Effects of Reduced Government Deficiency Payments on Post-Harvest Marketing Strategies

by

Steven Betts, Brian D. Adam, and B. Wade Brorsen

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Effects of reducing government deficiency payments on a wheat producer's post-harvest marketing strategies are evaluated. The deficiency payment is predicted using an average option pricing model to properly value both intrinsic and time values of the deficiency payment. The biggest loss to producers from reducing deficiency payments is in reduced revenue. Although the deficiency payment helps reduce revenue risk, marketing strategies are available that can reduce risk nearly as well as the deficiency payment program can. Some producers will compensate for reduced deficiency payments by increasing use of futures and options contracts. For others, however, the optimal strategy is to sell wheat at harvest, because of high opportunity cost, storage cost, or risk aversion. For those producers, the uncertain deficiency payments increase variability of returns, or risk. Reducing payments reduces this risk, and leads to decreased use of futures and options contracts.

Introduction

Government deficiency payments need to be considered in determining the best marketing strategies. The deficiency payment program is like a subsidized put option (Gardner; Irwin et al.). This option is not free because of acreage reduction requirements and other compliance restrictions.

Since price supports and hedging strategies serve similar purposes, optimal marketing strategies are influenced by the terms of the government programs. For example, Turvey and Baker found that for corn and soybean producers, participating in government programs decreases use of futures and option contracts. Legislation recently signed by the President replaces price supports and deficiency payments with revenue assurance payments that are gradually reduced over the next seven years. This removes the link between farm prices and farm subsidies, although some have suggested that the legislation may be revisited if the transition is not smooth.

The objective of this paper is to determine the effect of this change on a wheat producer's optimal post-harvest marketing strategies. In addition, the effect of reducing, but not eliminating, deficiency payments is evaluated for comparison. Two questions are of interest. First, are marketing strategies available to help producers minimize the post-harvest impact of changes in the government deficiency payments? Second, how much will revenue and risk change if those strategies are used? The paper evaluates changes in both the income-enhancing and risk-reducing impacts of the deficiency payment program, focusing particular attention on how reducing deficiency payments affects producers' marketing risk.

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Policy makers can use the results to assess how much producers may be able to offset the post-harvest effects of reduced target prices by using market-based strategies. Some have suggested that producers might be able to replace the risk-reduction features of the deficiency payment program with appropriate futures and options positions. Commodity futures exchanges can use the results to determine how changes in farm programs might affect their trading volume.

The paper considers a wheat producer who can sell part or all of his grain at harvest, and store any remaining grain for later sale. In addition, the producer can sell and/or buy futures and options contracts. At harvest, the producer forms expectations of cash, futures, and option prices that will prevail on the date he plans to offset any hedging instruments and sell the cash commodity. He also forms an expectation of the deficiency payment.

Since the deficiency payment depends on whether the target price is above or below the five-month or yearly average of U.S. prices, its value is predicted using an average option pricing model (Kang and Brorsen; Tirupattur and Hauser). Kang and Brorsen noted that some extension applications (e.g., Anderson, Adam, and Sahs) have computed the expected deficiency payment as the difference between the target price and expected harvesttime price. However, that method considers only the intrinsic value of the "option" and ignores the time value arising from the possibility that over the course of the marketing year U.S. prices will decrease, increasing the deficiency payment and making the "option" more valuable.

Although Kang and Brorsen suggested that an average option pricing model should allow for nonnormality and stochastic volatility, they found only small differences between the payments predicted using a generalized autoregressive conditional heteroskedasticity (GARCH) average option pricing model and those predicted using a Black average option pricing model. However, both the Black average option pricing model and the GARCH average option pricing model performed considerably better than a standard Black model.

This study builds on previous studies (e.g., Turvey and Baker) of commodity marketing strategies by using an average option pricing model to predict the deficiency payment. Comparisons are made between strategies chosen when the producer participates in the government program and those chosen when the producer does not participate. The effects of decreasing or eliminating deficiency payments and of other variables on optimal strategies and on the producer's risk-adjusted revenue are evaluated.

