Pre-harvest Marketing Strategies Increase Net Returns for Corn and Soybean Growers

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For an alternative view of the work presented in this module see:
Market Efficiency and Marketing to Enhance Income of Crop Producers, " by Carl R. Zulauf and Scott H. Irwin.

Topics

A condensed version of this paper can be found in Module 14.
This article can also be accessed via Supplementary Material.

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Abstract

Grain producers price grain prior to harvest to reduce financial risk and to enhance net returns. Since accomplishing the second objective is debatable, alternative corn and soybean pre-harvest options/hedge marketing strategies were designed to test the hypothesis that pre-harvest pricing could generate statistically higher average net returns than harvest sales, without increasing variability. Weekly seasonal futures price patterns from 1975 to 1994 were used to time marketings. The strategies were applied to Iowa and Ohio model farms. The hypothesis was accepted for some strategies that included options, but not for futures-only strategies.

Introduction *(or go to* ***Topics*** *)*

In the 1960s, Cootner and Samuelson popularized the Random Walk Theory and the efficient market hypothesis. These imply that prices fluctuate randomly about their intrinsic value and at any point in time, reflect all available market information. The concept was initially applied to stock markets which, unlike grain, are not influenced by seasonal factors related to weather. Using this concept, authors have argued that the optimum investment strategy in the stock market is to routinely buy and hold an index of stocks and bonds rather than attempting to time investments to beat the market (Murphy, Malkiel).

During the last 30 years, authors have applied this concept to agricultural futures markets, and have conducted marketing efficiency tests (Kamara). Results from these investigations have advanced the debate as to whether pre-harvest marketing strategies employing hedges and/or options can be used by grain producers to increase profits above those earned through a naive, harvest-time cash marketing strategy. This paper adds to the discussion by examining alternative corn and soybean pre-harvest marketing strategies, and tests the hypothesis that a set of pre-harvest marketing strategies can generate statistically higher mean net returns than those from the naive strategy of harvest sales. The testing procedure is to create simulated returns over variable costs of production for model farms in northern Iowa and Ohio, utilizing actual grain market data and yields for the 1979-1996 marketing years. When options are included as part of the pre-harvest strategy, the series is shortened to 1985 through 1996 to avoid synthesizing options premia. Seasonal patterns used to time marketings are from the 1975-76 through 1994-95 marketing years, thus incorporating a slightly longer time period than the simulated model farm analysis and excluding extreme price volatility in 1995-96 that might distort the seasonal analysis.

Marketing years are categorized by size of the U.S. crop relative to the prior year's utilization. A short crop is defined as a weather-induced decline in production below the previous year's utilization, where the U.S. average yield is more than five percent below a 1960-94 linear trend yield. That is, $P_t<U_{t-1}$, where P=U.S. production and U=total utilization. Its purpose is to identify years when new-crop futures (year t+1) encourage expanded production before planting decisions are made the following year . Other years are classified as normal-crop years, with a subset defined as years following short crops, or short crops ex post. *This classification is done, not anticipating that short crops can be forecast ex ante, but to identify different pricing strategies for use in years following short crops*

than in years of near-normal crops. Categorizing crops in this way also allows visualization of potential gains from using options markets, which retain upward price flexibility. This paper does not test for market efficiency in either the corn or soybean futures market. Instead, it examines seasonal price patterns, tests for seasonal pricing premiums, and compiles and compares potential returns from pre-harvest marketing strategies to returns from harvest sales. In this analysis, it is assumed that the fixed and variable costs of production are covered by pricing grain prior to or during the harvest period. Any improvement in prices after harvest is considered a return to storage and/or speculative functions and is not used to offset production costs. Therefore, the returns to basis improvement and price speculation during the storage period are not considered in this analysis.

For grain farmers, fixed production costs may be made years in advance and most variable costs are disbursed in the spring. To commit major costs without a known pre-harvest selling price and consideration of production risk is a speculative position. In the next section, risks with the speculative harvest sales strategy are examined. Prior to 1996, government target prices reduced price risk exposure for producers who used the harvest sale strategy.

