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Performance of Selected Pre-harvest and Post-harvest Corn and Soybean Marketing Strategies vs. Alternative Market Benchmarks

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Performance of Selected Pre-harvest and Post-harvest Corn and Soybean Marketing Strategies vs. Alternative Market Benchmarks

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Introduction

With volatile grain markets, rapidly increasing average size of U.S. cash grain farms, and narrow profit margins due to rising costs for land and other inputs, grain producers have become increasingly interested in expanding their marketing window by utilizing pre-harvest pricing opportunities including crop and revenue insurances (Patrick et al., 1998). The widespread use of harvest price revenue insurance provides a tool for maintaining a long physical commodity position that matches a short futures pre-harvest pricing position. If yields are low, this tool provides for replacement of lost bushels at the harvest value. With very generous government subsidies, it has made pre-harvest pricing much more feasible than in past years. The most common percent of actual proven yield history insured by Iowa farmers with these insurance tools in recent years has been 75%. Additionally, the use of market advisory services has become widespread among farmers. Most such services make extensive use of recommendations for pre-harvest pricing.

Some previous studies have noted that futures market behavior for corn and soybeans over an extended period of years frequently provided better pre-harvest pricing opportunities than are available at harvest (see Wisner, Blue, and Baldwin, 1998; O'Brien, 2000). Recent work on seasonality of commodity futures also shows evidence of recurring price patterns, which is reported in the literature review section of this paper. Others have indicated that the results are sensitive to the time period selected for study and the structure of the analytical model (e.g., Zulauf and Irwin, 1998). By expanding the marketing window to include pre-harvest as well as post-harvest pricing opportunities, farmers typically have access to a wider range of prices than are available if only post-harvest opportunities are considered. Farmers regularly commit fixed costs for producing grain more than a year in advance of harvest, and commit variable costs such as fertilizer, seed, chemicals, and fuel six to eight months or more before harvest. To do so without knowing what price will be received for the crop is, in essence, speculation. Expanding the marketing window increases the likelihood that farmers will find opportunities to market sizeable portions of their crops at prices that more than cover the producer's minimum cash outflow for production.

Purpose: To Update Earlier Work

This study was undertaken to update earlier work by the authors that analyzed selected pre-harvest pricing strategies utilizing options markets to establish a price floor for part of the crop in the spring, with additional pricing done by use of short hedges in early summer. The timing of implementing these strategies was moved back to late February if the previous year's U.S. crop was a weather-induced short crop. A weather-induced short crop as opposed to a government program induced short crop was defined as one in which U.S. production fell below the previous year's use and the U.S. average yield was at least 6% below a trend yield. Previous work by the authors indicated that selected pre-harvest strategies applied to actual farms in Iowa and Ohio over the 1985-1998 time period generated net returns well above those from a naïve strategy of systematically selling at harvest, with t-tests indicating statistical significance at the 5% level. Similar results were observed when the time period was extended to 2001.

The results from this study may explain the observed increase in the use of forward pricing by farmers, the emergence of new pre-harvest marketing tools focusing on late winter and spring pricing opportunities, and the emphasis on pre-harvest pricing by market advisory services (Irwin et al., 2003). Results reported here suggest that over the past 18 to 29 years, farmers have had the potential to reap substantial economic benefits from improving both their pre-harvest and post-harvest marketing skills.

Inconsistency with Efficient Market Hypothesis

While these patterns are intuitively inconsistent with the efficient market hypothesis (EMH), empirical data nevertheless show their existence. The observed patterns raise additional questions to be explored about market behavior, some of which have been examined in financial literature that is reviewed below (Bessembinder, 1992; Considine and Larson, 2001; De Roon, Nijman, and Veld, 2000; Rock, 1991). A price pattern motivating the authors to undertake this study is shown in Figure 1. The chart shows the weekly average closing Thursday December corn futures price for all years since 1975, from the end of December before harvest through early December after harvest. If the markets were closed on Thursday, the closing price for the previous business day was used. The period shown in the chart began with 1975 to avoid disruptive market behavior in the previous three years, brought about in part by an extreme depreciation in the value of the U.S. dollar in world currency markets and a shift from domestically focused grain markets to a global market focus. As further support for starting the study with the year, 1975, Milonas (1991, p.336.) showed one-month price variability of CBOT corn, wheat, soybean, soybean meal, and soybean oil futures prices by year from 1966 through 1986. Corn price variability in each of the years 1973 and 1974 was about seven times as large as in preceding years and about six times as large as in following years. For wheat, soybeans, and soybean products, the increases in price variability were even larger, but declined dramatically in the later years.

In Figure 1, note that in 29 years of data, the weekly average December futures price is relatively high from the start of the year until June, and then declines into the harvest season. Using the shorter time period from 1985 (start-up of options markets) through 2003, the pattern is similar, but shows an even more pronounced decline in mid-summer as uncertainty about crop prospects diminishes. Table 1 shows the average prices and standard deviation of December futures prices for selected weeks relating to the strategies studied here over the 29-year period versus the standard deviation for futures prices in early November.

Planting-time prices for both periods are significantly different from harvest prices at the 6% probability level, using a paired sample, two-tail t-test. Note that the average pre-harvest price differences versus harvest prices shown above are economically significant to producers. For a producer with 850 acres of corn yielding 150 bushels per acre, with 60% priced at planting time, the average annual dollar gain would be $12,240 to $13,770 versus harvest sales. Also note that the standard deviation of the pre-harvest price is lower than that of the harvest-time price.

This pattern helps to explain why in the last 5 to 6 years the grain industry has chosen to offer a large set of seasonal new-crop grain pricing contracts. These marketing instruments give farmers the average new-crop price for harvest delivery that is available in the first 6 months of the marketing year, or in some cases a designated shorter period. Other variations of these contracts give farmers a floor price that is based on this average, minus the cost of buying call options that retain upward price flexibility to take advantage of occasional years when prices rise sharply during the summer. The contracts are designed to allow farmers to take advantage of a long-standing tendency of the market to offer higher prices early in the year than at harvest time.

Figure 2 shows the pattern of December corn futures for all years following a weather-induced short crop from 1975 through 2003. In such years, the job of new-crop futures is to insure that a second short crop will not occur the next fall. If the futures market is successful in doing its job, prices will have a high probability of declining as harvest approaches. For the eight such years since 1975, that pattern emerged each year. The average pattern is shown in Figure 2 for both the longer and the shorter period. The post-short crop pricing strategy used in this study, with the farm conditions noted above, produced an average additional $17,600 per year gain over the harvest futures price for the post short crop years. Wisner, Blue, and Baldwin (1998) investigated this pattern back to the early 1900s in the Chicago corn futures market and since the early 1940s for soybeans. They found a strong tendency of this pattern to persist in post-short-crop years over the entire period, except for years that were the beginning of major wars (Wisner, Baldwin, and Blue, NCR 1997).

