot prices in both Memphis and Liverpool markets. The results are significant because they support a common belief that the futures markets are leading the spot market in price determinations. In contrast, this causal relationship was not found during the marketing loan impact period of 1986. Not only was the interrelationship between Memphis spot and December 1986 futures substantially weaker, but also the causality direction was changed to bidirectional. An additional causality test of the Memphis spot and December future relationship in first difference terms for 1986 shows essentially a random walk phenomenon. On the other hand, the causality tests of "A" Index and December futures of 1986 demonstrate a largely instantaneous and bidirectional relationship.

We found some causality testing results are consistent with our a priori beliefs, while some others are not. The empirical findings, however, provide clear evidence of the effect of policy shocks in terms of the causal relationships between spot and futures markets.

Marketing Loan Effect

The structural model was used for impact simulation analysis for the marketing loan program by assuming it was implemented 1 year earlier on August 1, 1985, instead of August 1, 1986. The solution for baseline and policy shock were analyzed in regard to Memphis spot price. A comparison was made of Memphis spot actual price movement over the 1984/85 crop year versus the marketing loan simulation (fig. 5).

FIGURE 5. MARKETING LOAN, MEMPHIS SPOT
ACTUAL VS. SIMULATION



The simulation results indicate Memphis spot would have been much lower than the actual level a year earlier. The difference between actual and simulated price level starting the 1985 season, August 1, was 5-7 cents per pound, widening rapidly to 32 cents by June-July, the end of the 1986 season.

An interesting contrast is that the marketing loan simulation results of Memphis spot were higher than actual prices in the first 6 months of the 1986-87 season. The gain ranged from 6 cents in August 1986 to 11 cents in January 1987.

Using annual data for crop years, 1985/86, 1986/87, and 1987/88, we find that the marketing loan impact shows a substantial drop in Memphis price: 18.37 cents per pound below actual the first year. But, the decline was offset by gains of 8.2 cents and 9.07 cents above actual for the following 2 crop years, (fig. 6). The simulation results reflect sharply higher export sales of 5.18 million bales the first year from the 1.96 million actual. In the following 2 years, simulated cotton exports were lower than actual, 5.18 million in 1987 and 5.09 in 1988, in response to higher prices (fig. 7).

FIGURE 6. MARKETING LOAN IMPACT ON
MEMPHIS SPOT, SIMULATION MINUS ACTUAL

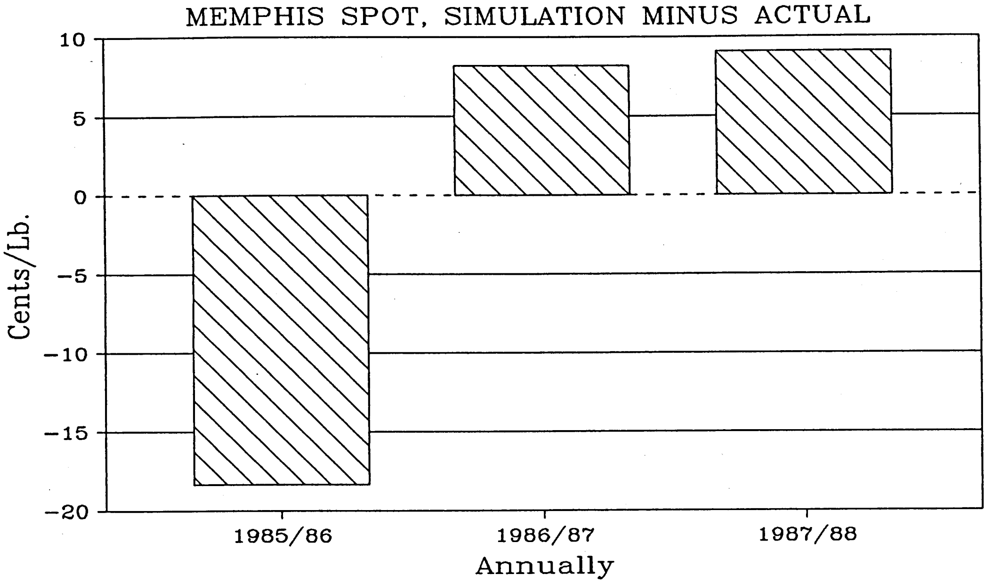
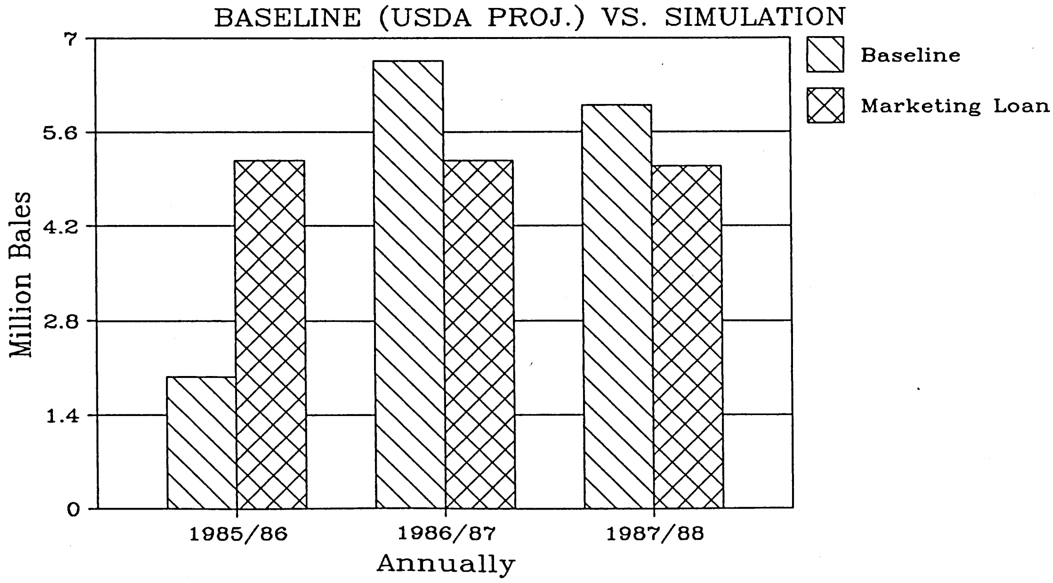


FIGURE 7. MARKETING LOAN IMPACT, EXPORT
BASELINE (USDA PROJ.) VS. SIMULATION



As shown by the simulation results, ending cotton stocks were sharply lower, a decline of 4.06 million bales from 9.36 million in 1985/86 (fig. 8). The downward stock adjustment would have continued in 1986/87, leading to 1.67 million fewer bales in stocks than the baseline of 5.32 million bales. However, because of higher prices in the third year, simulation results point to more production and less use, especially for exports. Thus, 1987/88 ending stocks would increase by 791,000 bales more than baseline projection.

Higher prices encourage production, decrease use, and would lead to a buildup of cotton stocks to the same level as before the marketing loan. The big difference is that the U.S. loan rate no longer establishes an effective world price floor. This suggests foreign competitors would share in the production adjustment with the United States. As a result, the level of U.S. Government-owned stocks will tend to be lower. Overall Government costs should be reduced somewhat from levels experienced before the marketing loan.

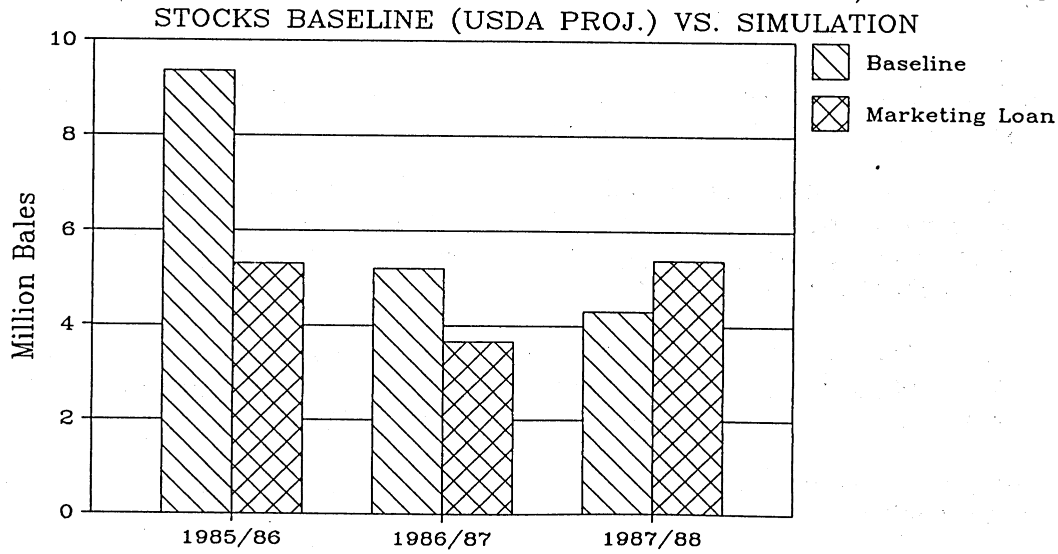
Conclusions

The cotton marketing loan provision of the 1985 farm act changed the price floor from the effective loan rate to the formula-based U.S. adjusted world price. The new program instrument will lead to more frequent price changes in both the futures and spot markets. Uncertainty in production and demand overseas and at home may cause substantial market fluctuations. The forces may also include foreign government policies on cotton and trade, weather, and other institutional factors of significance to the cotton industry.

Based upon impact simulation results, assuming the marketing loan was implemented a year earlier, Memphis spot prices in 1985/86 would have been 18 cents below actual, followed by 8-9 cent gains above actual the next two crop seasons.

With U.S. prices internationally competitive, cotton production and mill consumption are expected to adjust simultaneously, reflecting the same set of market forces in the United States and foreign countries. This adjustment process indicates some risk and uncertainty, but also points to a market condition in line with current technology and consumer demand. Under the marketing loan, Government

FIGURE 8. MARKETING LOAN IMPACT, ENDING STOCKS BASELINE (USDA PROJ.) VS. SIMULATION



costs may increase in the short run, but tend to be reduced in the long run. However, some form of U.S. production control appears needed to offset the incentive to increase production in response to higher prices.

This study provides significant evidence of policy effects on the intertemporal price relationships between cash and futures market. After the program impact period, we expect the normal historical pattern of narrowing basis to prevail. Despite the policy shock, the causal relationship between cash and futures should continue to reflect competitive market forces worldwide.

The causality tests suggest the importance of the futures market in relation to spot prices in both U.S. and foreign markets. Under such circumstances, it is important to monitor global market information and to maintain ongoing forecasts as a planning tool for decisionmaking by the cotton industry and in formulating Government policy.

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LONG-TERM EFFECTS OF THE 1985 FARM ACT ON PUT OPTION SHORT HEDGING FOR CORN AND SOYBEANS

Thomas L. Sporleder and John B. Penson, Jr.