Pre-harvest Pricing Environment *(or go to* ***Topics*** *)*

The 1975- 94 period was selected for seasonal analysis because it reflected a global market and unstable U.S. weather, in contrast to much more stable weather and a largely domestic, government controlled grain market of the 1950s and 1960s. The years, 1973 and 1974, were excluded since they represented a learning period in which the grain trade adjusted to dramatically changed market conditions. During 1975-1996, and 1911-1996, normal corn crop years occurred 69 and 76 percent of the time, respectively. Normal soybean crop years occurred 73 and 80 percent of the time since 1975 and 1937, respectively. Using our definition of a short crop year, there were six short soybean crop years and seven short corn crop years during the 1975-1996 period.

For normal crop years of the study period, Thursday's closing new-crop December corn futures prices from early January before harvest to harvest time traded in an average high-low range of $0.54 per bushel, with the harvest price almost always being the low. Annual extremes in high-low ranges from pre-harvest to harvest (excluding 1975) ranged from $1.10 above to only $0.26 per bushel above the harvest price. In 80 percent of the normal crop years, the pre-harvest new-crop price fluctuations exceeded harvest prices by $0.40 or more per bushel. Pre-harvest price highs—except for 1975— exceeded the harvest price and occurred well before harvest. The peak usually occurred before mid-July. Thus, pre-harvest futures prices were not good indicators of actual harvest prices in a given year. This conclusion was also reported by Tomek who wrote, "Futures prices can efficiently reflect a complex set of factors but still provide poor forecasts." *Moreover, in nearly three-fourths of the years, pre-harvest opportunities existed for pricing corn and soybean crops well above harvest-time prices.*

Figures 1 and **2** show new-crop corn futures price changes by year for normal and short crops, from spring to fall. Although the soybean figures are not shown here, similar pricing patterns appear for soybeans and are available from the authors. Student t tests indicate the spring December futures for normal corn and soybean crop years in this period were significantly different from October prices at the 2.7% and 1.9% levels, respectively. However, the difficulty with routine springtime hedging with new-crop futures is that prices rise sharply during short crop years, generating losses on futures positions. In the seven short-crop years of this period, corn prices increased by an average $0.27 per bushel from the first week of July to the first week of November (**Figure 2**). For the six short crop years for soybeans, prices increased on average $0.07 per bushel for the early July to the second week of October period. Unlike hedges, pre-harvest pricing with options captured part of the price increase that occurred during short crop years. Harvest cash marketings performed well in short-crop years, if the producer was not in the area of crop losses that were driving the market. In other years, returns over variable costs often were relatively low.

In the short crop ex post years, December corn and November soybean futures almost always were lower at harvest than in late winter before harvest (**Figures 3** and **4**). December corn futures prices in late February prior to harvest averaged $0.36 per bushel above the December futures price in early November. Based on the t-test, these differences were significant at the 3.9 percent level. New-crop November soybean prices in February before harvest averaged $1.00 per bushel above the November futures price in mid-October. These differences were statistically significant at the 1.8% level. Price patterns for these three categories of years are the foundation for the creation of pre-harvest marketing strategies tested here. An analysis of pre-harvest corn futures prices from 1911 through 1994 and soybeans for 1937 through 1994 revealed equally strong tendencies, interrupted a few times by the outbreak of major wars.

Literature Review *(or go to **Topics**)*

Similar price patterns and hints of price premia have been observed in certain commodity futures markets by other authors (Carter, Rausser, and Schmitz, Cootner, Monson and Hayenga, Pfeiffer, Sandell, and Kendrick, Stevenson and Bear). Evidence of risk premia in exchange rate and financial futures markets have also been reported (Bessembinder; Bessembinder and Cahn; Junkus). In contrast, price premia in either the corn or soybean futures markets were not observed for the time periods selected by Zulauf and Irwin. Working and Telser also searched for a risk premium in post-harvest grain futures markets and found none.

R.W. Anderson researched volatility in 160,000 price observations with an assortment of commodity markets including corn and soybean futures. He found that variance, and hence, volatility of futures prices changes with the magnitude of supply-demand uncertainty, and has strong and recurring seasonal patterns. "The fact that there is seasonality in the volatility of futures prices in markets with annual harvests will hardly come as a surprise to those familiar with the fundamental factors of supply and demand in those markets. However, these important seasonal factors have been over-looked in previous studies of the volatility of futures prices which have been concerned with the effect of changing time to maturity," (p. 345). Anderson found that volatility of corn and soybean futures prices peaks in June and July, and declines into fall. This has implications for options and possibly futures markets. In financial literature, the Capital Asset Pricing Model indicates market portfolio risk is measured by variance of returns, with risk premia tending to increase as variance increases (Engle et al.).

