Optimal Grain Marketing Strategies for a Southeast Indiana Case Farm




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Abstract

This paper examined optimal grain marketing strategies for a southeast Indiana case farm. Specifically, a downside risk model was used to examine the tradeoffs between net return and downside risk, and to determine whether the optimal marketing strategy changed as downside risk was reduced. The hedge and roll marketing strategy had the highest net return for both corn and soybeans. Even when downside risk was reduced, the hedge and roll strategy was an important component of optimal marketing strategies. Results stress the importance of using a portfolio of marketing strategies for corn and soybeans.

INTRODUCTION

While many studies have evaluated corn and soybean marketing strategies, few have evaluated marketing strategies in a portfolio context. Moreover, many studies utilize data prior to the start of the ethanol boom in 2007. To help fill the gap in research, this study examined the risk/return tradeoff between marketing strategies in a portfolio context for a farm in southeast Indiana using data from 1992 to 2021.

To provide motivation for our study, we summarize a few previous studies that have addressed a similar topic. Ke and Wang (2002) found a combination of revenue-based crop insurance with futures and government payments to be an optimal risk management portfolio for wheat farmers in the Pacific Northwest. The authors also found substitution effects between revenue-based crop insurance and the use of futures markets. Specifically, the optimal hedging ratio was reduced with the addition of revenue-based crop insurance.

Pritchett et al. (2004) simulated returns for corn and soybean farmers to assess the effectiveness of marketing and crop insurance risk management tools, where value-at-risk (VaR) was used to measure downside risk. Results indicated that of the 73 different risk management strategies examined, 9 out of the 10 top strategies included some form of price insurance in addition to yield insurance.

Using a portfolio approach, Schaffer (2010) examined various combinations of crop insurance and marketing strategies for four regions in Illinois. Results indicated that pre-harvest pricing and revenue-based crop insurance, when used together, significantly reduced risk and, in some cases, increased returns.

Edwards et al. (2020) addressed whether corn and soybeans should be hedged or unhedged, and

for how long corn and soybeans should be stored. Results suggested that storing corn and soybeans in Indiana could be a profitable strategy. Though the study did not use a risk/return model to capture inter-relationships between marketing strategies, the authors suggested that a combination of marketing strategies should be used since it is not possible to predict which strategy will be optimal in a specific year. Marketing strategies examined included unhedged storage, simple storage hedges, and rolling hedges. This article extends the results in Edwards et al. (2020) by computing the optimal mix of cash price and hedging strategies using a portfolio risk/return model. Also, our study, captures the interaction between crop insurance programs and marketing strategies.

Walters and Preston (2023) indicated that hedging should be viewed as a portfolio of prices. Although pre-harvest hedging can give poor returns if prices go up in the fall, when viewing a hedge as a portfolio, farm price increases as unsold bushels are worth more. Walters and Preston's study evaluated two strategies. The first strategy was to sell 100% of expected production at harvest, and the second examined the results of a portfolio that utilized the Terry Timer Approach, which stores grain until March 1 and then completes 10 equal bushel sales every 10 days after March 1, for 40% of expected production and selling the remainder of the crop at harvest. Results indicated that the 40/60 portfolio approach reduced the probability of receiving low prices in the fall and provided an example of how hedging reduces risk.

MARKETING STRATEGIES AND DOWNSIDE RISK

Marketing strategies were combined with an 80% revenue protection (RP) product, which is commonly used in southeast Indiana, to examine risk/return tradeoffs for corn and soybeans. Specifically, the 80% RP product was combined with three cash price strategies, a basic storage hedge strategy, and a hedge and roll strategy. Cash strategies included a marketing year average cash price strategy (October through August), a harvest cash price strategy (October through December), and a 6-month cash price strategy (October through March). The harvest cash price and 6-month cash price strategies used equal marketing weights for the individual months. The marketing year cash price strategy utilized historical monthly marketing weights reported by USDA-NASS. The basic storage hedge strategy allows a producer to sell July futures in October, then offset the July futures in May when the cash crop is sold.

The hedge and roll strategy is similar to the basic storage hedge strategy, the difference being that the producer initiates the hedge earlier in the year. With this strategy, a producer sells November futures for soybeans and December futures for corn in June. In October, the producer would then offset the futures position and simultaneously sell July futures. In May, the producer would offset the July futures position and simultaneously sell cash corn and soybeans.