Figure 3 shows the year-by-year changes in price of December corn futures from the selected transaction dates examined here. Six out of the 29 years showed lower prices in the pre-harvest period than at harvest. Five of these years reflected severe drought in the Corn Belt, and the remaining year was a time of widespread excessive rains.

Literature Review

In the 1960s, the Random Walk Theory and the efficient market hypothesis (EMH) were popularized by Cootner (1960) and Samuelson (1965). These concepts are based on the assumptions that in the aggregate, market participants are risk-neutral and have rational expectations. EMH implies that prices fluctuate randomly about their intrinsic value at each moment in time, reflect all available market information, and that futures prices are unbiased estimators of future spot prices (Taylor, 1985 and 1995). This concept was initially applied to stock markets that, unlike grain, are not affected by definite seasonal factors related to weather. Using these concepts, the 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 purchases and sales of investments to beat the market.

During the last 35 years, various authors have applied this concept to agricultural futures markets, and have conducted marketing efficiency tests (Kenyon, 1993). The results from their investigations have advanced the debate as to whether hedge and/or option-based pre-harvest marketing strategies can increase grain producers' profits from those generated by naïve strategies. Various naïve strategies tested have included selling the grain at harvest time, selling equal amounts daily throughout the marketing year, or selling equal amounts daily throughout a pre-defined pre-harvest period plus the post-harvest marketing period extending to the next harvest.

Gay and Kim (1987), after noting that seasonal patterns had been identified in stock markets, studied the Commodity Research Bureau (CRB) index of all major futures-traded commodities over a 29-year period. Over the historical period, they found negative returns for purchasing December CRB contracts. Chang and Tapley (1983) studied daily closes of 15 commodity futures markets and 6 financial futures markets on the CBOT for the 1972-1980 period. Their study indicated that grain returns typically peaked on Wednesdays, and had a second peak on Friday, but were negative on Mondays, in a pattern very similar to that of stock markets. The financial markets also exhibited a year-end effect and a half-month effect.

Tolmasky and Hindanov (2002) found defined seasonal patterns in petroleum and natural gas futures markets, as did Girma and Paulson (1998), and Considine and Larson (2001). The latter two authors indicated that empirical findings provide rather strong support for the presence of risk premiums in these energy markets that rise sharply with higher price volatilities. Heath, Jarrow, and Morton (1990) found evidence of risk premiums in bond markets. Other work that identified seasonality in commodity futures included Roll (1983), Rock (1991), and Admati and Pfleiderer (1988), and Anderson (1985). De Roon, Nijman, and Veld (2000, p. 414), in studying CBOT agricultural commodities, found seasonal parameters in their model that "clearly were significantly different from zero".

The explanations for these seasonal patterns vary, and appear inconsistent with the EMH. Milonas indicates, "Because the flow of information which affects commodities follows a seasonal pattern, commodity prices exhibit strong seasonalities which are captured in their volatilities" (p. 343). Wang (2001), in another study of investor returns in six agricultural futures markets from 1993 through 2000 uses an index of large trader sentiment based on the Commitment of Traders (COF) reports. Markets studied were corn, soybeans, soybean meal, wheat, cotton, and sugar. His study found conclusions consistent with the hedging pressure theory advanced by Keynes (1930). This theory argues that hedgers pay risk premiums to speculators to transfer otherwise non-marketable and unacceptable risks. His speculative sentiment indices indicate that large speculators earn positive returns for bearing the risks.

Focus of the Current Study

This paper adds to the above discussion by comparing prices generated from alternative corn and soybean pre-harvest and post-harvest marketing strategies to several alternative market and farmer benchmark prices**.** It also tests the hypothesis that a systematic set of pre-harvest marketing strategies has been able to generate statistically higher prices than those from the various naïve strategies. This hypothesis is tested by creating simulated gross returns for two actual farms in northern Iowa and one in Ohio, utilizing actual futures, options, local cash grain market data and actual farm yields for the 1985-2001 marketing years.

This study also identifies the net returns for storing grain into the post-harvest marketing period. Three strategies are evaluated: (1) monthly, store and sell an un-priced equal amount of corn and soybeans. (2) Monthly and during normal crop years, store and sell an equal amount of corn and soybeans that have been hedged. If a short crop year occurs, do not store the grain into the post harvest period. (3) Use a strategy that has long been employed by the grain elevator sector, namely to store and hedge the grain only if the market offers expected profitable opportunities for holding into the post-harvest marketing period. Otherwise the grain is sold at harvest. In future work, these findings will be incorporated into pre-and-post marketing strategies to test the hypothesis that these combined strategies will generate statistically higher prices than those from naïve strategies.

Work by Pfeiffer et al. (1990) identified profitable pre-harvest pricing strategies for Nebraska soybean growers, using options premiums simulated through the Black Model. Later work at Nebraska (Pfeiffer et al., 1996) using a Mean-Variance (EV) model identified a number of pre-harvest soybean pricing strategies that provide a higher income and lower variance than harvest cash sales. Irwin et al. (2003) chose to measure the performance of market advisory services against three alternative market benchmarks rather than harvest prices. Benchmarks used were 20 and 24-month price series, based on the assumption that farmers could sell equal amounts of their crops each business day from up to one year before to one year after harvest, using elevator contracts to avoid the divisibility problem with 5,000 bushel futures contracts. The 20-month benchmark was based on farmers initiating the pricing strategy eight months before harvest and completing it 12 months after harvest. Post-harvest prices were adjusted back to a harvest-equivalent price by deducting all costs associated with commercial storage. These benchmarks were adjusted to reflect the central Illinois basis, and LDPs during the 1998-2001 period. A third benchmark used to evaluate the performance of market advisory services was the average price received by Illinois farmers (hereafter referred to as the farmer benchmark), adjusted back to a harvest equivalent price by deducting the cost of commercial storage and adding in LDPs.

Using these benchmarks, Irwin et al. (2003) found that advisory services as a group, during the five years ending with the 2001 crops, were able to beat the farmer benchmark. For corn, advisory services as a group beat the market benchmarks by only one to three cents per bushel. For soybeans over this period, the advisory services were able to beat the market benchmarks by 11 to 18 cents per bushel. When using the farmer benchmarks for comparison, average gains from advisory services were 10 cents for corn and 17 cents for soybeans. The short time period covered by the study is a limitation in drawing conclusions about long-term performance.

Earlier work by Wisner, Baldwin and Blue tested the performance of pre-harvest pricing strategies reported here versus harvest sales. In the current analysis, the strategies also are compared with prices generated from the market benchmarks used by Irwin et al., with adjustments to reflect Iowa and Ohio conditions.