In analyzing one-week time cells from October 1972 through September 30, 1989 in corn, soybean, and Chicago wheat futures markets, Stevens found statistically significant evidence of short-term, weather-related persistence in corn and soybean futures prices that might cause temporary deviations from a random walk. This effect was greatest for corn in mid- and late February, June, and July. For soybeans, the periods showing greatest frequencies of price persistence were late January, early February, May, June, and July. Again in contrast to the above, Fama was unable to reject the random walk hypothesis in his study.

In earlier research, Wisner segregated corn marketing years into three types noted above. He calculated returns from strategies using late February hedges for short crop ex post years, with combinations of options and hedges for other years and market timing coinciding with average seasonal price peaks in normal-crop years. Use of options at planting time provided upward price flexibility in case a short-crop year occurred. Modest early July hedging positions added to average net income and provided less exposure to futures losses than planting-time hedges. Options were closed early to conserve time value. Results showed increases in average income over variable costs versus harvest cash marketings for Iowa and Nebraska locations, with little change in income variability.

In contrast, Alexander analyzed pre-harvest pricing of corn for model farms in Ohio. He did not include combinations of futures and options pricing strategies; instead each was considered separately. Further, no adjustment was made for years following short crops, and options positions were not closed early to recapture time value. Using t tests, he rejected the hypothesis that returns from pre-harvest pricing were significantly different from returns from harvest cash marketings. Expanding on Alexander's work, Zulauf and Irwin reached similar conclusions.

Previous work on futures and options markets has not fully resolved issues related to risk premia or seasonal weather influences on new-crop futures price volatility. For the most part, empirical work has not included the integration of hedging and options pricing strategies in the same crop year. Most work has not dealt with differences in seasonal price patterns for new-crop futures in years following short crops. This study incorporates these features.

Focus of this Study *(or go to* ***Topics*** *)*

A hypothesis tested here is that a set of pre-harvest marketing strategies exists that can generate statistically higher average net returns than the naive harvest marketing strategy, with little increase in variability of the returns. Net returns from 10 pre-harvest marketing strategies were generated and tested for statistical difference from the naive strategy, using a t test.

For the normal crop years, as noted earlier, new-crop futures prices for both corn and soybeans were near their average highs from May through early July (**Figure 5** displays the pricing patterns for corn; similar soybean data are available from the authors). The observed highs may represent a premium over harvest prices and may reflect early seasonal uncertainties in domestic and foreign production prospects. As production prospects become more certain, prices decline into the harvest period. For most strategies, puts and synthetic puts (combination of hedges and call purchases) were used to establish a price floor during normal crop years and to capture part of the upward trending price movement that occurred 31 and 27 percent of the time, respectively, for corn and soybeans.

In short-crop ex post years, average new-crop corn and soybean futures prices approached their highs during February and later declined into the harvest period (**Figure 6** displays this pricing patterns for soybeans; similar corn data are available from the authors). New-crop prices in short-crop ex post years are relatively high to stimulate an increase in plantings and to rebuild inventories. Producers respond and futures prices trend downward.

Decision Rules Underlying Marketing Strategies *(or go to* ***Topics*** *)*

See **Table 1** for marketing decision rules. Since rational producers would attempt to price grain at or near the average highs, hedge positions were placed routinely in the fourth week in February after short-crop years. Although two consecutive short crop years have a low probability of occurrence, synthetic put strategies were also employed after short crop years to protect against this outcome. To do this, in February a new-crop one-strike out-of-the-money call was purchased in conjunction with a hedge. Its purpose was to capture part of the potential price increase that could occur with two consecutive short crop years. This risk-averse strategy was employed with synthetic puts IV - VI as well as the mixed hedge/put III (**Table 1**).

Two alternative hedging rules were used for all other years. Short hedge positions were placed in either (1) the third week of May or (2) the first week of July (Hedge I and Hedge II strategies). Following Wisner's previous work, net returns were analyzed for 1979-1996 for the hedge strategies. With Synthetic Put I-III strategies and mixed hedge/put strategies I - II**,** these short hedging rules were also followed. For the Synthetic Put VII-IX strategies, the February short hedge rule was eliminated. All short hedges were placed during the third week of May for synthetic put strategies, and the previously purchased call options were sold at varying times.