The marketing strategies are designated by abbreviations in the results discussed below: "mktg year" represents the marketing year cash price strategy, "harvest" represents the harvest cash price strategy, "6-month" represents the 6-month cash price strategy, "basic hedge" represents the basic storage hedge strategy, and "hedge and roll" represents the hedge and roll strategy.

Numerous models can be used to examine the tradeoffs between risk and return (Barry, 1984; Hardaker et al., 2004). Given our interest in the potential safety net provided by crop insurance products and marketing strategies, expected net return and risk for combinations of marketing strategies were examined with a downside risk model. The Target MOTAD model maximizes expected income subject to a constraint or limit on the total negative deviation measured from a fixed target or target income (Tauer, 1983; Watts et al., 1984). This model focuses on the downside risk that occurs when net return falls below a target level. As with other portfolio models, tradeoffs between risk, as measured by the total negative deviations below a target income, and expected income or net returns are examined. The solution of the model that identifies the maximum expected income also has the highest level of total negative deviations below the target income. In other words, this is the profit maximizing solution. To generate the frontier, the constraint that computes the total negative deviations below the target income is relaxed. As we move along the frontier or risk/return tradeoff curve, solutions with lower deviation levels (i.e., lower downside risk) also have lower net returns. In general, solutions (i.e., suboptimal combinations of marketing strategies) that are below the frontier either have a lower net return and the same level of risk or the same net return and a higher level of risk. A target income or net return of $95 per acre was used for the analysis in this paper. This target income represents the average net return for all of the corn and soybean strategies during the 30-year study period.

FARM SETTING

Per acre costs for crop storage and interest varied among the marketing strategies so net returns, rather than gross returns, were computed and compared for each marketing strategy for a 30-year period (1992 to 2021). Gross returns were computed using crop yields obtained from an experimental field at the Southeast Purdue Agricultural center located in Jennings County, Indiana, cash crop prices (USDA-NASS), futures prices, crop insurance indemnity payments, and government payments. The experimental field was located on Clermont silt loam soil, with tile drainage. Prior to the installation of the tile drainage system in 1983, the soil was poorly drained (Kladivko, 2020). Crop insurance indemnity payments were computed using historical crop yields and historical projected and harvest crop insurance prices. Government payments were the same across marketing strategies and were obtained from several sources including Carson (2017), Purdue crop budgets, and estimated ARC-CO/PLC payments for Jennings County in Indiana from 2014 to 2021.

Historical costs were generated using actual costs, base year costs, and input price indices. Base year costs and input price indices were used for all costs except for crop storage costs, interest costs, cash rent, and crop insurance costs, which were computed using actual cost estimates. Crop budget information for 2021 for rotation corn and soybeans grown on high productivity soil was obtained from Dobbins et al. (2021). Thus, the base year for the crop budget was 2021. Keeping in mind the exceptions noted above, historical costs were computed using base year costs and USDA-NASS input price indices from 1992 to 2021. Turning to the actual cost estimates, crop storage costs were computed using a fixed rate per bushel ($0.01 per bushel per month), crop yields, and agricultural interest rates from the Federal Reserve Bank of Chicago. Interest costs for each crop were computed using agricultural interest rates, crop budget information, and bushels in storage. Crop insurance costs for the base year were estimated for Jennings County, Indiana, using the University of Illinois *farmdoc* crop insurance tools. Historical crop insurance costs were estimated using cost indices created with historical costs per acre in the FINBIN database (Center for Farm Financial Management). Cash rents were obtained from the annual Purdue cash rent and land value survey (Kuethe, 2023) and represent high-quality land in southeast Indiana.

RESULTS

The tradeoff between net return and downside risk is examined below for corn, soybeans, and both corn and soybeans together. This allows us to contrast the differences in corn and soybean marketing strategies when analyzed separately and together. More emphasis will be given to the results for corn and soybeans evaluated together. The negative deviations in the result tables represent total negative deviations below the $95 target income over the 30-year period. Annual deviations can be computed by dividing total negative deviations by 30.