LDP Strategies and Strategy Adjustments

Previous published work by the authors analyzed the performance of mixed futures and options strategies for the years from 1985 through 1996. Extending this work to 2001 required price adjustments to reflect the changing U.S. agricultural policies. Beginning with the 1998 marketing year, policy changes and depressed world markets activated the Loan Deficiency Payment (LDP) mechanism of the U.S. farm policy safety network for farmers. If prices drop below the loan rate, farmers are eligible to receive a direct payment, the LDP, approximately equal to the difference between the local cash price and the loan rate. This mechanism greatly complicates forward pricing of crops before harvest if the forward contract or local hedge equivalent price is below the loan rate. If the price rises after forward pricing (unless options are used), the price is locked in at a level below the market, and the LDP decreases or disappears altogether. For this paper, an adjustment was not made for this contingency. Lack of such an adjustment resulted in a bias against the pre-harvest strategies for two years of the study period. Future work will adjust for this by avoiding pre-harvest sales when prices are below the respective loan rates.

A second adjustment in the pricing strategies dealt with farmer decisions of whether to use the marketing loan or take the LDP, and if so, when. The LDP management strategy used here was to take the LDP at harvest, using the October average LDP per bushel for the respective crop for the respective state.

Farms Analyzed

For this study, yields from actual farms in northwest Ohio and northwest Iowa were used to capture the interaction of price and yield in determining farm incomes. The Iowa farms represented variations in land quality, with one farm having a lower variance of yields and a higher average yield than the other, to see whether results from the marketing strategies would be affected noticeably. One farm had a 140 bushel average yield for the 29 years ending in 2003 with a standard deviation of 18.6 bushels per acre, while the other had a 121 bushel per acre average yield with a 23.6 bushel per acre standard deviation. The Ohio farm had an average corn yield of 142 bushels per acre with a standard deviation of 42 bushels per acre. Differences in soybean yield levels and variability were somewhat less than for corn. Results for the two Iowa farms were very similar; for that reason strategies for only one Iowa farm are reported here.

For Iowa, the years 1985 through 2001 included one significant local drought and one extreme flood year, 1993. The Ohio farm experienced adverse weather and below normal yields for only one year. The study period also included record-high corn prices, prices well below the government loan rate, near-record corn exports, and very low corn exports. It spanned a period of four different U.S. farm bills and widely varying U.S. farm price/income support policies. Thus, the study period allowed the marketing strategies to be tested over a wide range of weather, market, and government policy conditions.

Pricing Strategies

The pricing strategies presented in this paper were the identical strategies reported in the previous work by the authors and described in detail in Wisner, Blue, and Baldwin (1998).

For corn in both the Iowa and Ohio farms the following strategies were used:

a) Hedge with December futures, May week 3 to November week 1 and

b) Hedge with December futures following normal year: May week 3 to November week 1 and hedge *with December* futures following a short crop year: February week 4 to November week 1.

In addition, results from the following pre-harvest mixed hedge/options corn strategies included:

a) After normal year: hedge with December/November futures, May week 3 to November week 1 and hold "one strike out-of-the-money" December call from May week 3 to July week 1; following a short crop year: hedge with December futures, February week 4 to November week 1.

b) After normal year: 80% of 10-year moving average production is hedged using at-the-money December put options, from May week1 to November week 1; the remaining 20% hedged is with futures, from July week 1 to November week 1; following a short crop year: hedge with December futures, from February week 1 to November week 1.

For soybeans in the both Iowa and Ohio farms the following strategies were used:

a) Hedge with November futures, May week 3 to October week 3.

b) Hedge with November futures following normal year: May week 3 to October week 3; hedge with November futures following a short crop year: February week 4 to October week 3.

c) Synthetic puts, hedging with November futures, May week 3 to October week 3 and with "one strike out-of-the-money" call options, May week 3 to July week 1.

For all strategies~~,~~ except the 80% put/20% hedge strategy noted above, the amount of production hedged with futures, and call options was 100% of the 10 year rolling average in a given year. The average corn yield has been increasing at about 1.4% per year, making the 10-year average a conservative measure of potential production. For example, for one of the northwest Iowa farms, the 10-year rolling average in at the start of the 2003 planting season was 127.1 bushels per acre, while the previous four-year average was 137 bushels. The constraint of matching sales to the nearest 5,000 bushels also helped to keep the sales level conservative relative to potential production. All transactions were based on closing market prices.

Prices, Option Premiums and Other Data

For the pre-harvest marketing strategies, closing Thursday cash, futures prices and options premiums were used. Cash prices were averages paid to farmers in northern Iowa and at Northwest Ohio elevators. If the markets were closed on Thursday, the preceding Wednesday's prices were used. Local basis patterns were also 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 premiums were charged at the annual prime rate plus 1 percent.

Hedges and options positions were executed up to the highest integer level not exceeding the expected 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 third week of October for soybeans and for the first week of November for corn). All cash transactions were made at these same times.

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 losses were recorded weekly.

Storage Costs

To calculate net returns to storage, commercial storage costs were used in order to maintain consistency with market benchmarks compiled by University of Illinois researchers. Commercial storage costs included (1) extra drying charges and shrinkage of corn (but not soybeans) by the elevator to lower moisture content one percentage point below the allowable level for immediate sale, (2) interest cost paid by farmers on the harvest-time value of the corn, and (3) typical commercial storage charges at local elevators.

Results

Pre-Harvest Pricing Strategies and Benchmark Prices

All annual corn and soybean pre-harvest marketing strategy, benchmark, and harvest prices, averages, standard deviations, and "t" tests are reported in Tables 2 –5 for a case farm in O'Brien County, Iowa and in northwestern Ohio. For comparative purposes, LDPs were added to the pre-harvest marketing strategy prices for the 1998 to 2001 period. The statistical differences for net revenues are not reported here as they have been in prior studies (Wisner, Blue and Baldwin, 1998). Thus, these results do not reflect the impact of local crop failures possibly biasing the results in favor of the benchmark results. Benchmark data were obtained from the University of Illinois. The 20 and 24-month market benchmarks were adjusted to equivalent levels for Ohio and Iowa using annual harvest basis differences among the respective states. It was assumed that basis variations at other times of the year would closely reflect relative differences at harvest. Northwest Iowa typically has a weaker basis than Illinois, while the northwest Ohio basis typically is slightly stronger than that of Illinois. The farmer benchmark data were adjusted by:

1) Obtaining USDA, NASS annual marketing year average prices paid to farmers for the three states for the study period.
2) Adding Illinois LDP data for the years 1998-2001 to the Illinois NASS farmer average price series.
3) Computing the difference between annual Illinois farmer benchmark prices and the NASS price series ~~+~~ plus LDPs.
4) Deducting this difference annually from Iowa and Ohio NASS data, and adding LDP data for the years 1998-2001 to the resulting Iowa and Ohio price series to achieve comparability with the Illinois series.