Procedures

Post-harvest marketing alternatives considered include immediate cash sales, delayed sales using storage, and the sale or purchase of futures and options contracts. These alternatives can be combined to form many different marketing strategies. The government deficiency payment program also is an alternative.

Producer revenue is represented by a one-period model that begins at harvest (June 20) and ends on November 30. These dates are chosen because June 20 is the typical harvest completion date in central Oklahoma and November has the highest average cash price of the year (Anderson and Adam). Marketing decisions are made at harvest and maintained until November 30 when any stored grain is sold and futures and option contracts are liquidated. Compared to considering sales on any day during the period, this limits the possible combinations of strategies but also eliminates the need for the producer to continually monitor prices (Mathews and Holthausen).

Producer revenue is calculated as:
Producer Revenue = Revenue from cash sale + Deficiency payment + Findley payment + Net revenue from futures/options transactions - Storage costs - Commission costs.
The producer revenue equation is written as

$$R = r\,((P_{c1}\,Y_c\,A_h)\beta) + (1-\beta)((P_{c2} - SC\Delta T)\,Y_c\,A_h) + G((DP_t + FP_t)Y_p A_{dp} + I_{dp}) + \textstyle\sum_j [p_{j2} - r\,p_{j1}]NP_j + \sum_i [c_{i2} - r\,c_{i1}1]NC_i + [f_2 - f_1]NF - (r\,tc_o)\,abs(NP_j)abs(NC_i) - (r\,tc_f)abs(NF) \qquad (1)$$

where
R = revenue from marketing activities (in November 30 dollars)
P_{c1}, P_{c2} = cash price received at time 1 and 2, respectively
Y_c, Y_p = actual and program yield, respectively
β = % of wheat sold at time 1
A_h, A_{dp} = acres harvested and acres eligible for deficiency payments, respectively
G = 1 if participating in government program; 0 otherwise
DP_t, FP_t = deficiency payment and Findley payment, respectively
I_{dp} = interest earned on the March and December DP's (Apr, May, Jun)
p_{jt} = put option premium at the jth strike price at time t, t=1, 2
r = risk-free rate of return + unity (r adjusts period 1 premium and commission values to period 2 terms)
NP_j, NC_i, NF = number of puts, calls, and futures contracts (negative values indicate sales)
c_{it} = call option premium at the ith strike price at time t, t=1, 2
f_t = futures price at time t, t=1, 2
SC = storage costs per bushel ($0.02/bu/month, or $0.00067/bu/day)
tc_o, t_f = transaction cost for an option (put or call) or futures contract ($80/contract for options, $70/contract for futures
ΔT = number of days grain is stored (163)

The first term in expression (1) is the revenue, adjusted to time 2 dollars, from selling a proportion β of the harvested production in time 1. The second term is the revenue from selling any remaining wheat (1 - β) in time 2, subtracting cost of storing from time 1 to time 2. The third term calculates the value in time 2 dollars of the deficiency payment and Findley payment applying to the program yield on the eligible acres, with associated interest. The remaining terms represent returns from buying and/or selling puts, calls, and futures contracts.

The government deficiency payment (DP) is computed using current program guidelines. The total deficiency payment is composed of a payment at sign-up (March), a payment in December, and a payment in July after harvest of the following year. The final DP is based on the marketing year average (MYA) price, which is the average of the U.S. monthly average prices from June 1 of the current year through May 31 of the following year, weighted by amount sold. Since this price is not known when the March or December DPs are issued, USDA uses an estimate. A projected MYA price is used to calculate the March DP. The December DP is a weighted average of the U.S. monthly average prices for the first five months of the marketing year plus 10 cents. If the March DP exceeds the calculated December DP (i.e., if prices rise after the initial projection by more than enough to make the deficiency payment smaller), the producer must return the difference, and the July DP will be zero. Finally, assuming no payback is required, the July DP uses the actual (12-month) MYA price to arrive at the total DP to be received. The following equation summarizes the calculation of the total DP:

Deficiency Payment = $March_{DP}$ + $December_{DP}$ + $July_{DP}$ - Payback.