Corn Marketing Strategies

Table 1 presents the expected net return for corn and negative deviations below the target income for individual marketing strategies (scenarios a, b, c, d, and e) as well as the expected net return and downside risk for the risk/return frontier (scenarios 1-7). The net return and downside risk for the individual marketing strategies will be discussed first. Of the individual strategies, the hedge and roll marketing strategy had the highest net return per acre ($113.60) and the lowest level of downside risk (1413). The net return for the basic storage hedge was $66.69. Net returns for the marketing year cash price, harvest cash price, and 6-month cash price strategies were $91.46, $59.27, and $77.98 per acre, respectively. Downside risk for the basic storage hedge and three cash price marketing strategies was from 18% (marketing year cash price strategy and 6-month cash price strategy) to 135% (basic storage hedge) higher than downside risk for the hedge and roll marketing strategy.

Turning to the risk/return tradeoff results in the upper part of Table 1, downside risk declines from scenario 1, the profit maximizing solution, to scenario 7. Notice that the levels of downside risk for scenarios 2 through 7 are lower than the downside risk levels for the individual marketing strategies. This result emphasizes the importance of diversification. Simply put, diversifying marketing strategies enables the farm to reduce downside risk. To further emphasize the reduction in downside risk, compare scenario 1 to scenario 4 and 7. Scenario 4, which is a mixed strategy composed of 12.8% of the crop marketed with the marketing year cash price strategy and 87.2% of the crop marketed with the hedge and roll strategy, has a net return that is 2.5% lower than the net return for scenario 1 and a downside risk level that is 8.0% lower. Going from scenario 1 to scenario 7, net return is reduced by 6.4%, but downside risk is reduced by

18.6%. Scenario 7 employs a mixed strategy composed of 32.7% of the crop marketed with the marketing year cash price strategy and 67.3% of the crop marketed with the hedge and roll strategy. In summary, as you move down the risk/return frontier, downside risk declines at a faster rate than net returns.

Soybean Marketing Strategies

The expected net return for soybeans and negative deviations below target income for individual marketing strategies (scenarios a, b, c, d, and e) and the risk/return frontier (scenarios are illustrated in Table 2. Similar to the standalone corn results, the hedge and roll marketing strategy had the highest net return per acre ($108.97). However, for soybeans, downside risk for the hedge and roll marketing strategy was from 6 to 11% higher than downside risk for the three cash price marketing strategies. Also, the marketing year cash price strategy had a net return that is less than $1 per acre lower than the net return for the hedge and roll strategy.

Looking at the risk/return tradeoff results, there is very little reduction in expected net return as downside risk is reduced. For example, the expected net return for scenario 4 is only $0.10 per acre less than that for scenario 1. In contrast, downside risk is reduced by 5.5% as you move from scenario 1 to scenario 4. Similar to the corn results, the soybean results point to the power associated with diversifying marketing strategies. As we move from scenario 1 to scenario 6 in Table 2, the amount of crop marketed with the hedge and roll strategy is smaller, and the amount of crop marketed with the marketing year cash price strategy increases.

Corn and Soybean Marketing Strategies

The results in the two subsections above represented optimal marketing strategies for corn and soybeans analyzed separately. This section analyzes corn and soybean marketing strategies simultaneously. Before discussing the results, we will provide some insight into why combining the marketing year cash price strategy with the hedge and roll strategy makes sense from a risk/return standpoint. First, note that the correlation between the two corn strategies is only 0.09 and that the correlation between the two soybean strategies is 0.37. These correlations are quite a bit lower than the correlations between the hedge and roll strategy and the other marketing strategies. Given this fact, it would be interesting to contrast the annual net returns between these two strategies. Figure 1 illustrates the difference in net returns between the hedge and roll strategy and the marketing year cash price strategy when we average the corn and soybean net returns (i.e., utilize a corn/soybean rotation). The difference in Figure 1 was computed by subtracting the average net return for corn and soybeans using the marketing year cash price strategy from the average net return for the hedge and roll strategy. Thus, low deviations indicate a preference toward the marketing year cash price strategy, and high deviations reveal a preference for the hedge and roll strategy. Obviously, there are some large differences in net returns in certain years. For example, the hedge and roll strategy performed very well in 2008 but had relatively low net returns in 2010 and 2020.

Table 3 illustrates the net return and downside risk for each individual marketing strategy. The hedge and roll strategy had the highest average net return per acre ($111.29). The average net return per acre for the other marketing strategies ranged from $78 for the harvest cash price strategy to $100 for the marketing year cash price strategy. The hedge and roll strategy also had the lowest downside risk level of any of the individual marketing strategies. Downside risk for the other marketing strategies ranged from 22% (6-month cash price strategy) to 38% (harvest price cash strategy), higher than that for the hedge and roll strategy.