Illinois farmer benchmark prices contain deductions from NASS prices for all costs associated with commercial storage, for that portion of the crop stored beyond harvest. LDPs are added to obtain the Illinois farmer benchmark series. Thus, the difference between the Illinois NASS farmer price and the benchmark reflects storage costs and LDPs. By deducting this difference from Iowa and Ohio NASS prices, we assumed that commercial storage costs would be approximately equal across state lines.

For 2002 and 2003, benchmark price data are currently not available for this analysis. In both 2002 and 2003, prices for soybeans in particular increased sharply as the harvest season began. Adding 2002 and 2003 data to the analysis will likely reduce the "t" test significance levels that are reported in this paper for the 1985 to 2001 time period.

Corn Results

For O'Brien County, Iowa, the pre-harvest marketing strategies reported here include (1) hedging from May, week 3 to November, week 1, (2) hedging from May, week 3 to November, week 1 following normal crop years and hedging from February, week 4 to November, week 1 following short crop years (normal/short crop hedge), and (3) (*synthetic put/short crop hedge*) hedge May week 3 to November week 1 and hold call May week 3 to July week 1 and following short crop year: hedge February week 4 to November week 1. The call is offset in July to capture the remaining time value based on the assumption that by July the size of the crop is known with some certainty.

As displayed in Table 2 for O'Brien County Iowa, average corn prices for the selected pre-harvest marketing strategies were about \$0.20 higher than the 20 and 24 month benchmark prices, about \$0.40 higher than the farmer benchmark price, and were about \$0.25 higher than the harvest price. The reported differences were statistically significant at less than one-half of one percent level for the 20 – month, 24 – month and the Farmer Adjusted price series, respectively. The statistical differences between the pre-harvest strategies and the harvest price series ranges between 0.3 and 1.8 percent. When comparing standard deviations between the benchmarks, harvest price series and the pre-harvest marketing strategies, a consistent pattern does not appear. For example, the standard deviation for the May to November hedge about equals the standard deviation for the 20 month adjusted benchmark and the farmer benchmark price series. The standard deviation for the 24-month benchmark is lower than the standard deviation for the hedge while the standard deviation for the harvest price series is higher. Similar findings are observed when the standard deviations are calculated as a percentage of the respective means. The standard deviations for the normal/short crop hedge and the synthetic put/short crop hedges are lower than most benchmark and harvest period standard deviations. When the standard deviations are calculated as a percentage of the respective means, the coefficients for both the normal/short crop hedge and the synthetic put/short crop hedge are lower than the corresponding coefficients for all benchmark and harvest prices. One can conclude that for the 1985-2001-time period, the pre-harvest marketing strategies statistically increased prices relative to the benchmark and harvest period, and may or may not have decreased the volatility within the price series.

As noted earlier, it should be recognized that in making these price variability comparisons, the pre-harvest strategies reflect both price and yield variability, whereas the benchmark prices reflect only price variability. The judgment on whether these strategies reduced price variability will be deferred to a later report when compatibility is achieved by introducing yield risk into the benchmark price series.

Similar comparisons are reported for a case study farm in northwestern Ohio in Table 3. Pre-harvest marketing strategies included a May to November hedge, normal/short crop hedge, and an (80%/20% put/hedge) with short crop hedge. For the latter strategy, 80 percent of the crop was locked into a put and the remaining 20 percent of the 10-year moving average yield was hedged in early July, subject to the limitation that transactions were made in 5,000-bushel units.

Average Ohio corn prices for the selected pre-harvest marketing strategies ranged from $0.14 to $0.18 higher than the 20 and 24-month benchmark prices and harvest series prices. Prices for the three pre-harvest strategies ranged from $0.32 to $0.35 higher than the farmer benchmark series. These differences were statistically significant at levels ranging from less than one percent to 10.6 percent. The (80%/20% put/hedge) with short crop hedge pre-harvest marketing strategy performed best, with the statistical significance ranging from less than one percent when compared to the farmer benchmark price series to two percent when compared to the harvest price series.

In contrast, there was more price variability in two of the pre-harvest marketing strategy price series than there was in the corresponding 20- and 24-month series. The standard deviations for the hedge from May week 3 to November week 1 and for the synthetic put were $0.46 and $0.42 respectively. Both pre-harvest standard deviations, as a percent of mean, were higher than the standard deviations for the 20- and 24-month benchmark price series. The $0.33 standard deviations for the normal and short crop pre-harvest hedge strategy, as a percent of mean, were lower than the corresponding standard deviations for all of the benchmark price series. As with Iowa, the Ohio pre-harvest strategies increased the average prices for 1985 to 2001 time period but did not consistently reduce the price volatility.

Although average corn prices reported for the Ohio pre-harvest pricing strategies were statistically significant relative to its bench mark and harvest price series, the gains were less than those reported for the O'Brien County Iowa market. This difference is explained by examining the basis for the Iowa market relative to the basis for the Ohio market.   Because the Eastern Corn Belt Ohio market is in close proximity to the grain-deficit northeastern U.S. dairy feeding area and the grain-deficit southeastern poultry and hog U.S. feeder area, and has excellent transportation rates to these domestic markets and to the export markets on both coasts, the Ohio basis is higher at harvest time than it is in Iowa. Further, the basis improvement in Ohio during the post harvest period (storage period) increases at a more rapid rate than the corresponding basis improvement in the Iowa market. Since the stronger Ohio basis is captured in the Ohio benchmark and harvest price series, the pre-harvest pricing strategies performed well in Ohio, but not as well as in the Iowa market (Tables 2 and 3).

Soybean Results

The soybean results for O'Brien County Iowa are reported in Table 4. Three pre-harvest marketing strategies are reported, including (1) hedging from May week 3 to October week 3, (2) hedging from May week 3 to October week 3 following normal crop years and hedging from February week 4 to October week 3 following short crop years, and (3) using a synthetic put which includes a hedge from May week 3 to October week 3 and an out of the money call from May week 3 to July week 1. Average prices received from the May week 3 to October week 3 hedging strategy exceeded the 20 and 24-month benchmark prices, farmer benchmark prices, and the harvest period prices by \$0.27, \$0.25, \$0.52 and \$0.30, respectively. These differences were statistically significant at less than 1.8 percent levels (Table 4). Similar findings and levels of significance also exist for the normal/short crop hedge and the synthetic put pre-harvest marketing strategies.