Synthetic put strategies and some mixed hedge/put strategies were created by buying either out-of-money options during the fourth week of February or the third week of May. Because of differences in seasonal price volatility and hence in the time value component of premiums, the calls were offset in three alternative months to evaluate impacts on net returns. It is well-known that in grain options, time value drops sharply in the last two months of trading. The options were closed early to avoid a sharp decline in this component of value. The temporary use of calls gave upward price flexibility after hedging during the period when crop prospects and hence price prospects were most uncertain. It was hypothesized that the observed increase in price volatility in July would generate higher mean net returns for offsetting calls in July than in either August or September. The hypothesis was accepted. When calls were offset, price protection was retained through the hedges.

Data and Simulation Model *(or go to* ***Topics*** *)*

To test the net-returns hypothesis, two model farms were simulated, one for northwest Iowa and one for Ohio (**Table 2**). The two farms capture effects from differences in yield levels and variability. Each had 1,000 harvested acres, half in corn and half in soybeans. Costs were from Extension budgets. O'Brien County, Iowa and Ohio state level yields were used (Iowa Department of Agriculture and Land Stewardship; Iowa State University; Ohio Enterprise Budgets; and Ohio Agricultural Statistics Annual Reports).

Production and Execution of Market Positions *(or go to* ***Topics*** *)*

Production levels for marketing purposes were based on the prior 10 year rolling average yields (**Table 2**). Hedges and options positions were executed up to the highest integer level not exceeding the average production, using 5,000 bushel contracts. With upward trending yields, this procedure provided a cushion to help avoid being oversold in years of short crops. When an oversold position occurred, the excess was bought back at the harvest futures price (the second week of October for soybeans and for the fourth week of October for corn). All cash transactions were made at these same times.

Prices, Option Premia and Other Data *(or go to* ***Topics*** *)*

For the pre-harvest and harvest marketing strategies, the relevant closing Thursday cash, futures prices and options premia were used. Cash prices were averages paid to farmers in northwest Iowa and at ten Ohio elevators (Baldwin and Dayton). If the markets were closed on Thursday, the preceding Wednesday's prices were used. Local basis patterns also were incorporated into the analysis. Round-turn brokerage fees of $40 and $60 were charged for futures and options accounts, respectively, and a 7 percent initial margin was used on futures accounts. Interest rates for investments in hedge-related costs and option premia were charged at the annual prime rate plus one percent. When futures profits were generated, the prevailing three month U.S. Treasury bill rate was credited to the account. Futures were marked to market each week, and maximum account draw-downs were recorded weekly.

Results *(or go to* ***Topics*** *)*

For the 10 pre-harvest marketing strategy simulations, means and variances of net returns were compared to the naive cash marketing strategy. Following prior studies, a t test was used to determine whether net returns from pre-harvest strategies were statistically different from the returns reported for the naive strategy. The results are summarized in **Tables 3** and **4**. Other associated results including activity in margin accounts, volumes of over/under hedging, and annual returns for highly significant strategies are reported in the text. Where appropriate, the results are analyzed from a farm perspective to demonstrate how strategies affect the total farm business. Differences between Ohio and Iowa farms are noted. As a precursor to the results discussion, note that none of the pre-harvest strategies would prevent storage. Note that call options were sold only to offset previous purchases. Spread risk was avoided by not rolling hedges or hedge-to-arrive (H-T-A) cash contracts into future time periods.

Hypothesis Testing *(or go to* ***Topics*** *)*

Soybeans

At the five percent level of probability or less, net returns for five out of the ten Ohio and four out of ten pre-harvest soybean strategies were significantly different from the net returns for the naive cash strategy, respectively (**Table 3**). Each of these strategies used options to retain upward price flexibility. Performances, based on statistical significance and mean return over variable costs, were about the same for three of the four sets of synthetic puts. The best-performing soybean pricing strategy, based on statistical significance, was the

Synthetic Put VII. This synthetic put was created by simultaneously placing a November new-crop short hedge and buying a $0.25 out-of-money November call during the third week of May. Purchasing the call retained upward pricing flexibility during the period of greatest uncertainty in the production cycle. Calls were offset in July since holding them longer reduced time value and net returns. Once that period of uncertainty was completed, history showed relatively little need to retain the calls. After sale of the calls, price protection was retained by the hedge.