The introduction of options on agricultural commodity futures has proliferated the possibilities for price risk management strategies to both long and short hedgers. Early analyses of options as a short hedge alternative to futures for producers suggests put options provide a favorable price risk management strategy, especially when yield uncertainty is high (4)1/. Also, interest in the potential use of options as a substitute for price support programs has surfaced (1,7). The 1985 farm act contains a provision which encourages study and analysis of the potential of options as a price support vehicle.

Two obvious differences between options and price supports were identified initially by Schertz (7). One difference is that current participation costs are minimal to producers through compliance provisions such as acreage diversion. However, the costs of options to provide a floor price comparable to a prevailing loan rate may be substantial to producers.

A second difference is that price support programs influence longrun market clearing price levels, whereas farmers' use of put options to provide floor price protection does not. Government price support programs are partially motivated by an income transfer goal. To the extent the Government programs influence equilibrium market price for a commodity, feedback effects obviously exist on the magnitude of deficiency payments and direct Government storage costs.

Federal farm law provisions obviously influence equilibrium commodity prices (3). This paper focuses on the interaction between the 1985 farm act and the potential long-term use of put option hedging by agricultural producers. One possibility is for crop producers to participate in Federal commodity programs and short hedge through the appropriate commodity options markets as a complement to their participation. A rational producer may participate in the farm program but examine the feasibility of using put options to secure a higher minimum price at harvest than the prevailing loan rate provided for that commodity.

Specifically, the aggregate effects of the 1985 farm act are estimated annually through 1990 for corn and soybeans. These results are then interpreted for their implication for put option short hedging as a potential complement to the loan program provisions for each commodity. That is, the influence of the 1985 farm act on long-term put option hedging is examined. Producers may participate in the program but also use short puts as a means of setting a more favorable floor price than is afforded by the 1985 farm act. Floor or minimum prices from various put strikes are estimated and examined relative to prevailing loan rates for each crop and year. The analysis highlights differences among the commodities analyzed.

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

Methods

The effect of 1985 farm law for corn and soybeans on annual equilibrium prices and real farm income is assessed through using the COMGEM macroeconomic model. COMGEM, a Commodity General Equilibrium Model, is an econometric model of the U.S. economy which examines agricultural prices and quantities in a systematic fashion.

COMGEM has a farm supply response and disappearance component for the major crop and livestock commodities (6). COMGEM was used in this study to project the effects of macroeconomic and farm policy provisions on commodity price levels, supplies, total use, and ending stocks for corn and soybeans.

Put premiums and the minimum floor price implied from selected strike prices for each commodity were estimated using the Grain Futures and Options Hedging Evaluator (8). This program calculates theoretical fair market put premiums using the standard Black commodity options pricing formula. The shortrun interest rate chosen was the 3-month Treasury bill rate projected by COMGEM. Put premiums for selected strike prices were estimated in each instance using 15-, 20-, 25-percent futures price volatility for the appropriate contract.

For each commodity analyzed, the put premium is based upon purchase at planting and offset at harvest. The approximate put premiums are calculated annually for appropriate years from 1988 through 1990. For the analysis, the harvest month futures price at hedge placement for each commodity is assumed equivalent to the annual equilibrium cash market price generated by COMGEM, adjusted for a representative basis.

Impacts of Policy Assumptions

The target prices and loan rates for the 1985 farm act used in this analysis are calculated based upon formulas in the 1985 Act and would be similar to those reported by Glaser (2). Loan rates are based on the assumption that the Secretary of Agriculture would assure U.S. farm products are competitive in world markets (5, p. 15). Set-aside levels are maintained throughout the study period at or near the 1987 level, depending on stock levels. Participation in the paid diversion program for corn and sorghum was assumed to be minimal.

The macroeconomic environment projected by COMGEM to the end of the decade reflects the assumption of continued high Federal deficits and fast money growth. This strong monetary and fiscal policy stimuli leads to accelerated growth in real GNP and inflation. Real GNP expands 5-6 percent per year, inflation ranges between 6 to 7 percent, and a real prime interest rate approaching 8 percent by the end of the decade.

Equilibrium prices during 1987-90 for corn and soybeans were projected by COMGEM under this general macroeconomic and farm policy environment (tables 1 and 2). For corn, the set-aside levels are not sufficient to reduce production. Relatively high target prices are expected to continue building stocks even though target prices decline beginning in 1988. On the strength of increased demand and reduced production, cash price exceeds loan rates by 1989.

Soybeans are expected to enjoy export and domestic market growth which encourages some increased production. Stocks peak in 1987, but fall subsequently. The equilibrium cash price is expected to exceed the loan rate annually for 1988 and beyond.

Short Hedging with Put Options

Farm programs obviously affect the need for short hedging by producers. One method of assessing this effect is to examine the extent to which short hedging by buying puts against a growing crop may complement or substitute for the loan provisions of the current farm legislation. The specific focus here is on calculation of premiums for selected put strikes which provide the same or higher price floor than is afforded by the loan rate for each commodity.

Corn

Over 1987-90, provisions of the 1985 farm act for corn relative to equilibrium cash price indicate loan rates above cash price for 1987 and 1988. The first year where short puts might complement participation in the farm program is 1989. For that year, a cash price of $1.81 per bushel, compared with a loan rate of $1.64 per bushel, is indicated by the COMGEM analysis.

Table 1--Effects on corn of 1985 farm act, selected items, 1987-90

	Crop year			
Item	1987	1988	1989	1990
Acres planted (mil.)	72.2	70.0	69.1	67.6
Acres harvested (mil.)	65.0	63.0	62.2	60.8
Yield (bu. per acre)	115.0	116.1	117.3	118.5
Beginning stocks (bil.bu.)	5.61	6.12	6.16	5.82
Production (bil. bu.)	7.48	7.32	7.29	7.21
Total supply (bil. bu)	13.09	13.44	13.45	13.03
Exports (bil. bu.)	1.57	1.74	1.90	2.04
Domestic use (bil. bu.)	5.40	5.54	5.73	5.98
Total use (bil. bu.)	6.97	7.28	7.63	8.02
Ending stocks (bil. bu.)	6.12	6.16	5.82	5.01
Target price (dol.)	3.03	2.97	2.88	2.75
Loan rate (dol.)	1.82	1.74	1.64	1.56
Set-aside (percent)	20	20	20	20
Farm price (dol.)	1.56	1.72	1.81	1.98
Subsidy cost (bil. dol.)	7.25	7.37	6.41	4.62
Storage cost (bil. dol.)	.80	.81	.79	.71
Total cost (bil. dol.)	8.05	8.18	7.20	5.33
Net cash income (bil. dol.)	3.55	4.68	3.40	1.96

Source: COMGEM, Agricultural and Food Policy Center, Texas A&M Univ.

Approximate put premiums were calculated for the 1989 and 1990 crops, assuming a hedge date of May 15 with a lift date of October 15, or a period of 153 days for the put hedge, with about 180 days from purchase until expiration. Three-month Treasury bill rates for 1989 were estimated by COMGEM at 9.6 percent and 11.3 for 1990. These rates were used as the interest rate in the Black model for the appropriate year. A basis 5 cents under was assumed typical. Premiums and implied floor prices for various strikes assuming 15-, 20-, and 25-percent futures price volatility were estimated. Implied floor price or minimum price is calculated in a standard manner as the strike price minus costs and basis. Costs are calculated to include the put premium, commissions, and the opportunity cost on commissions for the life of the hedge.

Results indicate that a put strike of about $1.80 in 1989 would produce a floor price for corn of $1.67, about $0.03 more than the loan rate floor provided by the 1985 farm act (at 20 percent volatility, table 3). For 1990, a strike of $1.70 is estimated to result in a floor of $1.63, or about $0.07 above the prevailing loan rate (table 4). The approximate premiums for these strikes were estimated to be $0.07 per bushel for 1989 and $0.01 per bushel for 1990. An at-the-money put strike of $1.90 is estimated to produce an $0.08 improvement over the loan for 1989 (table 3) while an at-the-money strike for 1990 of $2.00 is estimated to yield a $0.29 per bushel improvement over loan (table 4). Both calculations are at the 20-percent December futures price volatility.

Table 2--Effects on soybeans of 1985 farm act, selected items, 1987-90

Item	Crop Year 1987	1988	1989	1990
Acres planted (mil.)	61.0	61.4	61.7	61.9
Acres harvested (mil.)	59.5	59.9	60.2	60.4
Yield (bu. per acre)	31.7	32.2	32.8	33.4
Beginning stocks (bil. bu.)	.62	.55	.51	.48
Production (bil. bu.)	1.89	1.93	1.97	2.02
Total supply (bil. bu.)	2.51	2.48	2.48	2.50
Exports (bil. bu.)	.80	.81	.82	.83
Domestic use (bil. bu.)	1.16	1.16	1.18	1.19
Total use (bil. bu.)	1.96	1.97	2.00	2.02
Ending stocks (bil. bu.)	.55	.51	.48	.48
Loan rate (dol.)	4.77	4.50	4.50	4.50
Target rate (dol.)	---	---	---	---
Farm price (dol.)	4.59	4.54	4.63	4.72
Subsidy cost (bil. dol.)	---	---	---	---
Storage cost (bil. dol.)	.07	.07	.07	.07
Total cost (bil. dol.)	.07	.07	.07	.07
Net cash income (bil. dol.)	1.74	1.47	1.38	1.21

Source: COMGEM, Agricultural and Food Policy Center, Texas A&M Univ.

Soybeans

Over 1987-90, provisions of the 1985 farm act for soybeans relative to equilibrium cash price indicate loan rates above cash price only in 1987. For

Table 3--Corn: Approximate put premiums and implied floor prices at planting, for selected strikes, 1989

Assuming:				
Dec/89 futures price on 05/15/89			($/bu)	1.86
Expected basis at harvest			($/bu)	- .05
Short term interest rate			(%)	9.60

Strike price	Put premium	Commission + opp. cost + basis	Implied floor price	Premium as percentage of implied floor price
---- Dollars per bushel ----				Percent
Volatility of futures price = 15 percent:				
1.60	0.01	0.0567	1.53	0.65
1.70	.02	.0571	1.62	1.23
1.80	.05	.0583	1.69	2.96
1.90	.10	.0603	1.74	5.75
2.00	.16	.0628	1.78	9.00
2.10	.24	.0660	1.79	13.38
2.20	.34	.0701	1.79	19.00
Volatility of futures price = 20 percent:				
1.50	.01	.0567	1.43	.70
1.60	.01	.0571	1.52	1.31
1.70	.04	.0579	1.60	2.50
1.80	.07	.0591	1.67	4.19
1.90	.12	.0611	1.72	6.98
2.00	.18	.0636	1.76	10.25
2.10	.26	.0669	1.77	14.66
2.20	.34	.0701	1.79	19.00
Volatility of futures price = 25 percent:				
1.50	.01	.0567	1.43	.70
1.60	.03	.0575	1.51	1.98
1.70	.06	.0587	1.58	3.79
1.80	.10	.0603	1.64	6.10
1.90	.15	.0624	1.69	8.89
2.00	.21	.0648	1.73	12.17
2.10	.28	.0677	1.75	15.98
2.20	.35	.0705	1.78	19.67

soybeans, short puts potentially could complement farm program participation each year from 1988. For 1988, a cash price of $4.54 is used (table 5), compared with $4.63 for 1989 (table 6) and $4.72 for 1990 (table 7). The loan rate for each year is $4.50.