In prior research for the 1985 to 2001 period, prices for the synthetic put were statistically higher than the corresponding hedge strategies. Since the calls for the synthetic hedges were lifted in July to re-capture part of the time value, the synthetic hedge did not perform well in the 2002 and 2003 crop years where prices increased after the July period. In 2003, prices did not begin their rapid increase until after the September crop report was released. When benchmark data are available for these two years, introduction of the 2002 and 2003 price data into the analysis will likely reduce the significant levels reported here.

The standard deviation for the three pre-harvest marketing strategies was higher than the standard deviations for the 20-month and 24-month benchmark price series (Table 4). The standard deviations for the hedge and synthetic put were higher than the farmer benchmark price, and the standard deviation for the harvest price series was higher than the corresponding standard deviations for the two of the three pre-harvest hedging strategies. Similar findings were observed when the standard deviations were calculated as a percentage of the respective means. As with corn, the pre-harvest marketing strategies increased the price levels compared to the benchmark and harvest price series but did not conclusively reduce the price volatility. In making volatility comparisons, the reader is cautioned that the same qualifications noted above for corn also apply to soybeans.

The results for the case study farm in northwestern Ohio are reported in Table 5. The three pre-harvest marketing strategies are the May week 3 to October week 3 hedge, normal/short crop hedge where soybeans are hedged from May week 3 to October week 3 following normal crop years and are hedged from February week 4 to October week 3 following short crop years, and the synthetic put where a hedge is in place from May week 3 to October week 3 and an out-of-the-money call is owned from May week 3 to July week 1. The call is offset in July to capture the remaining time value based on the assumption that the size of the crop is relatively well known.

The average prices for these three pre-harvest marketing strategies varied by only four cents ranging from \$5.99 for the normal/short crop hedge to \$6.03 for the synthetic put. The prices for all three pre-harvest marketing strategies exceeded the benchmark prices and the harvest period prices, and were mostly significant at the less than one percent level. Except for the farmer benchmark price series, the gains from the pre-harvest marketing strategies were eight to nine cents better than the gains observed for Iowa. These state-to-state differences appear to reflect differences in behavior of basis patterns for the respective states, including Ohio's access to export markets through Toledo and the Ohio river-barge market.

The standard deviation for the two hedge pre-harvest marketing strategies are larger than the standard deviations for the benchmark price series and are lower than the standard deviation for the harvest price series. The standard deviation for the synthetic put is larger than all benchmark and harvest period standard deviations. Similar findings were observed when the standard deviation was calculated as a percentage of the respective means. For Ohio, the pre-harvest marketing strategies increase prices relative to the benchmark and harvest period price series but do not lower the price volatility. However, as noted in the corn results section, a later report in which benchmark prices are used to generate gross incomes on the case farm, volatility comparisons may change from those shown here. The authors hypothesize that such comparisons will narrow the price variability differences between the pre-harvest pricing alternatives and the benchmark prices.

Net Returns to Storage: Preliminary Findings, Iowa

At the time of this writing, the post-harvest marketing strategy analysis is continuing to be developed. Three strategies are being investigated: (1) annually sell equal amounts of corn or soybeans monthly from January to July on the open market; (2) hedge and sell equal amounts of these commodities monthly from January to July following a normal crop year, otherwise sell at harvest time following a short crop year; and (3) use a three-year moving average to store these commodities when the expected basis improvement is greater than the expected storage cost to a specific month, otherwise sell the grain at harvest. Both futures and basis risk are present in the first strategy. For the second strategy, basis risk affects the outcome, and grain is sold monthly following normal years even if some a priori monthly returns appear to be negative. For the third strategy, basis risk affects the outcome, but the storage activity is performed only to the month that has the highest positive expected returns. For years when the moving average basis implies that only losses will occur, the storage activity is not performed.

The analysis is based on both on-farm and off-farm storage costs and fees. Since the benchmark price series are adjusted to a harvest base by subtracting off-farm storage fees, the on-farm preliminary findings are not reported here. To calculate the fees for both Ohio and Iowa, the annual storage fees were acquired from the respective grain elevators. It was assumed that the moisture content would be reduced from 15% to 14%, and the annual prime interest rate was multiplied by the annual harvest price to determine the monthly opportunity cost to store grain.

Corn results

For Iowa, storing corn monthly from January to July over the study period resulted in an average loss of -\$0.11 per bushel with a standard deviation of \$0.28. Storing, selling corn monthly, and speculating on price resulted in a very a large range of annual profits and losses. Storing corn into an unexpected short crop year resulted in an annual profit of \$0.72 per bushel while storing corn following a short crop year resulted in an annual loss equaling -\$0.52 per bushel. Storing and selling an equal amount of corn monthly from January through April reduced the annual loss to - $0.09 per bushel and reduced the standard deviation to $0.18. By shortening the storage season, the farmer forgoes both the opportunity to earn an unexpected high profit during the beginning of the short crop year and avoids some large losses.

Hedging, storing, and selling corn monthly from January to July following normal crop years resulted in an average loss of -$0.07 with a standard deviation of $0.13. Hedging stored corn both reduced the loss and the volatility relative to the open storage strategy. The average loss was reduced by only four cents per bushel compared to open storage; however, the standard deviation was reduced by $0.15 per bushel. Storing, hedging, and selling an equal amount of corn from January to April resulted in a loss of -$0.05 per bushel with a standard deviation of $0.11 per bushel. Losses were reduced by four cents per bushel with a reduction in the standard deviation of $0.07 per bushel.

Finally, the third post harvest strategy in which corn was stored only when the three-year moving average basis suggested that a positive return would be generated resulted in an average loss of -$0.01 per bushel annually with a standard deviation of $0.05 per bushel. In short, selective storing and hedging of grain resulted in both a major reduction in losses and volatility. It should be noted that more often than not with this sales strategy, corn was not stored. These findings and the ones that will follow suggest that commercial storage rates either limit or prevent positive returns to storage. Elevator managers in Ohio confirmed that storage space was scare and thus storage rates were relatively high to encourage farmers to use other marketing alternatives such as delayed pricing.

Soybean results

For Iowa, storing soybeans monthly from January to July resulted in an average loss of -$0.14 per bushel with a standard deviation of $0.62. Storing, selling soybeans monthly and speculating on price resulted in a very a large range of annual profits and losses. Storing soybeans into an unexpected short crop year resulted in an annual profit of $1.36 per bushel while storing soybeans following a short crop year resulted in annual loss equaling -$1.14 per bushel. Storing and selling an equal amount of soybeans monthly from January through May reduced the annual loss to -$0.12 per bushel and reduced the standard deviation to $0.50. By shortening the storage season, the farmer gave up both the opportunity to earn an unexpected high profit during the beginning of the short crop year and avoided some of the large losses.