Consistent with the standalone corn and soybean results, combining marketing strategies reduced downside risk (Table 4). When corn and soybeans are analyzed together, the model allocated the entirety of the corn crop (or 50% of the total portfolio) to the corn hedge and roll strategy in all four scenarios. When examined from a whole-farm perspective, declines in downside risk were achieved through different combinations of soybean marketing strategies. For example, for scenario 1 the model chose to market both corn and soybeans using the hedge and roll strategy. Net return per acre and downside risk for this scenario was $111.29 and 979, respectively. For scenario 4, the model chose to market corn with the hedge and roll strategy, and to use a combination of the marketing year cash price and 6-month cash price strategies to market soybeans. Consistent with the standalone corn and soybean results, as we reduced downside risk, the reduction in net return was much smaller than the reduction in downside risk.

SUMMARY AND CONCLUSIONS

The purpose of this study was to identify which marketing strategies contributed to an optimal portfolio of strategies for a case farm in Jennings

County, Indiana, with Clermont silt loan soil. Risk/return tradeoffs were evaluated using a downside risk model. Marketing strategies examined included three cash price strategies (marketing year price, 6-month price, and harvest price), a basic storage hedge strategy, and a hedge and roll strategy. The hedge and roll strategy had the highest net return per acre over the study period when evaluating corn and soybeans separately, and when evaluating corn and soybean strategies together. To reduce downside risk, it was necessary to combine the hedge and roll strategy with a cash price strategy. When corn and soybeans were evaluated separately, the hedge and roll strategy was combined with a marketing year cash price strategy. When corn and soybeans were evaluated together, the corn hedge and roll strategy was combined with various combinations of the soybean hedge and roll, marketing year cash price, and six-month cash price strategies. The low correlation between the hedge and roll strategies and the other marketing strategies encouraged the use of mixed strategies. In general, the results strongly suggest that a portfolio approach is a beneficial strategy to mitigate downside risk. Specifically, combining various marketing strategies reduced risk, with, in many instances, only slightly lower net returns compared to the profit maximizing solution.

The results also suggest that there are advantages of storing corn and soybeans well into the next calendar year. This strategy does not always work, but in general it results in higher net returns compared to selling at harvest or marketing the crop during the first 6 months of the marketing year.

It is important to note that there are numerous assumptions that need to be considered when examining the results of this study. These assumptions relate to the years used in the analysis; the case farm's crop yields, which were higher than the county average; the cost structure of the case farm; the marketing strategies used in this study; and the location of the case farm, which would impact the relationships between crop prices and futures prices. It is important to note, however, that Edwards et al. (2020) studied a similar set of marketing strategies and did not assume a specific location in Indiana. Our results are consistent with their study. In summary, though changing the assumptions used in this study may create slightly different combinations of marketing strategies; the importance of combining marketing strategies, or the benefits of diversification, would likely hold for case farms located in other U.S. Corn Belt states and crop reporting districts.