Table 4--Corn: Approximate put premiums and implied floor prices at planting, for selected strikes, 1990

Assuming:				
Dec/90 futures price on 05/15/90			($/bu)	2.03
Expected basis at harvest			($/bu)	- .05
Short-term interest rate			(%)	11.30

Strike price	Put premium	Commission + opp. cost + basis	Implied floor price	Premium as percentage of implied floor price
Dollars per bushel				Percent
Volatility of futures price = 15 percent:				
1.80	0.01	0.0568	1.73	0.58
1.90	.03	.0577	1.81	1.66
2.00	.07	.0596	1.87	3.74
2.10	.12	.0621	1.92	6.26
2.20	.19	.0654	1.94	9.77
2.30	.27	.0693	1.96	13.77
2.40	.37	.0741	1.96	18.92
Volatility of futures price = 20 percent:				
1.70	.01	.0568	1.63	.61
1.80	.03	.0577	1.71	1.75
1.90	.06	.0592	1.78	3.37
2.00	.09	.0606	1.85	4.87
2.10	.15	.0635	1.89	7.95
2.20	.21	.0664	1.92	10.92
2.30	.29	.0702	1.94	14.95
2.40	.37	.0741	1.96	18.92
Volatility of futures price = 25 percent:				
1.60	.01	.0568	1.53	.65
1.70	.03	.0577	1.61	1.86
1.80	.05	.0587	1.69	2.96
1.90	.08	.0601	1.76	4.55
2.00	.12	.0621	1.82	6.60
2.10	.17	.0645	1.87	9.11
2.20	.24	.0678	1.89	12.68
2.30	.31	.0712	1.92	16.16
2.40	.38	.0745	1.95	19.53

Approximate put premiums were calculated for the 1988-90 crop seasons, assuming a hedge date of June 1 with a lift date of November 10, or a period of 131 days for the put hedge, with about 135 days from purchase until put expiration. The 3-

Table 5--Soybeans: Approximate put premiums and implied floor prices at planting, for selected strikes, 1988

Assuming:				
Nov/88 futures price on 06/01/88			($/bu)	4.84
Expected basis at harvest			($/bu)	-.30
Short-term interest			(%)	9.10

Strike price	Put premium	Commission + opp. cost + basis	Implied floor price	Premium as percentage of implied floor price
------------- Dollars per bushel		----------------		Percent
Volatility of futures price = 15 percent:				
4.25	0.01	0.3065	3.93	0.25
4.50	.05	.3079	4.14	1.21
4.75	.13	.3105	4.31	3.02
5.00	.26	.3148	4.43	5.88
5.25	.44	.3208	4.49	9.80
5.50	.66	.3281	4.51	14.63
Volatility of futures price = 20 percent:				
4.00	.01	.3065	3.68	.27
4.25	.04	.3075	3.90	1.02
4.50	.09	.3092	4.10	2.19
4.75	.18	.3122	4.26	4.23
5.00	.32	.3168	4.36	7.33
5.25	.49	.3224	4.44	11.04
5.50	.68	.3287	4.49	15.14
5.75	.91	.3363	4.50	20.21
6.00	1.07	.3436	4.59	23.33
Volatility of futures price = 25 percent:				
3.75	.01	.3065	3.43	.29
4.00	.03	.3072	3.66	.82
4.25	.07	.3085	3.87	1.81
4.50	.14	.3108	4.05	3.46
4.75	.24	.3141	4.20	5.72
5.00	.37	.3185	4.31	8.58
5.25	.53	.3237	4.40	12.06
5.50	.72	.3300	4.45	16.18
5.75	.93	.3370	4.48	20.75

month Treasury bill rate for 1988 was estimated by COMGEM at 9.1 percent, with 1989 and 1990 years the same as before. A basis of $0.30 cents under was assumed typical for soybeans. Premiums and implied floor prices for various November

Table 6--Soybeans: Approximate put premiums and implied floor prices at planting, for selected strikes, 1989

Assuming:		
Nov/89 futures price on 06/01/89	($/bu)	4.93
Expected basis at harvest	($/bu)	- .30
Short-term interest rate	(%)	9.60

Strike price	Put premium	Commission + opp. cost + basis	Implied floor price	Premium as percentage of implied floor price
------------- Dollars per bushel ---------------				Percent
Volatility of futures price = 15 percent:				
4.25	0.01	0.3066	3.93	0.25
4.50	.03	.3073	4.16	.72
4.75	.10	.3097	4.34	2.30
5.00	.21	.3135	4.48	4.69
5.25	.37	.3191	4.56	8.11
5.50	.58	.3265	4.59	12.63
5.75	.82	.3349	4.60	17.84
Volatility of futures price = 20 percent:				
4.00	.01	.3066	3.68	.27
4.25	.03	.3073	3.91	.77
4.50	.07	.3087	4.12	1.70
4.75	.15	.3114	4.29	3.50
5.00	.27	.3156	4.41	6.12
5.25	.42	.3209	4.51	9.31
5.50	.61	.3275	4.56	13.37
5.75	.82	.3349	4.60	17.84
Volatility of futures price = 25 percent:				
4.00	.02	.3069	3.67	.54
4.25	.06	.3083	3.88	1.55
4.50	.12	.3104	4.07	2.95
4.75	.20	.3132	4.24	4.72
5.00	.32	.3174	4.36	7.34
5.25	.48	.3230	4.45	10.79
5.50	.65	.3289	4.52	14.38
5.75	.85	.3359	4.56	18.62
6.00	1.07	.3436	4.59	23.33

soybean put strikes were estimated over the same range of price volatility used for corn. Implied floor prices were calculated in the same manner as for corn.

Table 7--Soybeans: Approximate put premiums and implied floor prices at planting, for selected strikes, 1990

Assuming:				
Nov/90 futures price on 06/01/90			($/bu)	5.02
Expected basis at harvest			($/bu)	- .30
Short-term interest rate			(%)	11.30
Strike price	Put premium	Commission + opp. cost + basis	Implied floor price	Premium as percentage of implied floor price
Dollars per bushel				Percent
Volatility of futures price = 15 percent:				
4.25	0.01	0.3067	3.93	0.25
4.50	.02	.3071	4.17	.48
4.75	.07	.3091	4.37	1.60
5.00	.16	.3128	4.53	3.53
5.25	.31	.3190	4.62	6.71
5.50	.50	.3268	4.67	10.70
5.75	.73	.3363	4.68	15.59
Volatility of futures price = 20 percent:				
4.00	.01	.3067	3.68	.27
4.25	.02	.3071	3.92	.51
4.50	.05	.3083	4.14	1.21
4.75	.12	.3112	4.32	2.78
5.00	.22	.3153	4.46	4.93
5.25	.36	.3210	4.57	7.88
5.50	.54	.3285	4.63	11.66
5.75	.74	.3367	4.67	15.83
6.00	.98	.3465	4.67	20.97
Volatility of futures price = 25 percent:				
4.00	.02	.3071	3.67	.54
4.25	.05	.3083	3.89	1.28
4.50	.09	.3099	4.10	2.20
4.75	.17	.3132	4.27	3.98
5.00	.28	.3178	4.40	6.36
5.25	.42	.3235	4.51	9.32
5.50	.59	.3305	4.58	12.88
5.75	.78	.3383	4.63	16.84
6.00	.99	.3470	4.66	21.23

Results for soybeans for 1988 suggest that few strikes will likely provide a floor roughly equivalent to the $4.50 loan rate across any of the three futures price volatilities assumed (table 5). The best floor for the 1988 crop is $4.51 at a strike of $5.50, assuming 15-percent volatility. Greater volatility would require a higher strike. For 1989, the picture changes (table 6). A floor of $4.51 is estimated to be available from puts for the 1989 crop at a strike of $5.25, assuming 20-percent November futures price volatility. At 25-percent volatility, the floor for this strike falls to $4.45.

The analysis suggests that, for the 1990 crop, at-the-money put options at planting provide a floor slightly exceeding the prevailing loan rate (table 7). The strikes and associated premiums estimated for 1990 indicate a floor of $4.68 at a $5.75 strike and 15-percent volatility. With a greater volatility of 20 percent, the floor available through puts at planting is estimated at $4.67 at a $5.75 strike. This situation would require purchasing a deep in-the-money put where the premium associated with the $5.75 strike is $0.74, or nearly all intrinsic value. Similarly, for the 25-percent volatility, a floor of only $4.63 is indicated for a strike of $5.75 and associated premium of $0.78.

Conclusions

The analysis broadly suggests that current provisions of the 1985 farm act coupled with a continuation of expansionary macroeconomic policy have an extensive influence on the potential producer use of puts to short hedge and complement program participation. The situation changes significantly over the 3 crop years analyzed. For 1988, the analysis suggests that neither corn nor soybean producers would expect short puts to offer advantages substantially above the 1988 prevailing loan rates.

However, for the 1989 crop, the analysis suggests that corn producers would have a better chance of using puts as a complement to farm program participation. At-the-money puts would produce floor prices about $0.05 to $0.10 per bushel above prevailing loan rates and in-the-money puts would provide slightly higher floors.

This compares with soybeans for 1989, where the analysis suggests that in-the-money puts might achieve no better than floor prices equivalent to loan rates. At-the-money puts in 1989 are associated with floors anywhere from $0.02 to $0.14 per bushel below the loan rate, depending on volatility. Thus, the likelihood of soybean producers benefiting substantially from short puts is doubtful, given current provisions for the 1989 crop year and projected economic conditions.

For 1990, the situation improves for corn relative to 1989 but remains marginal for soybeans. At-the-money puts for 1990 corn are estimated to imply a floor price from $0.26 to $0.31 per bushel above prevailing loan rates, depending on volatility. By contrast, in-the-money puts at a $5.50 strike would be required by soybean producers to imply a floor only $0.08 to $0.17 per bushel above prevailing loan rates, depending on volatility.

Overall, the analysis suggests that the 1985 farm act and projected macroeconomic conditions have their greatest effect on soybean producers, compared with corn producers. That is, soybean producers would be expected to have less chance of short hedging using puts to profitably complement program participation compared with corn producers.