Hedging, storing, and selling soybeans monthly from January to July following normal crop years resulted in an average loss of -$0.10 per bushel with a standard deviation of $0.11. The average loss was reduced by only three cents per bushel compared to open storage; however, the standard deviation was reduced by $0.51 per bushel. Storing, hedging, and selling an equal amount of soybeans from January to March or April resulted in a loss of- $0.07 per bushel with a standard deviation of $0.08 per bushel. Losses were reduced by five cents per bushel with a reduction in the standard deviation of $0.42 per bushel.

Finally, the third post harvest strategy in which soybeans were stored only when the three-year moving average basis suggested that a positive return would be generated resulted in an average loss of -$0.05 per bushel annually with a standard deviation of $0.01 per bushel. In short, selective storing of grain resulted in both a major reduction in losses and volatility. It should be noted that more often than not with this sales strategy, soybeans were not stored. Similar results were found for Ohio but are not reported here.

Conclusions

Prior research by the present authors and others identified opportunities for price enhancement through pre-harvest pricing of corn and soybeans with futures and options. In the last several years, with increasing farm size and other changes in grain production, the grain industry has developed a number of new pre-harvest grain contracts that are designed to let farmers participate in perceived seasonal patterns in new-crop corn and soybean futures prices. At the same time, agricultural economists at the AgMAS project at the University of Illinois have developed a set of benchmark prices for evaluating the performance of agricultural market advisory services. These benchmarks allow evaluation of pre-harvest pricing strategies from a broader perspective, in addition to the traditional benchmark of harvest prices. The work reported here was undertaken to analyses pre-harvest pricing strategy performance, and to determine whether incentives exist for use of the newer seasonal grain contracts for pre-harvest pricing.

The conclusion is that over the 1985-2001 period, economically and statistically significant incentives for use of pre-harvest pricing in corn and soybeans have existed, although these strategies did not produce greater income than the benchmark alternatives every year. Less detailed work indicates similar price behavior occurred for the 1975-2003 period. These findings help to explain the rapid expansion in offerings of alternative pre-harvest grain pricing contracts in the last several years. The behavior of the soybean market in the last two crop years suggests that when benchmark data are available for 2002 and 2003, the average gains from pre-harvest soybean pricing strategies may be less than those shown here. The impacts on corn results from addition of the 2002 and 2003 benchmark data are expected to be smaller.

One cannot conclude that the pre-harvest strategies shown here consistently reduce price variability from those of the benchmark alternatives. This conclusion will be revisited in a later report. The pre-harvest pricing models used here determine gross returns per acre from alternative strategies by incorporating yield variability from actual farms in northwest Iowa and northwest Ohio over the study period. The average prices from pre-harvest strategies in the model are then calculated by dividing gross income by bushels produced. Thus, price variability from various pre-harvest pricing alternatives reflects both price and yield variability, whereas the benchmark prices reflect only price variability.

In analyzing the net returns to off-farm storage, it is concluded that on average both hedged and unhedged storage lowered the value of farmer's crops from prices available at harvest. This conclusion held for both corn and soybeans. These results help to explain the increasing role of pre-harvest pricing alternatives in farmer marketing plans and their priority in recommendations of advisory services. Storage hedging strategies reduced losses and price volatility from that of open grain storage, but still generated negative returns. Negative storage returns together with price patterns, help to explain why the 20 and 24-month benchmark prices are above the farmer benchmarks. The farmer benchmarks reflect the marketing year average price received by farmers in their respective states, less costs of storing off the farm, plus LDPs that were paid in 1998-2001.

Implications, Limitations, and Areas for Further Research

Perhaps the most troubling aspect of this work is its apparent inconsistency with the Efficient Market Hypothesis. A number of other studies, as shown in the literature review, have noted similar patterns that point to seasonality in pre-harvest futures prices for corn and soybeans. The findings suggest a need for further work to understand and explain the market behavior of these commodities. While this study analyzes price behavior over a wide range of U.S. and world supply, demand, and policy conditions, it also will be important to continue updating these strategies periodically in the years ahead, to see whether the patterns identified here continue.

Other areas for future work, some of which the authors plan to pursue, include (1) incorporating production costs into the case farm analyses to examine impacts of the strategies and benchmark prices on the level and variability of net farm income, (2) expanding the strategies to include longer seasonal pricing periods that more closely match those in pre-harvest contracts such as Cargill's +A contracts, (3) analyzing post-harvest strategies using on-farm storage costs, (4) examining the impacts of adding revenue insurance to manage production risk simultaneously with price risk, and (5) testing to see whether the expanded role of South America in world soybean production has altered the performance of the soybean strategies. Rapidly expanded use of harvest-price revenue insurance also creates an opportunity for examination of its impact on optimal hedge ratios in pre-harvest pricing.

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Table 1. Average Futures Prices and Standard Deviations for Selected Periods			
	Average Thursday December Futures Prices, All Years - 1975 – 2003	**Average Thursday December Futures Prices , All Years – 1985- 2003**	**Standard Deviation, All Years 1975 – 2003**
Mid-May	\$2.63	\$2.50	\$0.38
Early November	\$2.47	\$2.32	\$0.48

Table 2. O'Brien County Iowa Adjusted Benchmark and Harvest Corn Prices, Selected Pre-Harvest Marketing Strategy Corn Prices And Related "t" Tests, 1985 – 2001							
	Iowa Adjusted Benchmark And Harvest Prices				Selected Pre-Harvest Marketing Strategy Prices		
Year	20-Month (1)	24 – Month (2)	Farmer – Adjusted (3)	Harvest (Nov) (4)	Hedge (5)	Normal/ Short Crop Hedge (6)	Synthetic Put & post hedge (7)
1985	2.06	2.13	1.78	2.06	2.36	2.36	2.33
1986	1.18	1.27	0.92	1.30	1.63	1.63	1.58
1987	1.56	1.55	1.51	1.41	1.68	1.68	1.60
1988	2.17	2.00	2.05	2.40	2.02	2.02	2.77
1989	2.16	2.19	1.99	1.85	2.28	2.39	2.39
1990	2.08	2.08	1.88	2.02	2.41	2.41	2.39
1991	2.07	2.08	1.88	2.21	2.23	2.23	2.18
1992	1.93	1.98	1.66	1.84	2.19	2.32	2.32
1993	2.14	2.14	2.10	2.23	2.05	2.05	2.07
1994	2.00	2.03	1.83	1.85	2.17	2.26	2.26
1995	2.84	2.67	2.73	2.94	2.39	2.39	2.42
1996	2.58	2.57	2.24	2.42	3.39	2.86	2.86
1997	2.12	2.18	1.89	2.45	2.32	2.32	2.32
1998	1.92	2.04	1.60	1.78	2.25	2.25	2.18
1999	1.79	1.87	1.56	1.50	2.11	2.11	2.05
2000	1.96	2.04	1.74	1.74	2.41	2.41	2.26
2001	1.87	1.92	1.73	1.65	1.97	1.97	1.94
Averages	**2.03**	**2.04**	**1.83**	**1.98**	**2.23**	**2.22**	**2.23**
Std. Dev.	0.36	0.32	0.37	0.43	0.38	0.29	0.33
Std. Dev., % of Mean	17.7	15.7	20.2	21.7	17.0	13.0	14.8
"t" test Hedge	0.0087	0.0047	0.0002	0.0176			
"t" test Normal Short Crop Hedge	0.0043	0.0007	6.73595E-05	0.0144			
"t" Test Synthetic Put	0.0015	0.0020	1.69918E-05	0.0029			