For Iowa's model farm, the average net annual returns from the synthetic put VII strategy exceeded returns from the naive marketing strategy by $7,317 at a significance level of 1.2% (**Table 3**). Ohio average net annual returns were increased by $6,635 with a significance level of less than 1%. Thus, the hypothesis that this strategy would increased net returns was accepted. Higher soybean yields in Iowa generated greater net returns relative to the Ohio model farm. Differences in yields and basis between the two states may also explain differences in the variance and coefficient of variation of returns. Variation in net returns, by both measures, is lower for Ohio (STD = $11,305 and CV = 0.19) than for Iowa (STD = $32,754 and CV = 0.41). For Ohio, both the standard deviation and the coefficient of variation (CV) were smaller for the Synthetic Put VII than for the naive strategy. Thus, in Ohio, the pre-harvest strategy increased average net returns and reduced the variation about the mean net return. For Iowa, the standard deviation was higher while the (CV) was lower for the Synthetic Put VII than for the naive strategy. Thus, in Iowa, the pre-harvest strategy increased net returns with a small percentage decrease in the variance about the mean.

Since average net returns for Synthetic Puts I, IV and VIII also exceeded those from cash marketings and were significant at less than a 5% level for both Iowa and Ohio, the hypothesis was accepted for these strategies. In addition, Synthetic Put II for Ohio was significant at less than the five percent level of probability. Of these five strategies (half of the ten tested), three were significant at less than the three percent level of probability. While the other half were not statistically significant, all strategies for both Ohio and Iowa generated greater mean net returns than harvest cash marketings and all of the Ohio strategies generated a lower CV than harvest cash marketings.

Combining a February short hedge in post short crop years with a synthetic put in other years (synthetic put I) increased mean net returns and reduced the variance about the means by an insignificant amount. Protecting against two consecutive short crop years (a more risk adverse strategy, synthetic put IV) decreased both the mean net returns and the variance by insignificant amounts relative to the outcomes for synthetic puts I and VII.

It is worth noting that the hedge II strategy in which a hedge was routinely placed in either February short crop ex post years or in July for other normal crop years generated the highest average net returns for both Iowa and Ohio. This strategy increased (decreased) the variance about the mean for Ohio (Iowa) relative to variances for the synthetic puts. Since the t-test generated a probability in the seven to eight percent range, it is inclusive whether the differences between the means for the hedge II strategy and the mean for the naive cash marketing sale are statistically different.

Corn *(or go to* ***Topics*** *)*

Difference in Corn Net Returns for Naive Strategy, Ohio Versus Iowa

Ohio and Iowa mean net corn returns for the 18-year period differed considerably for the naive strategy. One would expect the two means to be similar, and this is the case for the 12-year average, 1985-1996. For the 18-year period, Ohio's mean net returns were $55,125 vs. $49,217 for Iowa. The difference is explained by differences in yields, yield variability, and basis. In 1982, low prices and production shortfalls with the cash strategy generated a $15,162 loss over variable costs for Iowa's model farm, while Ohio net returns were a positive $24,000. Differences for 1993 were similar, although Iowa returns were small but positive. These naive strategy results show that low yields and low harvest-time prices can create major cash flow problems for a cash marketer.

Since only option-based corn strategies were statistically significant at the 5% level, only 12 year pre-harvest results are discussed in detail. The longer period of analysis applied only to hedges, and all hedging models showed larger mean net returns than the naive strategy, despite the lack of statistical significance.

Results for Pre-harvest Marketing Strategies Versus the Naive Marketing Strategy (or go to ***Topics*** *)*

Based on the five percent statistical significance level, two sets of mixed hedge/put strategies out performed the naive cash marketing sale strategy (**Table 4**). Results for three other options-based pre-harvest strategies showed statistical differences in net income versus harvest sales at less than the ten percent level of significance, although the hypothesis for these alternatives was rejected because significance exceeded five percent.

For the mixed hedge put II strategy, December futures were sold during the first week in February for post short crop years; otherwise $0.20 out-of-money puts were purchased in May for 80% of the average production and the remaining portion of the crop was hedged in July. Puts and futures were offset the second and fourth weeks of October, respectively. This strategy generated greater returns than the naive strategy every year following a short crop, including 1996. Its average net return was $64,352 for Iowa and $63,847 for Ohio (**Table 4**). Compared with cash marketings, this strategy increased mean annual net revenues for Iowa and Ohio by $11,101 and $9,906, respectively. Since these differences were significant at the 1.6 and 1.7% levels, respectively, the hypothesis that the pre-harvest strategy would increase net revenues was accepted. The standard deviation and coefficient of variation for Ohio are smaller than for Iowa suggesting that corn production and basis risk are greater in Iowa than in Ohio. For both states, the coefficients of variation for the Mixed Hedge/Put II strategy were near those of the naive strategy. Thus, these pre-harvest strategy produced higher net returns without a significant increase in variability.