This analysis obviously is limited by the need to make a number of major assumptions, both in estimating the 1985 farm act effects on commodity price, and on estimating the implied floor prices likely available from put options. Although the numbers may not prove to be correct in absolute magnitude, the relative effects on corn compared to soybeans should be reasonably accurate.

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HOW MUCH SHOULD FARMERS HEDGE AT PLANTING TIME?

Dwight Grant

The best hedge at planting time depends on the benefits and costs of trading futures or forward contracts. This paper reports estimates of a benefit, the risk-reducing potential of futures, and a cost, the estimated expected loss from trading futures. On the basis of these estimates the best hedge appears to be small relative to a farmer's expected output.1/ This result is consistent with surveys (1) that indicate that relatively few farmers hedge their crops.2/ It differs from the popular prescription that farmers should trade futures to reduce risk. The reason is clear. While futures effectively eliminate price risk, they are much less effective at eliminating joint price and yield risk.

Numerous empirical studies demonstrate that futures (or forward) positions effectively eliminate price risk. The proportion eliminated depends on the length of the holding period for the spot position. It also depends on the physical similarity of the spot asset and deliverable asset. Finally, it depends on the proximity of the timing and location of the spot asset's sale and the futures contract delivery. The longer the holding period and the more similar the spot and futures positions, the higher the proportion of price risk that futures eliminate. For example, this paper reports the risk reduction from matching a certain spot position with a short futures position of approximately equal size. For the interval from mid-May to mid-October, Chicago Board of Trade (CBOT) futures in corn eliminate approximately 95, 91, and 83 percent of the price risk of corn sold in Des Moines (IA), Omaha (NE), and Wilson (NC). For soybeans, the corresponding values are 98, 89, and 97 percent.

These results are typical when the spot position is a certain quantity. When the spot position is uncertain, as is the case at planting time, the effects of hedging are not well-documented. The influence of yield uncertainty is acknowledged in the recommendation that farmers should hedge less than their expected yields. A popular rule-of-thumb is 50-75 percent of expected yield.

This paper provides empirical estimates of the variance-minimizing hedges for corn and soybeans. Briefly, they are less than expected yields, vary more

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1/ The reference is to farmers. The least aggregated available data is average county yield data for counties.

2/ Underscored numerals in parentheses refer to items in References at end of paper.

widely than the 50- to 75-percent range cited, and vary by region and crop. In addition the paper reports the effectiveness of hedging and the expected loss from doing so. These results suggest that the answer to the question posed in the title of this paper is: "Not much!"

When farmers plant crops, they expose themselves to revenue risk. Revenue is the product of price and yield. Likewise, revenue risk depends upon price risk, yield risk, and their interactions. Farmers can manage their revenue risks by trading futures contracts. Viewed narrowly, futures trading alters exposure to price risk but not yield risk. This narrow view ignores the potentially influential correlation between price and yield.

Each farmer is typically a small producer relative to the market. The yield for a single farmer does not affect price. Because of weather, insects, or disease, yield may be correlated with the yields of other farmers. If so, it will be positively correlated with market yield. This will produce a negative correlation between an individual farmer's yield and the futures price. Thus futures can be used to hedge both price and yield risk.

The next section of this paper develops a model of hedging at planting time. A report of empirical results follows that. The paper closes with an analysis of the implications of these results for optimal futures trading by farmers.

The Hedging Decision

To formally pose the problem, assume a farmer has selected a scale of output and incurred all of the costs required to produce a single commodity.3/ The prices and yield of the crop at harvest are random variables. The farmer's objective is to maximize one-period expected utility of income by trading futures.

$$\max_{h} EU(\pi) \quad (1)$$

where

$$\tilde{\pi} = \tilde{p}\tilde{q} + h(\tilde{f} - F) \quad (2)$$

E is the expectations operator.

U( ) is the utility function.

$\tilde{\pi}$ is income. Tildes identify random variables.

$\tilde{p}$ is the end-of-period local price of output.

$\tilde{q}$ is the realized output.

h is the quantity of futures sold (-) or bought (+).

$\tilde{f}$ is the futures price at harvest.

F is the futures price at planting.

3/ This study ignores the interaction between the choices of a scale of output and the choice of an optimal futures position. Similarly, it ignores the case in which a farmer produces more than one commodity. For an analysis of the former issue, see (2).

The expected utility maximizing hedge, h*, is the solution of the first-order condition $\partial EU(\pi)/\partial h = 0$. Substituting equation (2) into equation (1) and applying the chain rule produces:

$$E[U'(\pi)(f - F)] = 0 \qquad (3)$$

where $U'(\pi) = \partial U(\pi)/\partial\pi$. The expected value of the product of two random variables is the product of their expected values, plus their covariance. Therefore

$$EU'(\pi)E(f - F) + cov(U'(\pi),f) = 0 \qquad (4)$$

To produce an empirically tractable solution, assume that π and f are normally distributed. This allows application of Stein's theorem.4/

$$cov(U'(\pi),f) = EU''(\pi)cov(\pi,f) \qquad (5)$$

where $U''(\pi) = \partial U^2(\pi)/\partial\pi^2$. Substituting equation (2) into the right-hand-side of equation (5) produces

$$cov(U'(\pi),f) = EU''(\pi)[cov(pq,f) + (h)var(f)] \qquad (6)$$

Substituting equation (6) into equation (4) and solving for the optimal h yields

$$h^* = - \frac{[cov(pq,f)]}{var(f)} - \frac{EU'(\pi)E(f - F)}{EU''(\pi)var(f)} \qquad (7)$$

This result separates the optimal hedge into two parts. The first is the variance-minimizing hedge. We call it the revenue hedge. The other is the expected gain or loss adjustment. We call it the wealth adjustment.

The Revenue Hedge

The revenue hedge is the best hedge for a risk averse farmer if the expected gain or loss from hedging, [E(f-F)], is zero. When cov(pq,f) is positive, as is always the case in the extensive empirical results reported below, the revenue hedge is a short position.

The revenue hedge can be divided into three components, the price hedge, the yield hedge and the interaction hedge.

$$h^{**} = - \frac{[E(q)cov(p,f) + E(p)cov(q,f) + cov(\Delta p\Delta q,f)]}{var(f)} \qquad (8)$$

$\Delta p = (p-E(p))$, and $\Delta q = (q-E(q))$. If yield is certain $\Delta q = 0$ and the hedge is the first component of equation (8), the price hedge is:

$$h^{**} = -q\ cov(p,f)/var(f) \qquad (8.1)$$

4/ A simple statement of Stein's theorem is

$$cov(U'(x),y) = EU''(x)cov(x,y)$$

where U is a twice differentiable continuous function and x and y are bivariate normal variables.

This familiar result is the variance-minimizing hedge when price is the only source of risk. If a price hedge involves spot and futures in the same asset, the correlation between p and f may be close to 1.00. The variances of p and f may be approximately equal. If so, the price hedge will be a short position approximately equal to output, q.

To identify the second component of the revenue hedge assume p is certain. Only yield and the futures price are risky.5/ When $\Delta p = 0$ hedge is the second component of equation (8), the yield hedge is:

$$h^{**} = -p\ \mathrm{cov}(q,f)/\mathrm{var}(f) \qquad (8.2)$$

The size of this component depends on the covariance between local yield and national futures prices. It will be 0.00 unless individual yields are positively correlated. In that case, cov(q,p) should be negative. If so, the yield hedge will reduce the absolute size of the revenue short hedge relative to the price short hedge.

The third term of (8) comes into play when both price and yield are random. In addition to the price and yield hedges, the revenue hedge includes an interaction (between price and yield) hedge.

$$\mathrm{cov}(\Delta p \Delta q, f)/\mathrm{var}(f) \qquad (8.3)$$

If the correlation between p and f is close to 1.00, the interaction hedge is likely to be negative.

The proportion of risk the revenue hedge eliminates can be measured by the coefficient of determination between revenue and the futures price, $R^2(pq,f)$, measures that.

$$\begin{aligned} \mathrm{var}(pq+h^{**}(f-F)) &= \mathrm{var}(pq) + 2h^{**}\mathrm{cov}(pq,f) + h^{**2}\mathrm{var}(f) \\ &= \mathrm{var}(pq) - \frac{2(\mathrm{cov}(pq,f))^2}{\mathrm{var}(f)} + \frac{(\mathrm{cov}(pq,f))^2}{\mathrm{var}(f)} \\ &= \mathrm{var}(pq)[1 - R^2(pq,f)] \qquad (9) \end{aligned}$$

<u>The Wealth Adjustment</u>

The second term of equation (7) adjusts for the expected gain or loss from trading futures. The farmer's risk tolerance, $EU'(\pi)/EU''(\pi)$, and the expected gain or loss from trading determine its sign. A risk averter's risk tolerance is negative. Therefore, the wealth adjustment term will vary directly with E(f-F). For example, if the revenue hedge is a short position and the farmer expects to lose money on a short position, $E(f-F) > 0$, the wealth adjustment will reduce the size of the optimal short position relative to the revenue hedge.

The Empirical Analysis

This paper summarizes the results from another study (2). More complete descriptions of the data, methodology, and results are available in that study.

5/ In this case, the futures contract must be written in terms of some price other than p.

Data

The study examines U.S. corn and soybean production for 1961-83. The basic data are corn and soybean prices and yields. The yield data include counties and regions in Iowa, Nebraska, and North Carolina. They also include State aggregate yields for those 3 States and 16 others.6/ Finally, there are national aggregate yield data. There are spot and futures price time series for each commodity. For each of Iowa, Nebraska, and North Carolina, the spot price series are for delivery to a central point within that State. Because local prices are not available for all States included, the spot price series for other States and for the United States is a Chicago delivery series.7/ All prices are measured at planting time, the first Thursday after May 15, and harvest time, the first Thursday after October 15.

The ideal data base for this study would be time series of farmers' expectations of prices and yields. This, combined with harvest-time realizations, would permit estimates of the components of the best hedge. These data are not available. Therefore, this study uses futures prices as proxies for a farmer's conditional price expectations at planting time. It uses one of two estimates of regional yields as a proxy for the farmer's yield expectations. Where regional yields exhibit a statistically significant trend over time, expected yield at planting time is the estimated value of a linear regression of yield on time. Otherwise, it is the mean value for the entire time period.

The study does not include the effects of Government policy other than through its observed effects on yields and market prices. Market prices may not be appropriate if farmers actually receive support prices. Furthermore, the estimated yield and price distributions may not reflect anticipated effects of Government policy. In these respects, soybeans have an advantage over corn. There was little Government intervention in the soybean market during the study period.