(1) 20-Month Adjusted Benchmark Prices
(2) 24-Month Adjusted Benchmark Prices
(3) Farmer Adjusted Benchmark Prices
(4) Harvest (Nov 1st) Prices Plus LDP Payments
(5) Hedge May Week 3 to November Week 1
(6) Hedge Following Normal Year: May Week 3 to November Week 1 and Hedge Following Short Crop Year: February Week 4 to November Week 1
(7) After Normal Year: Hedge May Week 3 to November Week 1 and hold Call May Week 3 to July Week 1and following Short Crop Year: Hedge February Week 4 to November Week 1

Table 3. Northwestern Ohio Adjusted Benchmark and Harvest Corn Prices, Selected Pre-Harvest Marketing Strategy Corn Prices And Related "t" Tests, 1985 – 2001							
	Ohio Adjusted Benchmark And Harvest Prices				**Selected Pre-Harvest Marketing Strategy Prices**		
Year	**20-Month (1)**	**24 – Month (2)**	**Farmer – Adjusted (3)**	**Harvest (Nov) (4)**	**Hedge (5)**	**Normal/ Short Crop Hedge (6)**	**80% Put 20% hedge(7)**
1985	1.97	2.04	1.97	1.98	2.31	2.3107	2.2894
1986	1.29	1.38	1.01	1.40	1.53	1.5325	1.4704
1987	1.71	1.70	1.57	1.56	1.87	1.8675	1.5776
1988	2.35	2.17	2.21	2.57	2.29	2.2913	2.6217
1989	2.31	2.33	2.19	2.00	2.39	2.4863	2.4863
1990	2.12	2.11	1.99	2.06	2.37	2.365	2.2041
1991	2.23	2.24	2.06	2.38	2.32	2.3192	2.2213
1992	1.98	2.02	1.72	1.88	2.21	2.3206	2.3206
1993	2.21	2.21	2.23	2.30	1.95	1.949	2.223
1994	2.08	2.10	1.84	1.92	2.27	2.3857	2.3857
1995	3.01	2.83	2.85	3.11	2.34	2.3375	2.9567
1996	2.72	2.71	2.39	2.57	3.83	3.1659	3.1659
1997	2.23	2.28	2.04	2.56	2.45	2.445	2.4473
1998	1.97	2.09	1.77	1.95	2.24	2.24	2.05
1999	1.94	2.02	1.69	1.90	2.23	2.23	2.09
2000	2.01	2.09	1.91	2.07	2.49	2.49	2.22
2001	2.04	2.09	1.85	1.99	2.14	2.14	1.97
Averages	2.13	2.14	1.96	2.13	2.31	2.29	2.28
Std. Dev.	0.37	0.33	0.39	0.41	0.46	0.33	0.42
Std. Dev., % of Mean	17.4	15.4	19.9	19.3	19.9	14.4	18.4
"t" test Hedge	0.0529	0.0519	0.0025	0.1062			
"t" test Normal Short Crop Hedge	0.0313	0.0194	0.0006	0.0906			
"t" Test Synthetic Put	0.0016	0.0058	1.21 E -05	0.0200			

(1) 20-Month Adjusted Benchmark Prices
(2) 24-Month Adjusted Benchmark Prices
(3) Farmer Adjusted Benchmark Prices
(4) Harvest (Nov 1st) Prices Plus LDP Payments
(5) Hedge May Week 3 to November Week 1
(6) Hedge Following Normal Year May Week 3 to November Week 1 and Hedge Following Short Crop Year February Week 4 to November Week 1
(7) Following Normal Year: 80% of Expected Production is hedged using at the money put options. May week1 to November week 1 and with remaining 20% hedged from July week 1 to November week 1 and Following Short Crop year: Hedge From February Week 1 to November week 1.

Table 4. O'Brien County Iowa Adjusted Benchmark and Harvest Soybean Prices, Selected Pre-Harvest Marketing Strategy Soybean Prices And Related "t" Tests, 1985 – 2001							
	Iowa Adjusted Benchmark And Harvest Prices				**Selected Pre-Harvest Marketing Strategy Prices**		
Year	**20-Month (1)**	**24 – Month (2)**	**Farmer – Adjusted (3)**	**Harvest (Oct) (4)**	**Hedge (5)**	**Normal/ Short Crop Hedge (6)**	**Synthetic Put (7)**
1985	4.93	5.07	4.67	4.79	5.54	5.54	5.4342
1986	4.55	4.60	4.48	4.46	4.69	4.69	4.5992
1987	5.41	5.21	5.68	4.99	5.14	5.14	5.0271
1988	6.94	6.51	6.88	7.69	7.37	7.37	8.2296
1989	5.58	5.73	5.39	5.32	6.26	6.58	6.3176
1990	5.40	5.41	5.28	5.82	6.07	6.07	6.0894
1991	5.27	5.35	5.19	5.35	5.55	5.55	5.4435
1992	5.44	5.45	5.26	4.99	5.66	5.66	5.5874
1993	5.98	5.92	6.06	5.86	5.72	5.72	6.0324
1994	5.34	5.42	5.12	4.89	5.79	5.81	5.6138
1995	6.14	6.02	6.35	6.02	5.62	5.62	5.6186
1996	7.01	6.88	7.01	6.50	7.44	6.90	7.1915
1997	5.96	6.03	5.96	6.63	6.58	6.58	6.376
1998	5.46	5.67	4.96	5.19	5.75	5.75	5.69
1999	5.04	5.24	5.18	5.26	5.16	5.16	5.08
2000	5.33	5.37	5.17	5.33	6.01	6.01	5.75
2001	5.16	5.25	5.35	5.22	5.16	5.16	5.24
Averages	5.58	5.60	5.53	5.55	5.85	5.84	5.84
Std. Dev.	0.65	0.55	0.69	0.80	0.74	0.69	0.86
Std. Dev., % of Mean	11.7	9.8	12.5	14.4	12.7	11.8	14.7
"t" test Hedge	0.0078	0.0085	0.0194	0.0125			
"t" test Normal Short Crop Hedge	0.0186	0.0161	0.0195	0.0175			
"t" Test Synthetic Put	0.0218	0.0458	0.0314	0.0062			