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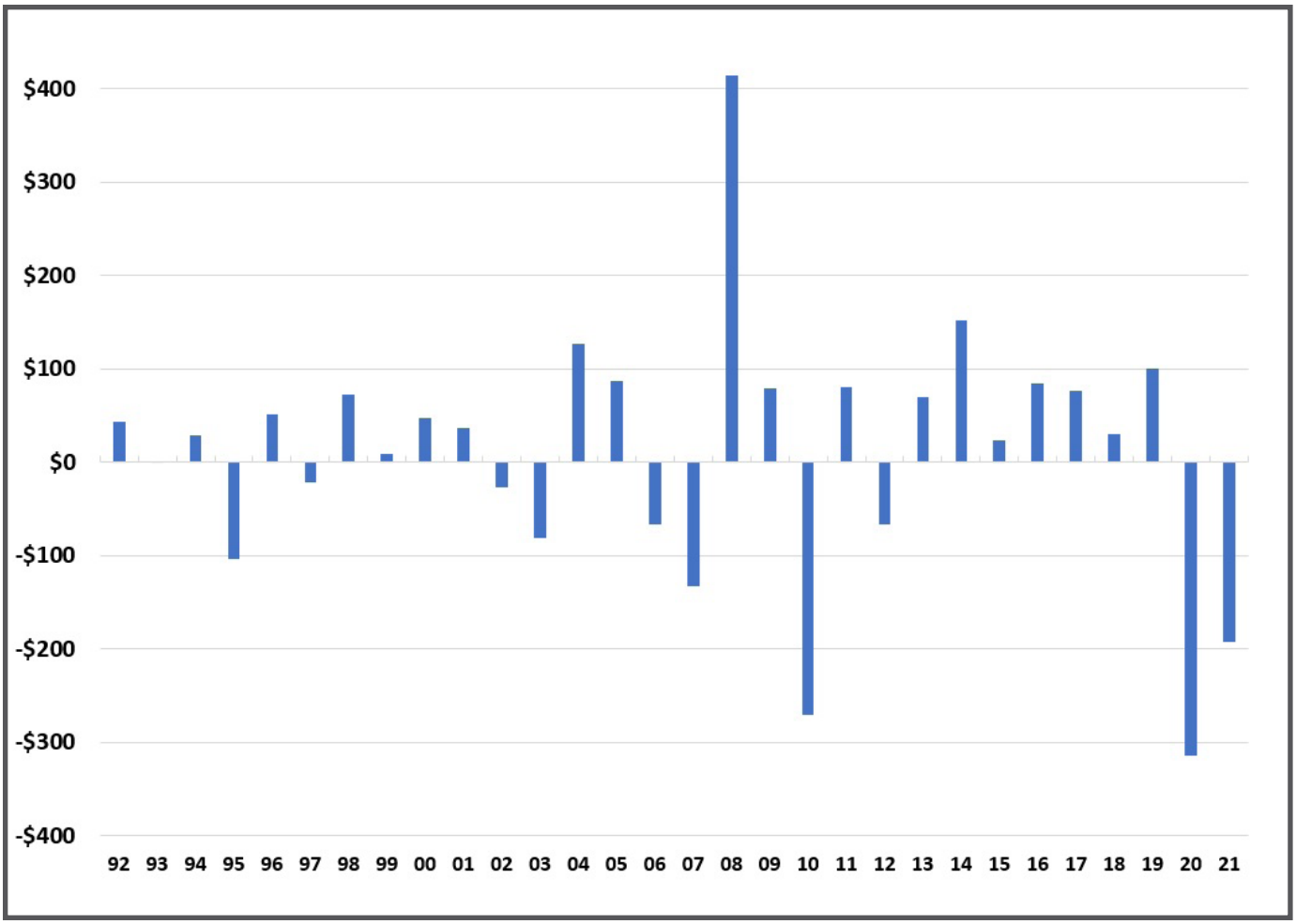

Figure 1. Difference in net return per acre between hedge and roll and marketing year cash price strategies

Table 1. Expected Net Return and Downside Risk for Corn on a Southeast Indiana Case Farm									
Scenario	**Expected Net Return ($/acre)**	**Δ in Net Return (%)**	**Negative Deviations ($/acre)**	**Δ in Neg Dev (%)**	**Mktg Year (%)**	**Harvest (%)**	**6-Month (%)**	**Basic Hedge (%)**	**Hedge and Roll (%)**
1	113.60	N/A	1413	N/A	0.000	-	-	-	1.000
2	113.33	-0.002	1400	-0.009	0.012	-	-	-	0.988
3	112.11	-0.013	1350	-0.045	0.067	-	-	-	0.933
4	110.77	-0.025	1300	-0.080	0.128	-	-	-	0.872
5	109.36	-0.037	1250	-0.115	0.192	-	-	-	0.808
6	107.91	-0.050	1200	-0.151	0.257	-	-	-	0.743
7	106.35	-0.064	1150	-0.186	0.327	-	-	-	0.673
a	91.46	N/A	1674	N/A	1.000	0.000	0.000	0.000	0.000
b	59.27	N/A	1904	N/A	0.000	1.000	0.000	0.000	0.000
c	77.98	N/A	1673	N/A	0.000	0.000	1.000	0.000	0.000
d	66.69	N/A	3327	N/A	0.000	0.000	0.000	1.000	0.000
e	113.60	N/A	1413	N/A	0.000	0.000	0.000	0.000	1.000