All of the hedges are estimated using ordinary-least-squares time series regressions. The dependent variables are revenue, price, yield, and the interaction between price and yield. The independent variable is the futures price. All of these variables are measured as unexpected percentage changes from planting time to harvest time. Deviations from expected values are used because the expected values of the price and yield series are not all stable over time. Percentage values are used to adjust for possible heteroskedasticity and to facilitate interpretation of the results. This produces estimates of hedges as a percentage of expected yield.

6/ The other 16 States are Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio, South Carolina, South Dakota, and Tennessee. These were selected because they all produced at least 15 million bushels of soybeans in 1983.

7/ There are two possible objections to this series. First, the Chicago delivery market may not active enough for this be a reliable series. Second, local price basis risk may be substantial. The Chicago and Des Moines price series are sufficiently similar to mitigate our concern for the first objection. See table 1. The significance of the second is an open question. For example, the basis risks for Chicago and North Carolina prices are virtually identical for soybeans but moderately different for corn.

Summary of Hedge Estimates

The larger study reports corn and soybean hedge estimates for 63, 53, and 61 counties and regions in Iowa, Nebraska, and North Carolina, and for 19 States and the country as a whole. This paper includes illustrative results for individual counties, regions, and States, as well as summary data. To begin, we examine the price hedge estimates for the different regions.

All of the estimates are similar and none of the price hedges is significantly different from 1.00. The Nebraska soybean estimate and the North Carolina corn estimates differ most from the others. One can hypothesize that the latter is a result of the physical distance between the two markets. The North Carolina spot price is less highly correlated with the futures price with the result that the variance-minimizing hedge is smaller and less effective. The difference is sufficiently small that it is not of obvious economic significance. Whether it indicates a general relationship for locations distant from Chicago awaits further study. The relationship does not appear to extend to soybeans. Chicago spot prices appear to be reasonable proxies to use when examining risk.

Table 2 illustrates the county level results. These results illustrate that the estimates of the revenue hedges vary by county and by commodity. The same is true for the proportion of risk, R^2, that the revenue hedge eliminates. It ranges from 4 percent to 67 percent for corn with an average of 36 percent and from 14 percent to 44 percent for soybeans with an average of only 25 percent.

This is also a convenient point at which to discuss the issue of aggregation. These estimates are based on the least aggregated data available to us, county yield data. As such, they provide the best approximation of an individual farmer's experience. This study also includes regional, State, and national results. They indicate the effects of aggregation on the estimates. The objective is to determine whether there is a pattern that allows us to the extrapolate the county results to individual farms.

The hedge estimates for each commodity are all regression coefficients calculated with the same variable -- the futures price -- as the independent variable. Therefore, they are additive. As a result, the hedge calculated

Table 1--Price hedges and their effectiveness

	Corn			Soybeans		
Area	Price hedge	S.E.	R^2	Price hedge	S.E.	R^2
Chicago	0.97	0.058	0.93	0.97	0.033	0.98
Iowa	.92	.047	.95	.96	.032	.98
Nebraska	.93	.063	.91	1.08	.087	.89
N. Carolina	.87	.086	.83	.98	.039	.97

from county data is a weighted average of the hedges for individual farmers. The results in table 2 illustrate that. The simple average of the various hedges are approximately equal to the county estimate.

The same is not true for revenue risk and measures of risk reduction. Farmers' yields are not perfectly positively correlated. Averaging yields eliminates some portion of variance through diversification. On average, farmers' yields and revenues are riskier than county yields and revenues and county estimates may overstate the effectiveness of hedging. For example, the average R^2's for the counties are 36 percent and 25 percent for corn and soybeans, while the estimates for the region are 42 percent and 33 percent.

Table 3 summarizes estimates for the areas examined. The average of the county revenue hedges for Iowa, Nebraska, and North Carolina are consistent for the two commodities and fall in the range 0.67 to 0.83. As the results for Nebraska illustrated, however, the county estimates are quite widely dispersed around these means. The average R^2s for the counties of these three States are 51 percent for corn and 45 percent for soybeans. Recall that these are likely to be higher values than the average for farmers in those States. Furthermore, there is considerable variability between counties and there is likely to be even more variability in the risk reduction individual farmers can accomplish.

The average of the estimates for the 19 States indicate that both hedge ratios and risk reduction are lower than for Iowa, Nebraska, and North Carolina. This

Table 2--Results for counties in southeast Nebraska

Commodity/ county	Revenue hedge	Standard error	R^2	Yield hedge	Interaction hedge
Corn:					
Clay	-0.94	0.14	0.67	0.00	-0.01
Gage	-.51 1/	.19	.25	-.36	.06
Johnson	-.30 1/	.27	.06	.56 2/	.08
Nuckolls	-.85	.13	.66	.06	.02
Pawnee	-.35	.36	.04	.51	.07
Saline	-.73	.17	.46	.17	.03
Southeast	-.65	.17	.42	.24	.04
Soybeans:					
Clay	-.67	.20	.35	-.35	.07
Gage	-.40 1/	.22	.14	-.63	.06
Johnson	-.50 1/	.25	.16	.60 2/	.00
Nuckolls	-.84	.20	.44	.22	.02
Pawnee	-.46 1/	.24	.15	.58 2/	.05
Saline	-.60	.21	.28	.45 2/	.03
Southeast	-.55 1/	.17	.33	.49 2/	.04

1/ Significantly different from 1.00 at a 5% confidence level.
2/ Significantly different from 0.00 at a 5% confidence level.

is more marked for soybeans than for corn. The average revenue hedge for the 19 States is 0.61 for soybeans and the average R^2 is 46. To indicate the range of estimates, the table includes data for Kansas. The variance minimizing soybean hedge based on average Kansas yields is 0.22 and it eliminates only 5 percent of revenue risk.

Sensitivity of the Effectiveness Measures

The estimated hedges and effectiveness measures are hypothetical, *ex post* estimates. We ought to report the effectiveness of a hedge estimated in one period and applied in a subsequent period. Out-of-sample effectiveness will be less than or equal to the in-sample estimates. The difference will depend upon the size of estimation errors and the stability of the revenue hedge. In lieu of out-of-sample tests, we estimated the sensitivity of the effectiveness measures to changes in the revenue hedge. The proportion of risk eliminated is essentially constant for hedges within 5 percentage points of the revenue hedge. Effectiveness declines only 1-3 percentage points when the hedge deviates 10 percentage points from the revenue hedge. Even deviations of 20 percentage points reduce the effectiveness by only 3-6 percentage points. This means moderate "errors" in the choice of revenue hedges will not be costly. Moreover, it indicates that the marginal value of hedging, in terms of risk reduction, decreases rapidly. Assuming hedging is not a free good, farmers are likely to choose hedges that are at least 10-20 percentage points below their best estimates of the revenue hedge.

Table 3--Hedge estimates and their effectiveness

Commodity/State	Revenue hedge	R^2	Yield hedge	Interaction hedge
Corn:				
Iowa	-0.73	0.57	0.17	0.02
Nebraska	-.68	.42	.21	.04
North Carolina 1/	-.83	.39	.06	-.02
Kansas 1/	-.79	.60	.18	.00
19 States 1/	-.70	.41	.24	.02
United States 2/	-.70	.65	.24	.03
Soybeans:				
Iowa	-.73	.65	.18	.06
Nebraska	-.67	.37	.38	.03
North Carolina 1/	-.79	.50	.14	.04
Kansas 1/	-.22	.05	.77	-.01
19 States 1/	-.61	.46	.32	.02
United States 2/	-.60	.83	.30	.04

1/ Average values for counties or States.
2/ Values for State or national average yields.

The Wealth Effect of Futures

One of the potential costs of hedging is an expected loss on the futures position. Its influence is captured in the second component of equation (7).

$$- \frac{EU'(\pi)E(f-F)}{EU''(\pi)var(f)}$$

If E(f-F) is positive, farmers will have an incentive to decrease short sales. If it is negative, they will have an incentive to increase short sales. For 1961-83, the mean values of (f_i - F_i) are 3.36 percent for corn and 5.29 percent for soybeans. The estimated standard deviations are 20.1 percent and 17.6 percent. We cannot reject the null hypothesis that E(f) = F in either case. The t-values are 0.80 for corn and 1.44 for soybeans. Nevertheless, this mild evidence of backwardation suggests that there may be an influential cost to hedging that will reduce the size of farmers' optimal hedges.

Conclusions

Four observations suggest that the optimal hedge for farmers at planting time may be small: (1) Variance-minimizing hedges (20-90 percent) and their effectiveness (0-70 percent) are small and variable. (2) These values derive from aggregated data. Individual farmers are likely to experience lower and more variable risk reduction. (3) The marginal contribution of hedging to risk reduction diminishes rapidly. (4) The expected cost of hedging appears to be economically important.

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OPTIMAL SOYBEAN MARKETING STRATEGIES: THE SOUTH CAROLINA CASE

Charles E. Curtis, Jr., Kandice H. Kahl, and Cathy S. McKinnell

Price fluctuations in agricultural commodity markets have increased substantially since 1972. Substantial commodity price variation has increased the importance of the choice of marketing strategies. The availability of a variety of marketing strategies including hedging, options, and storage has given the producer a greater ability to manage product sales. Consideration of both the absolute level of revenues and the revenue risk generated by a marketing strategy through time is important for the manager. The potential for increased income and reduced risk from diversification or mixing of marketing alternatives should also be explored.

Reemergence of agricultural options trading in the fall of 1984 has been touted as a powerful addition to hedging and other marketing strategies previously available to U.S. farmers. Much discussion has centered around the expectation that options provide farmers with a greater degree of price flexibility (by providing a floor but not a ceiling for prices) and reduced income risk. Recent studies (3, 2, 5, 4) have explored the risk-return properties of options as they affect the farm firm and, in general, found them to be a risk-efficient addition.1/

This study examines some strategies available to South Carolina soybean producers during the 1972-81 crop years. The specific objectives were as follows: (1) to identify risk-efficient portfolios from a set of soybean marketing strategies available to South Carolina producers and (2) to evaluate the contribution of options as a new market risk management tool.

Simulation of Soybean Gross Revenues

Twenty-four individual strategies from seven types of marketing alternatives were examined for possible inclusion in the optimal portfolios. These general alternatives serve as reasonable models for types of strategies most often considered by producers. See table 1 for a listing of the strategies. Curtis, Kahl, and McKinnell (1) present a more detailed description. The calculation of revenues per acre received from each of the general categories included in this analysis is as follows:

Cash market speculative strategies involve cash market sales in November or in April with no forward pricing protection,

Revenues = $(F_T + B_T - S)\ (Y_a)$, where:

T = the date of the cash market transaction (either November or April);

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1/ Underscored numerals in parentheses indicate items in References at end of paper.