The mixed hedge/put III strategy was modeled to reduce the potential price risk associated with back-to-back short crop years. Thus, a one-strike out-of-the- money new-crop call was purchased in conjunction with the short hedge that was placed in February during short crop ex post years. This strategy also increased the mean net returns relative to the net returns for the naive cash marketing strategy. Since the t-test for both states was significant at less than a 3.0% significance level, the hypothesis for this strategy was also accepted. Again, the standard deviations and coefficient of variation were approximately equal to those for the naive strategy. Results from the hedge/put III strategy suggest that a risk-adverse producer can use calls during the short crop ex post years without significantly modifying the mean net return and variance about the mean relative to the hedge/put II strategy. Buying calls in short crop ex post years may capture part of any major price increase that occurs after February and may increase average net returns relative to the cash marketing strategy.

Other Observations About the Results and Evidence of Price Premiums *(or go to* ***Topics*** *)*

When marketing years are segregated by crop size, there is evidence of repeated seasonal variations in new-crop corn and soybean futures prices during and before the growing season. Pre-harvest pricing with extensive use of options markets showed economically as well as statistically significant increases in returns versus speculative harvest cash marketings for the period analyzed here. For the 12 year time period, the statistically best-performing strategies produced mean annual net returns over variable costs for the 1,000 acre Ohio and Iowa farms that were $17,009 and $18,897, respectively, above those from harvest cash marketings. At the same time, the coefficients of variation were lower for both farms than with the naive alternative, and t tests indicate returns were significantly different from harvest cash marketings at less than the three percent level of probability. These strategies are simple, straightforward, and easily applied by farmers with moderate marketing skills.

Options positions are an important element in generating increased incomes through their ability to retain upward price flexibility in years when prices rise sharply. Exposure to hedge margin calls was limited by conservative volumes sold and heavy use of options markets, although large margin calls did occur for a time in 1996. The maximum margin call for soybeans equaled $29,994 for the farms in each state. For corn, the maximum margin call equaled $31,327 for the Ohio farm and $37,023 for the Iowa farm. On average, annual margin calls for the 1000 acre farm equaled $11,290 for Ohio and $13,269 for Iowa. Producers, who use these strategies must have ample cash flow or a source of credit to sustain the price shocks that appear in the futures market. For those using the February hedge-synthetic put strategy in 1996, margin calls would be partially offset by increasing value of the long call positions that would assist in securing financing for the hedged positions. Interest costs on hedged positions were minor and over and under hedging were minimized by using the 10 year moving average yield to estimate future production.

Risk Premium Tests *(or go to* ***Topics*** *)*

Fifty percent of Ohio soybeans, 40% of Iowa soybeans and 20% of the corn strategies had significantly higher net returns than naive harvest cash sales at the 5 percent significance level, and other strategies for both crops and states were in the inconclusive range at the 10% significance level. Thus, it seemed prudent to test for possible existence of risk premiums in spring and summer new-crop corn and soybean futures prices. The testing procedure used was regression of prices in period t+1 on prices in period t. The equation used was $P_t +_1 = a +b P_t+e$, where P_{t+1} is the harvest price (mid-October for soybeans, the first Thursday of November for corn), and P_t is mid-May for soybeans or the first week of July for corn. The term "e" is an error term. Following Fama, if a=0 and b=1, no risk premium is present. If a<1 and b=1, a contango situation exists where fall prices are below earlier period prices and a risk premium may exist. If a>0 and b=1, a normal backwardation situation exists, where fall prices are above spring/early summer prices. This test was applied to corn and soybeans for the 1949-71 and 1975-96 periods. The former period excluded market abnormalities immediately following World War II. The latter period excluded

1972-74, a period of major readjustment in global financial and commodity markets in response to several highly unusual developments including global inflation stemming from the quadrupling of world energy prices and a move to flexible currency exchange rates.