Since the deficiency payment is based on the difference between the target price and the marketing year average price, incorporating the deficiency payment into a producer's expectations requires predicting the MYA.[1] Here, a Monte Carlo approach is used to generate 2,000 representative price distributions of U.S. monthly average prices. Figure 1 is a schematic of the simulation described here. Prices are assumed to be distributed lognormally.[2] Monthly prices are used rather than daily because the deficiency payment is computed based on a monthly survey. The following equation is used to generate the prices (Naylor; Mapp; Arias, pp.29-30):

$$P_t = \exp(\ln P_{t-1} + e_t\sigma_t + \mu_t - \frac{1}{2}\ln[1 + \frac{P_{t-1}^2 \exp(\sigma^2) - 1}{P_{t-1}^2}]) \qquad (2)$$

where

P_t = U.S. monthly average price in month t

e_t = random error term generated with the Monte Carlo approach (taken from a standard normal distribution), using antithetic variates for increased precision.

σ_t = volatility of log price returns of historical US monthly average prices in month t

μ_t = means of log price returns of historical U.S. average prices in month t.

Volatilities and means are calculated for each month over the years 1974 - 1993.[3]

Each of the 2,000 replications of the price generating process generates twelve U.S. monthly average prices (June - May) that are used to calculate the MYA and five-month average prices. Figure 2 illustrates a sample of 10 of the 2,000 monthly average price replications. The 2,000 generated U.S. monthly average prices for November are used to obtain the November 30 Gulf cash price and the December Kansas City futures contract price using the coefficients of a regression equation specified as:

$$\begin{bmatrix} Gulf\text{-}USBasis_N \\ Gulf\text{-}DKCBasis_N \end{bmatrix} =$$

$$\begin{bmatrix} .26618 - .32973\ USPrice_{N-1} + .20771\ GulfPrice_{N-1} - .12229\ USPrice_J + .28786\ GulfPrice_J \\ -.10213 + .22391\ USPrice_{N-1} - .12180\ DKCPrice_{N-1} - .080841\ GulfPrice_J - .049737\ DKCPrice_J \end{bmatrix} + \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} \quad (3)$$

where

$Gulf\text{-}USBasis_N$ = November 30 Gulf price - U.S. monthly average price for November; ($GulfPrice_N$ = $Gulf\text{-}USBasis_N$ + $USPrice_N$)
$USPrice_N$ = U.S. monthly average price for November
$USPrice_{N-1}$ = Previous year's U.S. monthly average price for November
$USPrice_J$ = U.S. monthly average price for June
$GulfPrice_N$ = Gulf price on November 30
$GulfPrice_{N-1}$ = Previous year's Gulf price on November 30
$GulfPrice_J$ = Gulf price on June 20
$Gulf\text{-}DKCBasis_N$ = U.S. monthly average price for November - November 30 price of the December Kansas City futures contract; $DKCPrice_N$ = $USPrice_N$ - $Gulf\text{-}DKCBasis_N$
$DKCPrice_N$ = Average price of the December Kansas City futures contract for November
$DKCPrice_{N-1}$ = Previous year's average price of the December Kansas City futures contract for November
$DKCPrice_J$ = Price of the December Kansas City futures contract on June 20
v_1, v_2 = error terms.

The seemingly unrelated regression (SUR) approach in SHAZAM was used to estimate this system of equations. SUR provides more efficient estimates since it allows the error structure from one equation to affect estimates of the related equation (futures and Gulf cash prices are related through a basis). The error term associated with the system of equations can be expressed as the product of two components. The 2x2 Cholesky decomposition of the variance/covariance matrix of the SUR system is multiplied by a 2x2,000 matrix of randomly generated error terms (using antithetic variates for increased precision) to produce the error term vector in equation 2.

Together with the simulation, this regression provides 2,000 observations of each of the following prices: MYA price, five-month average price, November 30 Gulf price, and the November 30 price of the December Kansas City futures contract. Market efficiency is assumed. Specifically, the price of the December Kansas City wheat futures contract on

June 20 is specified to be an unbiased forecast of the contract's price on November 30. Similarly, it is assumed that the options premiums on June 20 equal their expected value.[4]

Marketing strategies that allow the producer to buy and sell puts, calls, and futures contracts, as well as store wheat, are evaluated at each of the 2,000 sets of prices using the producer revenue equation. Specifically, the producer is assumed to have harvested 10,000 bushels of wheat. At harvest, the producer may buy or sell zero, one or two 5000-bushel contracts of each of the following: futures contracts, put options at each of three strike prices, and call options at each of three strike prices. The producer may sell all, one-half, or none of the crop at harvest. Any wheat produced but not sold at harvest is sold on November 30 at the prevailing Gulf price. In all, 234,375 strategies are considered.