Table 1--Individual marketing strategies considered for possible inclusion in optimal portfolios

1. Cash market speculative strategies

    1.1 Unpriced sale at harvest (cash sale in Nov.)
    1.2 Unpriced storage (cash sale in Apr.)

2. Routine hedges

    2.3 Hedge in May for Nov.
    2.4 Hedge in July for Nov.
    2.5 Hedge in July for Apr.
    2.6 Hedge in Nov. for Apr.

3. Routine put option purchases

    3.7 Buy put in May for Nov.
    3.8 Buy put in July for Nov.
    3.9 Buy put in July for Apr.
    3.10 Buy put in Nov. for Apr.

4. Selective hedges signaled by dual moving averages

    4.11 Hedge in May for Nov. based on 3- and 5-week moving averages
    4.12 Hedge in July for Nov. based on 3- and 5-week moving averages
    4.13 Hedge in July for Apr. based on 3- and 5-week moving averages
    4.14 Hedge in Nov. for Apr. based on 3- and 5-week moving averages

5. Selective put option purchases signaled by dual moving averages

    5.15 Buy put in May for Nov. based on 3- and 5-week moving averages
    5.16 Buy put in July for Nov. based on 3- and 5-week moving averages
    5.17 Buy put in July for Apr. based on 3- and 5-week moving averages
    5.18 Buy put in Nov. for Apr. based on 3- and 5-week moving averages

6. Multiple selective hedges signaled by dual moving averages

    6.19 Multiple hedge in May for Nov. based on 3- and 5-week moving averages
    6.20 Multiple hedge in July for Nov. based on 3- and 5-week moving averages
    6.21 Multiple hedge in July for Apr. based on 3- and 5-week moving averages
    6.22 Multiple hedge in Nov. for Apr. based on 3- and 5-week moving averages

7. Options/futures market speculative strategies

    7.23 Buy call in Nov. for Apr.
    7.24 Buy futures in Nov. for Apr.

F = futures price for the January contract if T is November and the May contract if T is April;

B = Basis = Cash Price - Futures Price;

S = storage cost per bushel which is 0 if T is November and a 5-month storage charge if T is April; and

Y_a = actual yield in bushels per acre.

Routine hedges involve placing a hedge each year in a certain month regardless of market conditions and holding the hedge until November or April when the cash market sale is made,

Revenues = $(F_p - F_l - C)(Y_f) + (F_T + B_T - S)(Y_a)$, where:

p = the date the futures market position is placed;

l = the date the futures market position is lifted, time T in this case;

C = all charges per bushel incurred in a round turn of a futures contract; and

Y_f = actual yield in bushels per acre, for harvest hedging; 60 percent of expected yield in bushels per acre, for preharvest hedging. (Expected yield is estimated as the median of actual yields during the 3 most recent years.)

Routine put option purchases involve buying put options each year in a certain month regardless of market conditions and holding the options until November or April when the cash market sale is made,

Revenues = $(P_l - P_p - C)(Y_o) + (F_T + B_T - S)(Y_a)$, where:

P = the market premium on the near-the-money option on the January futures contract if T represents November or on the May futures contract if T represents April;

C = all charges per bushel incurred in a round turn of an options contract (assumed to be the same as for a futures contract); and

Y_o = actual yield in bushels per acre, for harvest put purchases; expected yield in bushels per acre, for preharvest put purchases.

Selective hedges signaled by dual moving averages involve placing a hedge when a sell signal is obtained from studying 3- and 5-week moving averages and holding the hedge until November or April when the cash market sale is made,

$$\text{Revenues} = (F_p - F_l - C)(Y_f) + (F_T + B_T - S)(Y_a)$$

Selective put option purchases signaled by dual moving averages involve buying put options when a sell signal is obtained from studying 3- and 5-week moving averages and holding the options until November or April when the cash market sale is made,

$$\text{Revenues} = (P_l - P_p - C)(Y_o) + (F_T + B_T - S)(Y_a)$$

Multiple selective hedges signaled by dual moving averages involve placing a hedge when a sell signal is obtained from studying 3- and 5-week moving averages and liquidating the hedge when a buy signal is obtained. The placing and liquidating of hedges continues until November or April when the cash market sale is made, with no long futures position ever held,

$$\text{Revenues} = \left[\sum_{i=1}^{n} (F_{pi} - F_{li} - C_i)(Y_f)\right] + (F_T + B_T - S)(Y_a), \text{ where:}$$

i = the number of the hedge.

Options/futures market speculative strategies involve selling in the cash market in November and buying a call option or buying a futures contract for liquidation in April,

$$\text{Revenues} = (F_T + B_T + P_l - P_p - C)(Y_a) \text{ (for (7.23) in table 1)}$$

$$\text{Revenues} = (F_T + B_T - F_p + F_l - C)(Y_a) \text{ (for (7.24) in table 1)}$$

The revenues from each marketing strategy were calculated for each year 1972 through 1981. Strategies were compared using revenues per acre instead of prices because revenues are more important to producers.

State-average yields for South Carolina were used to calculate revenues. Cash prices were monthly average prices received by farmers. Futures prices were Thursday closing prices.

Actual option premiums were not available for the entire period of analysis, since options were not trading until October 1984. Thus, option premiums were simulated using the Black model as described in Wolf (10). Wilson (9) has shown that soybean option premiums estimated using the Black model were not significantly different from actual market premiums during 1984-85. In this analysis, all purchased option contracts were assumed to be liquidated in the option market. Thus, option profits always equal the difference between the premium received and the premium paid for the option minus transaction costs. Calculated option premiums were used throughout the analysis to maintain a consistent comparison of the risks and revenues from option strategies for the various years. The standard deviation of prices was calculated using the six most recent Thursday prices of the underlying futures contract.

Storage costs were calculated as the variable costs of storage plus the opportunity cost of storage. Commission charges were assumed to be 2 cents in real terms per bushel per round turn for both futures and options contracts. All final results were adjusted for inflation using the Prices Paid by Farmers Index (1985=100). In all preharvest strategies, futures or options placement activities began during the second week of the month. Harvest was assumed to be the first week of November. Storage was assumed to terminate in the first week of April. Options/futures speculative positions were placed in the first week of November and liquidated in the first week of April. In all cases, options and futures contracts are assumed to be available in single bushel increments.

The Target MOTAD Model

Target MOTAD, as described by Watts, Held, and Helmers (8) and Tauer (7) was employed to determine risk-efficient portfolios of marketing strategies. Target MOTAD maximizes expected revenues subject to a given level of expected absolute negative deviations below a fixed target and other technical constraints.

The target MOTAD model used in this analysis can be expressed as:

maximize: yx

subject to: $Ax \geq \text{ or } \leq b$

$-Yx + Tx + Id^- \leq 0$

$vd^- \leq D$

$x, d^- \geq 0$, where:

y = a 1 by n vector of expected revenues from each strategy;

x = an n by 1 vector of the percentage of the total portfolio represented by the various strategies;

A = an m by n matrix of technical coefficients, where m is the number of constraints and n is the number of strategies considered, including a row requiring total cash market sales to equal production from 100 acres;

b = an m by 1 vector of resource constraints;

Y = an s by n matrix of actual revenues for all strategies for the s years considered;

T = an s by n matrix in which all elements are the target represented by the fixed revenue per acre necessary to cover production costs;

I = an s by s identity matrix;

v = a 1 by s vector in which each element is "1/s" where s is the number of years considered;

d^- = an s by 1 vector of deviations below the fixed revenue target;

0 = a column vector of appropriate length (s or n), composed of zeros; and

D = a scalar representing average deviations below the fixed revenue target.

Target MOTAD is initially used to determine the portfolio of marketing strategies that maximizes expected revenues, with risk unconstrained. An efficient frontier is developed by parametrically decreasing the average deviation (D) from the level associated with the initial linear programming solution. A portfolio of marketing strategies that is on the frontier represents the portfolio that maximizes average revenue for a given level of average deviation. The specific portfolio of marketing strategies preferred by any one producing firm will depend on the nature of the firm's revenue and risk preferences. Each firm will select a portfolio at the tangency point between an iso-utility curve and the risk-efficient frontier of preferred portfolios. If the addition of new marketing strategies causes a shift of the frontier so that more average revenues can be obtained with less or equal risk, then the addition improves the risk-revenue alternatives of the firm and enables the firm to obtain a higher iso-utility curve.

The targets in Target MOTAD are the reference points from which deviations (risk) are measured. The choice of an appropriate target is crucial when applying this technique, because the results can vary depending on the target selected.

Efficient frontiers could be developed for various fixed targets representing revenues required for longrun survival of various firms. In this analysis, the target selected was a level of revenues adequate to assure the longrun survival of an average producer.

A target of $158 per acre was selected. This figure reflects total costs per acre (excluding returns to risk and management) for dryland full season soybean production, as specified in the 1985 Cooperative Extension Service enterprise budget. Thus, costs were assumed to change from year to year only because of inflation.

The producer was assumed to have planted soybeans on 100 acres each year, so the results could be interpreted as percentages. The model requires producers to sell their total soybean production in the cash market in either November or April.

Optimal Soybean Marketing Portfolio Identification

Expected revenues per acre and risk, defined as the average negative deviations below the target, were calculated for the 24 individual marketing strategies (table 2). Option strategies performed well, comprising 6 of the top 10 income-producing alternatives. They also represented 7 of the 10 least risky alternatives. Storage strategies ranked high, representing 7 of the top 10 revenue-producing strategies and 6 of the 10 least risky strategies. This finding is consistent with the typically large basis improvement observed in South Carolina during the storage period. Cash sale at harvest (strategy 1.1) did not perform well during the period. The futures speculative strategy (strategy 7.24) displayed risk substantially higher than the other alternatives. Routine and selective preharvest hedging generally performed poorly.

Table 2--Ranking of South Carolina soybean marketing strategies, by revenue and risk, 1972-1981

Strategy	Expected revenue	Expected risk1/	Revenue rank2/	Risk rank3/
	--- Dollars per acre ---		----- Number ----	
1. Cash speculative:				
1.1	174.72	7.88	18	11
1.2	187.98	9.22	8	13
2. Routine hedges				
2.3	162.38	12.08	24	23
2.4	172.55	9.95	20	19
2.5	181.96	6.84	12	7
2.6	182.39	5.34	11	1
3. Routine put purchases:				
3.7	179.95	5.80	16	3
3.8	184.44	5.84	10	4
3.9	200.28	5.87	3	5
3.10	204.21	5.69	2	2
4. Selective hedges:				
4.11	167.10	11.76	23	22
4.12	171.43	10.10	22	20
4.13	180.92	7.09	15	9
4.14	175.35	9.50	17	16
5. Selective put purchases:				
5.15	181.35	6.96	14	8
5.16	181.61	7.27	13	10
5.17	204.47	6.12	1	6
5.18	188.16	9.24	6	14
6. Multiple selective hedges:				
6.19	172.90	9.70	19	17
6.20	171.56	9.76	21	18
6.21	188.08	9.38	7	15
6.22	189.77	10.67	5	21
7. Options/futures speculative:				
7.23	195.48	8.01	4	12
7.24	187.50	29.95	9	24

1/ Expected risk of falling below $158 per acre gross income.
2/ Highest expected revenues = 1.
3/ Lowest expected risk = 1.