Definitions:

a: 100% allocated to marketing year cash price strategy

b: 100% allocated to harvest cash price strategy

c: 100% allocated to 6-month cash price strategy

d: 100% allocated to basic hedge strategy

e: 100% allocated to hedge and roll strategy

Table 2. Expected Net Return and Downside Risk for Soybeans on a Southeast Indiana Case Farm									
Scenario	Expected Net Return ($/acre)	Δ in Net Return (%)	Negative Deviations ($/acre)	Δ in Neg Dev (%)	Mktg Year (%)	Harvest (%)	6-Month (%)	Basic Hedge (%)	Hedge and Roll (%)
1	108.97	N/A	1005	N/A	0.000	-	-	-	1.000
2	108.96	0.000	1000	-0.005	0.015	-	-	-	0.985
3	108.91	-0.001	975	-0.030	0.078	-	-	-	0.922
4	108.87	-0.001	950	-0.055	0.142	-	-	-	0.858
5	108.78	-0.002	925	-0.080	0.262	-	-	-	0.738
6	108.64	-0.003	900	-0.104	0.462	-	-	-	0.538
a	108.25	N/A	948	N/A	1.000	0.000	0.000	0.000	0.000
b	96.75	N/A	939	N/A	0.000	1.000	0.000	0.000	0.000
c	105.80	N/A	908	N/A	0.000	0.000	1.000	0.000	0.000
d	91.28	N/A	1115	N/A	0.000	0.000	0.000	1.000	0.000
e	108.97	N/A	1006	N/A	0.000	0.000	0.000	0.000	1.000

Definitions:

a: 100% allocated to marketing year cash price strategy

b: 100% allocated to harvest cash price strategy

c: 100% allocated to 6-month cash price strategy

d: 100% allocated to basic hedge strategy

e: 100% allocated to hedge and roll strategy

Table 3. Expected Net Return and Downside Risk for Individual Marketing Strategies, Southeast Indiana, Case Farm					
	Scenario				
	a	b	c	d	e
Expected Net Return ($/acre)	99.86	77.85	91.96	78.99	111.29
Negative Deviations ($/acre)	1300	1350	1194	1240	979
Corn: Mktg Year (%)	0.500	0.000	0.000	0.000	0.000
Corn: Harvest (%)	0.000	0.500	0.000	0.000	0.000
Corn: 6-Month (%)	0.000	0.000	0.500	0.000	0.000
Corn: Basic Hedge (%)	0.000	0.000	0.000	0.500	0.000
Corn: Hedge and Roll (%)	0.000	0.000	0.000	0.000	0.500
Soybeans: Mktg Year (%)	0.500	0.000	0.000	0.000	0.000
Soybeans: Harvest (%)	0.000	0.500	0.000	0.000	0.000
Soybeans: 6-Month (%)	0.000	0.000	0.500	0.000	0.000
Soybeans: Basic Hedge (%)	0.000	0.000	0.000	0.500	0.000
Soybeans: Hedge and Roll (%)	0.000	0.000	0.000	0.000	0.500
Definitions: a: Marketing year cash price strategy b: Harvest cash price strategy c: 6-month cash price strategy d: Basic hedge strategy e: Hedge and roll strategy					

Table 4. Expected Net Return and Downside Risk for Corn and Soybeans on a Southeast Indiana, Case Farm				
	Scenario			
	#1	#2	#3	#4
Expected Net Return ($/acre)	111.29	111.18	111.00	110.24
Change in Net Return (%)	N/A	-0.001	-0.003	-0.009
Negative Deviations ($/acre)	979	950	925	900
Change in Negative Deviations (%)	N/A	-0.030	-0.055	-0.081
Corn: Mktg Year (%)	0.000	0.000	0.000	0.000
Corn: Harvest (%)	0.000	0.000	0.000	0.000
Corn: 6-Month (%)	0.000	0.000	0.000	0.000
Corn: Basic Hedge (%)	0.000	0.000	0.000	0.000
Corn: Hedge and Roll (%)	0.500	0.500	0.500	0.500
Soybeans: Mktg Year (%)	0.000	0.147	0.395	0.222
Soybeans: Harvest (%)	0.000	0.000	0.000	0.000
Soybeans: 6-Month (%)	0.000	0.000	0.000	0.278
Soybeans: Basic Hedge (%)	0.000	0.000	0.000	0.000
Soybeans: Hedge and Roll (%)	0.500	0.353	0.105	0.000