For each strategy, expected utility is calculated, and for each level of risk aversion the strategy with highest expected utility is selected. Expected utility measures are converted into risk-adjusted dollars by expressing them as certainty equivalents.[5] Thus, economic significance is used rather than statistical significance. The model is optimized for four scenarios, all of which set harvest-time Gulf cash, Kansas City futures, and U.S. monthly average prices at their average June 20 price over the last 20 years. Since harvest-time prices are set at historical averages, the model is not appropriate for recommending particular strategies in a particular year. Rather, the model is designed to assess the average effect that reducing or eliminating government deficiency payments might have on producers' marketing strategies.

In the first scenario, target price is set at its current level ($4.00/bu.). In a second scenario, the target price is reduced to the average of previous June monthly average U.S. prices ($3.17/bu.), reflecting alternative farm policy proposals to reduce target prices.[6] Both of these assume the producer participates in the government deficiency payment program.

In the third and fourth scenarios it is assumed that no deficiency payment program exists. If the current program encourages producers to produce more than they otherwise would, resulting in higher stocks, price volatility is probably lower than it would be without a program. To allow for the possibility that prices would become more volatile without a government program, it is assumed in the third scenario that prices are 50 percent more volatile than under the current program.

Other evidence suggests that price volatility might increase by more than 50 percent in the absence of government support prices. A graph provided by Crain and Lee suggests that prices were two to three times more volatile under programs which resulted in a greater market orientation than under other program regimes. In the fourth scenario, it is assumed that prices are twice as volatile as assumed in the first two scenarios.

It is assumed that commercial storage costs two cents/bu./month (see Anderson and Noyes). In addition, a producer incurs an opportunity cost of foregone interest by not selling the wheat. The interest rate assumed here is 10%, the average interest rate over the period 1974-1993 charged by the Bank for Cooperatives. Sensitivity of the results to alternate interest rates is discussed later.

adjusted return for the $4.00 target price scenario gives $40,137 - $7,334 = $32,803, which is only $3 more than the risk-adjusted return for the $3.17 target price scenario, $32,800. This small loss in risk-reduction benefit from reducing the deficiency payment indicates that the main benefit of the deficiency payment in this case is as an income supplement.

Using similar calculations and comparing the current program with the non-participation scenario, the risk-reduction benefit (risk-adjusted return minus expected deficiency payment and interest) that is lost by the producer when moving to the scenario with no government program and prices that are 50 percent more volatile is $40. Under the scenario where prices are twice as volatile, the producer loses an additional $19 (for a total of $59 compared with the current program) in risk-adjusted revenue because of the increased risk.

Table 2 indicates that a producer with medium risk aversion under the $4.00 target price scenario chooses a strategy of selling 50 percent of the wheat at harvest and storing the remaining 50 percent for sale in November. If the target price is reduced, the optimal strategy is still to sell 50 percent of the wheat at harvest, and also to sell one in-the-money call option. Under the no-government-program scenarios, the optimal strategy is to sell all the wheat at harvest, eliminating all price risk and neutralizing the impacts of more volatile prices.

These results indicate that reducing the deficiency payment increases risk enough to affect the optimal strategy for a producer with medium risk aversion. When target price is reduced, the producer compensates for the increased risk by selling a call option. By hedging, the producer is able to reduce the standard deviation of revenue, or risk, from $2,988 with a $3.17 target selling all wheat in November (see the second column in Table 1) to $890. When volatility is higher under the no-program scenarios, the optimal strategy is to sell the wheat at harvest and do nothing further. This reduces standard deviation to $0, completely eliminating risk, but also forgoes potential gain in price after harvest. Reducing the risk requires a sacrifice in expected return. However, after subtracting differences in expected deficiency payment, the producer's certainty equivalent changes little.