This is primarily attributed to yield volatility over the study period and subsequent futures losses. For example, in 1980, a routine hedge in May for harvest delivery would have lost $2.48 per bushel on 60 percent of expected production (22 bu.) while actual production was only 13 bushels.

Table 3 displays the optimal portfolios of soybean marketing strategies with and without options available. In the absence of options, a multiple selective hedge during the storage period represented the high-income solution. With risk reductions, the multiple selective hedge was replaced by a routine storage hedge. When options were included as possible strategies, they increased expected revenue by $15 and reduced risk by $4 (comparing high points of the frontiers).

Options were the only strategies included in the optimal portfolios. A selective put purchase (strategy 5.17) produced the highest revenues. With risk reductions, the optimal portfolio consisted of combinations of routine put purchases. When acceptable risk levels were reduced, preharvest routine put purchases became the dominant marketing strategies. However, the inclusion of these strategies caused a rather substantial reduction in revenues (-$23) for a modest risk reduction (-$1).

Table 4 illustrates the performance of the individual strategies and the elicited portfolios during the out-of-sample period 1982-1985. Of the more notable results, 3 of the top 6 (out of 30) ranking marketing approaches were portfolios. In all cases, revenues were below the cost target. The portfolios with options achieved high ranks while the mixes discerned without options ranked low.

Limitations and Conclusion

There are some notable limitations to these results. In particular, the results are strictly optimal only for the specific location and time period

Table 3--South Carolina risk-efficient soybean marketing portfolios, $158 target, crop years 1972-1981

Portfolio	Expected revenue	Expected risk	Selected strategies 1.2	2.6	3.7	3.9	3.10	5.17	6.22
	Dollars per acre		------------ Percent -------------						
Without options:									
A.1	189.77	10.75							100
A.2	186.08	7.73		50					50
A.3	182.39	5.38		100					
With options:									
B.1	204.47	6.17						100	
B.2	192.89	5.28			37	61	2		
B.3	181.30	5.08			93	7			

analyzed. In addition, the potential for different results exists for individual farmers because their basis patterns and yield data could be different from State averages. The results are also strictly optimal only for the marketing strategies included. The inclusion of different or additional strategies could produce portfolios that dominate those discussed here.

Table 4--Ranking of marketing activity performances, South Carolina, 1982-85

Strategy or portfolio	1982-85 Revenue	1982-85 Risk	Strategy revenue rank	Strategy risk rank	Strategy and portfolio revenue rank	Strategy and portfolio risk rank
	Dollars per acre		------------	Number	------------	
1.1	115.83	42.17	18	18	23	23
1.2	116.77	41.23	16	16	21	21
2.3	117.91	40.09	12	12	16	16
2.4	113.72	44.28	22	22	27	27
2.5	118.99	39.01	11	11	15	15
2.6	122.02	35.98	8	8	12	12
3.7	127.57	30.43	1	1	1	1
3.8	120.13	37.87	10	10	14	14
3.9	124.03	33.97	5	5	8	8
3.10	124.82	33.18	4	4	7	7
4.11	123.05	34.95	7	7	10	10
4.12	116.16	41.84	17	17	22	22
4.13	120.57	37.43	9	9	13	13
4.14	115.20	42.80	20	20	25	25
5.15	126.27	31.73	2	2	3	3
5.16	115.77	42.23	19	19	24	24
5.17	125.01	32.99	3	3	5	5
5.18	116.83	41.17	15	15	20	20
6.19	123.43	34.57	6	6	9	9
5.20	117.01	40.99	14	14	19	19
6.21	114.13	43.87	21	21	26	26
6.22	113.65	44.35	23	23	29	29
7.23	117.56	40.44	13	13	18	18
7.24	108.31	49.69	24	24	30	30
A1	113.65	44.35			28	28
A2	117.83	40.17			17	17
A3	122.02	35.98			11	11
B1	125.01	32.99			6	6
B2	125.36	32.64			4	4
B3	127.32	30.68			2	2

Finally, the results which included strategies involving options are dependent on the simulated premiums. Although the Black model is typically used in explaining and predicting option premiums, actual premiums might have been different from these simulated premiums.

Some major conclusions can be drawn after reviewing the empirical results. Storing until April provided consistent income enhancement and risk abatement due mostly to strong basis improvement in most years. Futures market speculation (strategy 7.24) substantially increased risk. Preharvest futures hedging was not preferred even when pricing was limited to 60 percent of expected yields. This was attributed to large interyear yield variations associated with futures losses. A better measure of expected yields and an improved preharvest hedging restriction might have improved performance of these strategies.

The addition of strategies involving options causes an increase in expected revenues and a decrease in expected risk (table 3). Option strategies were the only strategies included in the optimal portfolios when option purchases were permitted. A selective put purchase (Portfolio B.1) produced sizable increases in expected revenues over routine put purchase (Portfolios B.2 and B.3), with minimal increases in risk. Finally, the elicited portfolios with options achieved good results during the 1982-85 crop years.

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PART VII: PANEL--WHAT KINDS OF FUTURES-OPTIONS PROGRAMS WILL WORK?

DISCUSSION

Stephen J. Beier

When I first started thinking about answers to the question, "what kind of futures or options program would work in the future," the first thing I needed to do was take a look at the past. Things which generally worked well with other marketing tools should be the foundation from which you could project things that would work well in the future. So looking at previous marketing tools, I asked: what kind of general characteristics seemed to identify them? What made them workable?

I came up with four things.

The first common characteristic of many marketing tools is simplicity. Any program defined as successful must have broad acceptance. This means the concepts and terminology must be simple. To get people to use a program, you must keep it simple. The terminology must be concise and accurate.

The second common characteristic of a successful marketing tool is that it must provide season-long protection. We talk with our farmers about making time their ally, not their adversary. Too many people market grain by cash flow needs. They have a note due tomorrow so they sell grain today. Time is their adversary, not their ally.

What we are trying to do in a marketing plan is to give farmers as much time to meet their price objectives as possible without having to give all kinds of reasons why it did or did not get there. Say the objective is $6 beans. If you give the market 24 months to reach the objective, you are going to be more successful year in and year out than if you give it 12 months. We talk about a 24-month marketing period; that is season-long protection.

Number three is staying power. If we want to maintain price protection, we want to have staying power. A farmer must have the ability to maintain a hedge or an options position. Farmers need cash flow sources that will guarantee payment of margin calls over the life of the marketing period. Again, we are talking 18-24 months.

The fourth thing is the risk-reward ratio. We have talked about it in a number of places throughout this seminar. Farmers must understand the relationship between risk and reward in the market. Emotions often confuse logic and put farmers in the position of betting their farms on some make-believe scenario.

I think there are two approaches to marketing and you can use one or the other or both. A saying that illustrates the idea is: "Defense wins games, offense sells tickets." I think it is defense that saves the farm; offense gets points in the coffee shop. I am not saying one or the other is good or bad. Perhaps what's best is a combination of both. The best scenario is to go to the coffee shop and say you sold beans for $8. But if you think you are going to sell beans for $8 year after year, you are not going to be a winner. So if you are betting the farm on that, just try to think about what the market has to offer and try to get some

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profit from your operation before you say you are going to play the market in an anticipatory mode. Many times when I see the latter, I think the former should come first.

I think marketing is more an art than science. Too many times when we cannot be completely scientific, we do not apply any scientific skills at all. What is wrong with locking in a percentage of your crop at a profit? Too many times we want to play the game of anticipating what the market is going to do rather than being comfortable with locking in a profit.

Now I want to talk about a couple of strategies we use to try to capitalize on such opportunities.

The first example will be a discussion of futures. There has been enough said about fixed price forward contracts, so I want to talk about the hedged-to-arrive contract. It is something like the minimum price contract in that the producer can lock-in the futures value. We are talking about a 24-month marketing period and it starts 12 months in advance of harvest. In July 1986, we had people in a position to know what a profit for their operation would be when December 1987 corn came on the board and they were in a position to put an order in the market. We sold December corn the very first day it traded Why? Because it traded at a level that would yield a profit for some people. One of the things we thought about the 1986 crop was that the Government was committed to getting out of carrying stocks and there would be more "free" stocks. We anticipated cash prices would go below loan, so we thought there would be some opportunity -- whether it be a marketing loan or payment-in-kind -- where an incentive would be offered to take back the option to forfeit your grain at loan. We thought that a sale above the loan sounded like a good idea, especially when CCC released "free" stocks into the market at a lower price. December corn opened at $2.27, well above the loan. We had people who wanted to take that profit and as PIK and roll came into being, they bought it back at the posted county prices of around $1.25 per bushel. That corn had been put under loan at $1.84 to $1.86 and had a hedge on it at $2.27. Not all farmers are going broke. This was a case of an anticipatory kind of marketing plan. We were betting on something that was going to happen but that is not here today. It wasn't necessarily the other case when the defense was just taking a profit.

<u>Simple</u>? Yes. Farmers didn't have to pay brokerage fees and they didn't have to meet any margin calls. All they knew was that they were locking in future value and were anticipating an improved basis.

<u>Season-long protection</u>? Even though we weren't offering a 15-month basis in advance, we were willing to offset the future risk. We were able to provide that protection 15 months before the fact.

<u>Staying power</u>? You bet. Because the elevator made the margin calls, the customer did not have to worry about their staying power.

<u>Risk-reward</u>? Farmers have to evaluate what that is worth to them. Are they playing a defensive game or are they looking for anticipatory moves? If you are anticipating, you are never certain that you are right. You have to manage the risks.

A perfect example is the options we offer with a minimum price contract. We do not use a minimum price contract extensively because most of our people sell cash grain and do not want to pay the cost of the premium when they see no upside potential. But it is simple. In our case, we don't have to talk about puts, calls, premiums, time value, and intrinsic value. All we say is there is a $5 value minus a 20-cent premium minus a 5-cent basis. Would you like or not like to lock-in a minimum price of $4.75 with a one-time right to amend it if it goes higher? Yes or No? Simple? I think so.

Season-long protection? Length of time is a limitation on the minimum price contract because of time value.

Staying power? I think it has staying power, especially in the kinds of markets we have seen here in the last couple of weeks.

Risk-reward? You have to build in the common sense of risk-reward; what is your objective? How much are you willing to take from the market and walk away with? Too many try to take everything. Options are not the cure-all marketing tool. Just because you have an option doesn't mean you don't have to do something. You must still establish the final selling price.