(1) 20-Month Adjusted Benchmark Prices
(2) 24-Month Adjusted Benchmark Prices
(3) Farmer Adjusted Benchmark Prices
(4) Harvest (Nov 1st) Prices Plus LDP Payments
(5) Hedge May Week 3 to October Week 3
(6) Hedge Following Normal Year May Week 3 to October Week 3 and Hedge Following Short Crop Year February Week 4 to October Week 3
(7) Hedge May Week 3 to October Week 3 and hold Call May Week 3 to July Week 1

Table 5. Northwest Ohio Adjusted Benchmark and Harvest Soybean Prices, Selected Pre-Harvest Marketing Strategy Soybean Prices And Related "t" Tests, 1985 – 2001							
	Ohio Adjusted Benchmark And Harvest Prices				**Selected Pre-Harvest Marketing Strategy Prices**		
Year	**20-Month (1)**	**24 – Month (2)**	**Farmer – Adjusted (3)**	**Harvest (Oct) (4)**	**Hedge (5)**	**Normal/ Short Crop Hedge (6)**	**Synthetic Put (7)**
1985	4.82	4.95	4.78	4.68	5.29	5.29	5.21
1986	4.75	4.80	4.61	4.66	4.91	4.91	4.82
1987	5.53	5.34	5.65	5.11	5.43	5.43	5.31
1988	7.07	6.65	7.09	7.82	7.61	7.61	9.06
1989	5.73	5.89	5.50	5.48	6.40	6.73	6.46
1990	5.38	5.40	5.46	5.81	6.18	6.18	6.19
1991	5.34	5.42	5.37	5.42	5.76	5.76	5.63
1992	5.47	5.48	5.37	5.02	5.69	5.69	5.62
1993	5.91	5.85	6.14	5.79	5.70	5.70	6.02
1994	5.41	5.50	5.20	4.96	5.96	5.98	5.79
1995	6.31	6.19	6.40	6.19	5.94	5.94	5.93
1996	7.19	7.06	7.07	6.69	7.67	7.12	7.41
1997	6.12	6.18	6.12	6.79	6.82	6.82	6.59
1998	5.47	5.68	5.16	5.20	5.86	5.86	5.80
1999	5.16	5.36	5.37	5.39	5.40	5.40	5.32
2000	5.29	5.33	5.31	5.27	6.06	6.06	5.81
2001	5.29	5.38	5.46	5.30	5.40	5.40	5.46
Averages	5.66	5.67	5.65	5.62	6.01	5.99	6.03
Std. Dev.	0.68	0.58	0.70	0.83	0.76	0.71	0.99
Std. Dev., % of Mean	12.0	10.2	12.4	14.8	12.7	11.9	16.4
"t" test Hedge	0.0007	0.0010	0.0039	0.0015			
"t" test Normal Short Crop Hedge	0.0026	0.0023	0.0084	0.0023			
"t" Test Synthetic Put	0.0094	0.0244	0.0133	0.0008			

(1) 20-Month Adjusted Benchmark Prices
(2) 24-Month Adjusted Benchmark Prices
(3) Farmer Adjusted Benchmark Prices
(4) Harvest (Nov 1st) Prices Plus LDP Payments
(5) Hedge May Week 3 to October Week 3
(6) Hedge Following Normal Year May Week 3 to October Week 3 and Hedge Following Short Crop Year February Week 4 to October Week 3
(7) Hedge May Week 3 to October Week 3 and hold Call May Week 3 to July Week 1

Figure 1. Weekly Average December Corn Futures, All Years, 1975 Through 2003 & 1985-2003--All Years

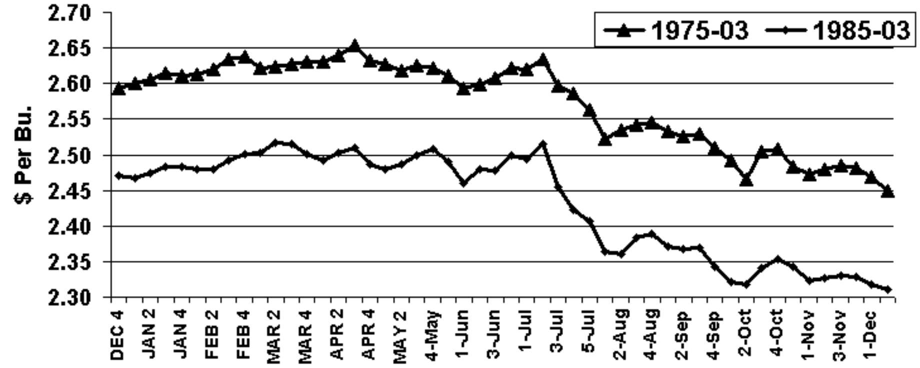

Figure 2. Weekly Average December Corn Futures, After Short Crops, 1975 Through 2003 & 1985-2003

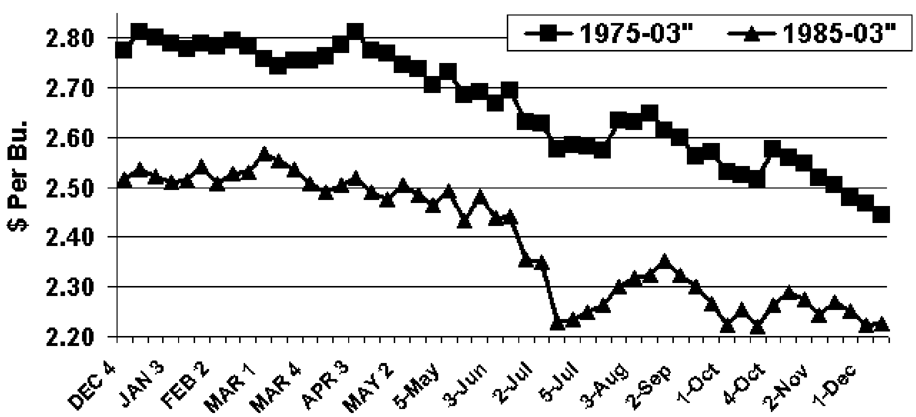

Figure 3. Change in December Corn Futures, Late Feb./May to Early Nov.

Prices declined, Feb./May to Nov., 79% of 29 years