Comparing risk-adjusted returns provides a measure of how much of the risk-reducing features of the deficiency payment can be replaced by market strategies. The fifth line of Table 2 indicates that the producer loses $38 in risk-reduction benefit when the target price is reduced from $4.00/bu. to $3.17/bu. When moving to the no-government scenarios, however, the producer actually gains $33 in risk-reduction benefits. This result likely arises because of the integer contract restrictions. Selling at harvest more than offsets the additional risk from eliminating the program. At the same time, because the market is relatively efficient with prices increasing through time on average by the approximate amount of storage cost, the loss in expected revenue is not large. Thus, for the producer with medium risk aversion, alternative marketing strategies may more than make up for the risk-reduction benefits lost when the deficiency payment is reduced.

Table 3 indicates that a producer with high risk aversion sells all wheat at harvest under three of the four scenarios. This locks in a price, avoids storage cost and earns

The simulation is based on prices occurring over 1974 - 1993, except that the futures price is constrained to be unbiased. In other words, we assume that the June 20 December futures price is the best available predictor of the November 30 December futures price. This means that although on any given year the November 30 price could be higher or lower than the June 20 price, the average November 30 futures price is the same as the average June 20 price.[7] Also, since no set-aside has been required for the last two years, the percent of base acres required to be set aside is set at zero. It is assumed that the flex acres requirement is met using acres other than those considered in this analysis.

Results

Results indicate that the biggest loss to producers from reducing deficiency payments is in reduced revenue. Although the deficiency payment helps reduce revenue risk, marketing strategies are available that can reduce risk nearly as well as the deficiency payment program can. A further result is that reducing or eliminating government deficiency payments does not necessarily reduce hedging.

Tables 1 - 3 present results for the four scenarios for three different levels of risk aversion. Table 1 indicates that producers with low risk aversion choose the same strategy in each scenario, storing all of the wheat at harvest and selling it on November 30; no futures or options are used. When risk matters little, the gain in cash price from harvest to November more than offsets the storage cost. It should be noted that the cash price assumed here is the Gulf price less $0.75/bu. transportation costs. Thus, the cash prices should approximate central Oklahoma prices.

Table 1 also shows that standard deviation of returns, or risk, increases as deficiency payments are reduced or eliminated. The increased risk comes primarily from lowering or removing the "floor" on prices. With a $4.00 target price, returns could range from $3.22/bu. to $4.98/bu., depending on the year. With a $3.17 target price, that range is from $2.37/bu. to $4.61/bu. Thus, reducing the target price from $4.00 to $3.17 shifts the minimum price received downward by $0.85/bu. but shifts the maximum price received downward by only $0.37/bu. The range widens (to a range of $1.76/bu. to $5.34/bu.) under the scenario with 50 percent higher price volatility, and to a range of $1.44/bu. to $6.17/bu. under the scenario with 100 percent higher price volatility. However, because the producer in Table 1 cares little about risk, the effect on risk of reducing the deficiency payment is not enough to change the producer's optimal strategy.[8]

Also, since the Table 1 producer is not very concerned about risk, the risk-adjusted revenue changes little after subtracting the increase in expected deficiency payment and its associated interest. The fifth line of each table records for each scenario the risk-reduction benefit lost by the producer when moving from the current program to that scenario. For example, the risk-adjusted return in the scenario with target price of $4.00 is $40,137, while the risk-adjusted return with a $3.17 target price is $32,800. Subtracting the deficiency payment plus interest in the second scenario ($553 + $7 = $560) from the deficiency payment plus interest in the first scenario ($7,707 + $187 = $7,894) gives a difference in deficiency payments between the two scenarios of $7,334. Subtracting this from the risk-interest over the time period, but passes up the opportunity to gain from price increases. However, the uncertain deficiency payment increases risk, since it is no longer offset by the value of the producer's long cash position. With a long cash position (wheat in storage), if prices increase the value of the cash position increases, but the deficiency payment decreases. If prices decrease, the value of the cash position decreases, but that loss is offset by an increasing deficiency payment. These offsetting effects of the deficiency payment are lost if the wheat is sold at harvest.