DISCUSSION

Don Nitchie

When using forward pricing tools in the past, producers could become easily confused between risk and opportunity. This was true because any of the forward pricing tools prior to the introduction of agricultural options were not very flexible. Once you locked in a price using either cash-forward contracting or hedging, you removed risk but also opportunity. The incentive to capitalize on price increases was great. Therefore, too many times producers would lift a hedge or remain unpriced if they thought the market was going higher.

Options offer much greater flexibility. By purchasing put options, a producer can manage risk without locking out the opportunity of price increases. Psychologically, this makes purchasing put options a much more palatable and potentially useful forward pricing tool. Producers can select degrees of risk and opportunity they are willing to accept.

Even though these proceedings are not about livestock, I'm going to give you a livestock perspective. Agriculture in general has been very depressed during the 1980s. But livestock prices, with the exception of 1984, have been very active. This activity spells risks and opportunities for the sellers of livestock. The ability to purchase put options has allowed livestock producers to manage short-term risks for long-term profits. After the put purchase, if prices fall, producers will not get as high a price as they would if they had done nothing. But, it will be a close second. If prices decline, they won't get as high a price as they would if they sold futures. But, receiving second best a lot of times can add up to substantial longrun profits.

A word on dealing with the perception of options being too expensive. My first question is, how many producers can identify in dollars what their total risk is? Secondly, how much has the lack of price risk management cost them in the longrun? With livestock options, I would also recommend that they look at the amount of capital they are protecting. Livestock are fairly valuable right now and have been fairly profitable. Wouldn't you think those options might be more expensive than options guaranteeing a floor price on a less valuable and less profitable commodity? One way that some feedlots try to reduce the cost of put options, but not sacrifice downside price protection, is by doing a "fence." In a fence, they sell a call with a higher strike price, to finance the cost of a put.

To further point out the flexibility of options, I will describe some "follow-up" strategies that some livestock producers use--again, without sacrificing risk protection. Some people may "roll-down-puts" if a market is declining. If their first purchase increases in value, they will sell it back and purchase a cheaper put. In an ascending market, they will "roll-up-puts." Their first put purchased declines in value, but they are able to buy a higher strike price put to move their floor price to higher levels. Some producers will purchase a call option to turn an already established forward-cash contract into a "put-like" risk-reward

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profile. This restores upside market potential without giving up downside risk protection.

From all of this, I encourage all researchers to "free-up" your assumptions and look beyond just purchasing a put option. It's a great start, but there are lots of creative minds out in the industry who are constantly learning new ways to manage risk and opportunity using agricultural options. Last of all, I encourage all of you to educate producers about these new marketing tools whenever possible. Educational support may be the best support you can give to all producers.

DISCUSSION

Keith Spears

Today's producers are engaged in high-risk business. In fact, almost every step of the American producers' daily operation involves risks. By taking advantage of the programs offered by the U.S. Government, today's producers have a way to minimize these risks. The Government program provides income and price-risk protection through the target price and CCC loan program. This is why many producers feel there is no incentive to use the futures markets.

For one thing, variable yields prevent hedging total crops. Many cautious producers are unwilling to assume the additional risk of having a short position on the futures market in the event that they should lose their crop due to weather. Yet this is not a great problem when using options.

Then, basis variation, the biggest problem, makes calculating the effective hedged price difficult, maybe even impossible. Historical basis information is either not available for many markets, or it is very expensive to develop. Also, very few qualified hedging brokers who understand agriculture keep basis history for the local area or have the volume of hedging business to make a living solely in the hedging arena. Many producers have had a bad experience or have heard of a bad experience with brokers trying "to churn" the account.

Another drawback to producers using the futures markets is that many bankers do not understand the futures market and are more comfortable with more traditional cash forward pricing tools. Given the financial conditions facing many producers, bankers with little understanding of the futures market may not extend the line of credit necessary to cover margin calls when the market moves against the hedged position. Futures markets are also highly visible, and many producers perceive adverse cash price moves with manipulation in the futures market. In fact, producers feel the market can be manipulated by the big traders, whether a speculator or a major handler such as Cargil or ADM.

Furthermore, contract size is not flexible enough to meet the needs of many producers. For example, some wheat growers don't produce 5,000 bushels of wheat; thus, they are prohibited from hedging their production.

Time can also be a barrier to the producers' use of the futures markets. The time required in using the futures market is prohibitive in many producers' minds. The feeling is that they must be close to a terminal with futures price quotes when the exchange is open in order to take advantage of price moves. This, then, translates into the preconceived notion that they do not have access to timely information which would facilitate the use of the futures in hedging.

Finally, many growers are unwilling or unable to handle the emotional stress associated with a move against their futures position, even though the losses in the futures market are being offset by gains in the cash market, subject to basis risk. Margin calls reinforce the feeling that they made a mistake, and those who are not comfortable with hedging can get into real trouble due to this stress.

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Adding to this stress is the fact that concepts and terminology are sometimes difficult to grasp; that makes expending the human effort to learn them less attractive.

It is undeniable that the everyday existence of today's producers is a gamble; yet through the target price and the CCC loan program, the Government has offered producers ways to minimize their losses.

DISCUSSION

Lyle E. Stallman

The question posed, as I understand it, is: What kind of futures options programs will work? My first reaction is: Will work at what? If we mean to replace Government programs totally, I don't believe the idea is politically possible. If we're talking partial replacement, such as a substitute for the adjusted loan level, that may be possible politically and economically. (I would hope that it would be separate and distinct from the deficiency payment.) So, before we really get into addressing the question, I'd like to give you some idea of the environment, at least as I see it in Iowa.

The supposition of the question here is that we have a Government program to deal with and replace. If you are curious about changes and trends, I invite you to Iowa to get the latest on the very rapidly changing hog and cattle industry. Twenty-five percent of the hogs are grown in Iowa and we have immense change in custom feeding--probably the number 1 new trend. Elevators, in particular elevators that have a feed business, are in this or looking to get into this very quickly. This is a market that is not controlled by Government programs and that's why I'm pointing to it. What's happening there? Well, what's happening is that in one way or another, directly or indirectly, new marketing approaches and professional marketing services are being provided to the marketplace. In some cases you could say that so-called custom hog feeding is "strong arm," because the producer may basically become a tenant raising the hogs and other people make the decisions and there are some hog producers that aren't very happy about that. As a pragmatist, I will point out that is one way to get professional services applied to the marketing function. I expect that we will see the adoption of the use of futures and options, as well as professional marketing services, by grain producers as we are seeing in livestock. But, in the case of grains, this adoption is slower due to the insulation from price risk that farm programs provide to producers.

Let's go back to the question. What kind of futures and options program will work? Well, I'm going to assume in my remarks that we're adopting the idea that futures or options could be used as a substitute for some part of the farm program across the board; not a pilot program, but a reality. My first reaction is not economics, but practical application. Agricultural policy commonly does not consider its affect upon education and the information liability in the countryside. Jim Gill pointed out yesterday that there was demand from the grassroots instantly for PIK information, and I am familiar with that. We've been providing a daily news wire on Government activity and what it means to producers. Now you may not think that there is enough to write about on the subject daily, but we have for some months and there are a number of people who are interested in that.

What's the country's reaction to PIK? First of all, whose reaction? Who is the farmer? Are we talking about operators? If so, which operator? We can see a big difference between the 10-15 percent who are commonly referred to as "innovators," compared with other producers. We have people who are affiliates

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and who have customers on a marketing program. They tell us that their customers love PIK; it's lucrative now that they know how to play the game. What if we ask farmers in general? Many are still trying to figure PIK out and they don't like it. It's a change, and they're very frustrated. Absentee landlords are largely disinterested. They want to assign the PIK redemption function to someone else. Resident landlords largely depend on the operator to handle it. Elevator operators: What's their reaction? We think they feel the PIK program is lucrative. They like it from that standpoint, but they will tell you that they did not anticipate the educational liability they were going to have with the producer. In the PIK program, the elevator bore the focus of the educational effort.

Why do I pick on PIK? Well, from an economic perspective I'll challenge the researchers in the room to refute that PIK is a marketing loan. We could spend all day defining that, but it operates similar to a marketing loan. It's more complex than past programs. In fact, to older farmers who have been around farm policy for decades, it was a downright shock. They were accustomed to the old "put it in the bin 9 months and then the Government takes it over." The concept that loan grain could move before 9 months is a mystery and they are still dealing with it. My point is that the change created a huge educational liability. And who was there to resolve it, to address that problem?

OK, how is an option versus farm program swap different from this PIK experience? I'm going to assume that the educational liability for an options or futures program would be covered--and it's a very unlikely assumption. So, I'm going to jump to the mechanics, and I see some profound questions here. If we're going to invite or force farmers to deal with options and futures directly, are we going to force them to deal with an existing brokers? The brokers may not like that initially; they may find some headaches later. In any case, can the brokerage system and the regulators handle it? The effort it would take just to register hundreds of thousands of producers is huge. The next alternative would be to force or invite producers to go to an elevator. Can the elevator handle the transaction? Is the elevator going to be obligated to continuing education? Is the producer, as with PIK, going to be tempted to make the elevator an agent? "Here, Mr. Elevator, you do it for me. I don't understand it, I don't want to understand it." That has happened in PIK.

And in either case, whether we go to the futures market or the cash market, can the exchanges handle it?

We've talked about subsidized options. Well, first of all, my problem is if they're "free" to the people who use them, I don't think they are going to have much respect for the experience because there's no penalty. The threat of a penalty is what offers the best lessons in business and in life. You remember those lessons that cost you something. Who's going to be responsible for the ongoing education with subsidized options? Another point, and again, very pragmatic. How many people here have ever used an option to hedge? Even if you use an option, do you realize you still have to price? All you've done is set a floor. If the market moves in your favor you still have to do something. On what basis and how do you make that decision? Who's there to answer those questions? And futures: I'd like to get into that on margin calls, but don't have the time. I'll jump to the bottom line. In our experience, the bottom line in our service hasn't got anything to do with money. It's psychology. We're actually paid primarily to help people understand the marketing process they're going through and deal with the emotions, the indecision, and the unfamiliarity. And until you have experienced $10,000 per day in margin calls, I don't think you know what I'm talking about.

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One concern I have is that a subsidized program could force the evolution of 10-15 percent of the "innovator" farmers being in charge of 90 percent of the production, as we suggested yesterday. It could actually force that to happen faster, depending on how it's done.

What's my conclusion? First of all, today's program says something about sponsoring education. Terrific! Someone has to provide funding for that area. Farmers would be very interested in that. Should all producers use futures and options rather than a farm program? Well, I'm not convinced it's a solution. If it's done, I suggest we steer producers to cash instruments because (1) that's what they're doing now, (2) educating the local elevator can be handled in the present environment and (3) cash instruments tend to be less discriminatory against those producers who are not the 10-15 percent "innovators."

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