For soybeans, no statistically significant risk premium was found in either period when categories of crops were combined. However, the statistically significant returns generated in selected strategies noted above were obtained from options strategies, rather than futures alone, and thus are not inconsistent with this finding. The corn analysis for the earlier period suggests a risk premium may have been present. The beta coefficient was not significantly different from one. On the other hand, the constant term was negative, and was significantly different from zero and one at far less than one percent. Its negative sign implies that fall prices were below early summer prices, an indication that is consistent with the differences in means. Results for corn for the later period are not as straight-forward. The beta coefficient is indicated to be significantly different from zero and one, and has a value of 0.57. In contrast, the constant term , at 0.97, is not significantly different from one. Means of P_t and P_{t+1} are significantly different from zero at the 2 percent level, with the early July mean being above early November. This combination seems to hint that a risk premium may have been present.

For a longer look at short-crop ex post years, we examined futures prices since early years of trading. The only short-crop ex post years with higher fall new-crop corn prices than in late winter or spring since 1912 were the start of World War I (1914), the Korean War (1951); and 1975, with highly unusual world economic conditions. Since November soybean futures started in 1937, prices from winter and/or spring to fall in such years reveal only two exceptions (1941 and 1954) to the downward trend. Average winter-to-fall hedge gains were 13 and 12 percent, respectively, with significant differences vs. harvest prices at less than one-tenth percent probability levels using the t test.

Conclusion *(or go to* ***Topics*** *)*

This paper is an empirical analysis of several pre-harvest pricing strategies that incorporate historical price, cost, and yield variability, using short hedges and options market strategies which create a price floor, separately and in combinations with each other. The findings, that pre-harvest marketing strategies may increase profits relative to naive harvest sales, run counter to what would be expected from the efficient market hypothesis and random walk theory. The authors suggest at least two possible reasons for the results. First, the increased income may be associated with changes in the market’s perceived probability distributions of yields for individual years as the planting and growing seasons progress and more information becomes available relative to probable yields for the specific crop, as well as for domestic and foreign substitutes. Second, the results may reflect Grossman and Stiglitz’ hypothesis that costs of acquiring and interpreting information slow price adjustments, with the market not yet having detected arbitrage opportunities.

We do not conclude that the corn and soybean markets are inefficient. Rather, we suggest that a careful look at market functions is in order, as well as an examination of changes in the set of information that is available as the planting and growing seasons progress. The concept of returns which vary with seasonal changes in perceived production risk may be at work here. It should also be recognized that wide dissemination of this information may change price patterns. Further, changes in national and global storage policy from large publicly owned stocks to a "just in time" alternative may modify future price patterns. Thus, past market performance does not guarantee future performance. Nonetheless, the analysis shows justification for encouraging producers with moderate marketing skills and willingness to use options to carefully develop marketing plans that may include pre-harvest pricing strategies and good estimates of production costs, living expenses, returns to assets, and strategies for managing production risks. These cost ranges can then be compared to prices available through futures and options markets. Patterns identified here show frequently higher spring and early summer new-crop prices than those at harvest. Producers should also be aware that inadequate attention to yield risk combined with poorly organized and poorly planned marketing strategies, can add to risk, as in other farm management decision areas.

Areas for Further Research *(or go to* ***Topics*** *)*

Other new-crop pricing strategies could be tested using this framework, including options fences with alternative out-of-the-money call sales. Conversion of fences to hedges in July could be considered. Rolling new-crop options to successively higher strike prices on rising markets may also merit consideration. Analyzing farms in other geographic areas, and with irrigated crops may prove useful for extension work. Storage alternatives could be added.

Work on seasonal volatility of corn and soybean futures prices and its relation to options premia could be useful. Tests for normality in the distribution of spring-to-fall futures price changes and further work on mean-reversion tendencies for the spring-to-fall time period seems appropriate. It might be fruitful to compare fall harvest price distributions implied by spring options markets with the longer-term distribution of actual harvest-time futures prices. Nonparametric statistical tests and tests for existence of seasonal risk premia may be appropriate.

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Endnotes

1. Even though yields were above trend, government program-induced short corn crops in 1987 and 1990. The market had no need to create price incentives to expand planted acreage, as happens with weather-induced short crops.

End of Module *(or go to* ***Topics*** *)*

Module 14 | **Introduction** | **MRP Introduction**
Universities and Agribusinesses |**Table of Contents** | **or Go to Modules :**

1 | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **Questionnaire**
Supplementary Material