Thus, under a $4.00 target price, the producer is able to reduce price risk by selling 50 percent at harvest, but maintains 50 percent in storage to offset the deficiency payment. Under a target price of $3.17, the producer sells all wheat at harvest. But even though the deficiency payment is smaller, it increases risk since there is no offsetting cash position, so the producer hedges the deficiency payment by selling an out-of-the-money put option. This reduces standard deviation to $607. For the two scenarios with no government program, the producer reduces standard deviation to $0, since wheat is sold at harvest and the producer no longer faces any risk. Under the current program, the amount of any deficiency payment is not known at harvest when the wheat is sold, and is thus risky; the risk averse producer finds that reducing government deficiency payments reduces risk.

In fact, after netting out the income-enhancing aspect of the deficiency payment, the highly risk averse producer actually gains risk-reduction benefit when the target price is reduced from $4.00 to $3.17. The table indicates that the producer loses -$150 (gains $150) in risk-reduction benefit when the target price is reduced to $3.17. The producer removes all price risk by selling wheat at harvest, and reducing the deficiency payment reduces the risk involved in the uncertain deficiency payment. The producer gains an additional $118 in risk-reduction benefit under the no-government-program scenarios, since standard deviation of returns is reduced to zero.[9]

To summarize, after subtracting the income-increasing features of the deficiency payment program and looking only at the risk-reduction benefit, producers with low levels of risk aversion lose small amounts of risk-adjusted revenue when target prices are reduced or eliminated. Producers with medium or high levels of risk aversion may gain or lose risk-reduction benefit, depending on the scenario. A far bigger loss to producers is the revenue-increasing aspects of the deficiency payment program, although this loss would be smaller than reported here if participating in the government program required a set-aside of eligible acres.

The above results assumed commercial storage costs of 2¢/bu./month, and a cost of capital of 10%, the average rate over the time period. Results not reported here indicate that if a producer faces storage costs that are only slightly higher (1¢/bu./month higher) or has a cost of capital 2% higher than the average rate, the optimal strategies change. Under either of those situations, the optimal strategy under all of the scenarios is to sell wheat at harvest because the total cost of storage and foregone interest is higher. This is consistent with the results obtained by Anderson and Adam. Then, the producer faces no further price or revenue risk, and hedging is not needed. However, when the producer is participating in the government deficiency payment program, the deficiency payment increases uncertainty. This is particularly true when the target price is high (e.g. $4.00) and the expected deficiency payment is large. Thus, reducing the target price and, with it, the deficiency payment, may reduce producers' use of futures and options.

Conclusions

The biggest loss to producers from reducing deficiency payments is in reduced revenue. Although the deficiency payment helps reduce revenue risk, marketing strategies are available that can reduce risk within a marketing year nearly as well as the deficiency payment program can.

For a producer with a low level of risk aversion, reducing the target price or eliminating the government deficiency payment program does not affect the optimal post-harvest wheat marketing strategy of storing the wheat and selling it in November.

For a producer with a medium level of risk aversion, reducing the target price leads to increased hedging. Contrary to conventional wisdom, however, for a producer with a medium or high level of risk aversion and/or one who faces a high storage cost, reducing the target price or eliminating the deficiency payment entirely can actually reduce risk. Such a producer sells wheat at harvest, which eliminates all revenue risk. A deficiency payment would increase the producer's uncertainty about his final revenue, since the value of the deficiency payment is not known until the end of the marketing year. Reducing or eliminating the deficiency payment reduces or eliminates this risk. Of course, it also reduces or eliminates a producer's expected revenue.

Thus, while some producers will find it advantageous to hedge if target prices and government price supports are reduced, others may not. Some likely will reduce risk by selling at harvest instead of storing for later sale.

Finally, it should be noted that this study has examined post-harvest marketing strategies within a marketing year. It has not considered the effects on year-to-year variation in prices, and the associated risk in long-term investment decisions, of reducing or eliminating target prices.

Table 1: Optimal Post-Harvest Marketing Strategy for a Wheat Producer: Low Risk Aversion; 10% Interest Rate

	Participation in Government Program Target Price = $4.00/bu	Participation in Government Program Target Price = $3.17/bu.	No Government Program (50% higher volatility)	No Government Program (100% higher volatility)
Expected Revenue	$40,143 ($4.01/bu)	$32,809 ($3.28/bu)	$32,229 ($3.22/bu)	$32,229 ($3.22/bu)
Range (lowest and highest returns in 2,000 years)	$3.22/bu. - $4.98/bu.	$2.37/bu. - $4.61/bu.	$1.76/bu. - $5.34/bu.	$1.44/bu. - $6.17/bu.
Standard Deviation	$2,492	$2,988	$5,045	$6,767
Risk-adjusted Return ($/bu)	$40,137	$32,800	$32,203	$32,184
Risk-reducing Benefits Lost by Reducing Deficiency Payment (compared to current program)	------	$3	$40	$59
Expected Deficiency and Findley Payments	$7,707	$553	$0	$0
Interest on Deficiency and Findley Payments	$187	$7	$0	$0
Percent Sold at Harvest	0	0	0	0
Futures Contract				
Put ($0.10 out-of-the-money)				
Call ($0.10 in-the-money)				

Table 2: Optimal Post-Harvest Marketing Strategy for a Wheat Producer: Medium Risk Aversion; 10% Interest Rate

	Participation in Government Program Target Price = $4.00/bu	Participation in Government Program Target Price = $3.17/bu.	No Government Program (50% higher volatility)	No Government Program (100% higher volatility)
Expected Revenue	$40,058 ($4.01/bu)	$32,684 ($3.27/bu)	$32,079 ($3.21/bu)	$32,079 ($3.21/bu)
Range (lowest and highest returns in 2,000 years)	$3.35/bu. - $4.54/bu.	$2.89/bu. - $3.74/bu.	$3.21/bu. - $3.21/bu.	$3.21/bu. - $3.21/bu.
Standard Deviation	$1,535	$890	$0	$0
Risk-adjusted Return ($/bu)	$39,940	$32,644	$32,079	$32,079
Risk-reducing Benefits Lost by Reducing Deficiency Payment (compared to current program)[a]	-------	$38	-$33	-$33
Expected Deficiency and Findley Payments	$7,707	$553	$0	$0
Interest on Deficiency and Findley Payments	$187	$7	$0	$0
Percent Sold at Harvest	50	50	100	100
Futures Contract				
Put ($0.10 out-of-the-money)				
Call ($0.10 in-the-money)		sell 1 contract		

[a]Negative numbers indicate that risk-reduction benefits are gained, not lost, when deficiency payment is reduced.

Table 3: Optimal Post-Harvest Marketing Strategy for a Wheat Producer: High Risk Aversion; 10% Interest Rate

	Participation in Government Program Target Price = $4.00/bu	Participation in Government Program Target Price = $3.17/bu.	No Government Program (50% higher volatility)	No Government Program (100% higher volatility)
Expected Revenue	$40,058 ($4.01/bu)	$32,577 ($3.23/bu)	$32,079 ($3.21/bu)	$32,079 ($3.21/bu)
Range (lowest and highest returns in 2,000 years)	$3.35/bu. - $4.54/bu.	$2.96/bu. - $3.60/bu.	$3.21/bu. - $3.21/bu.	$3.21/bu. - $3.21/bu.
Standard Deviation	$1,535	$607	$0	$0
Risk-adjusted Return ($/bu)	$39,705	$32,521	$32,079	$32,079
Risk-reducing Benefits Lost by Reducing Deficiency Payment (compared to current program)[a]	-----	-$150	-$268	-$268
Expected Deficiency and Findley Payments	$7,717	$553	$0	$0
Interest on Deficiency and Findley Payments	$187	$7	$0	$0
Percent Sold at Harvest	50	100	100	100
Futures Contract				
Put ($0.10 out-of-the-money)		sell 1 contract		
Call ($0.10 in-the-money)				

[a]Negative numbers indicate that risk-reduction benefits are gained, not lost, when deficiency payment is reduced.

Figure 1. Schematic of Simulation

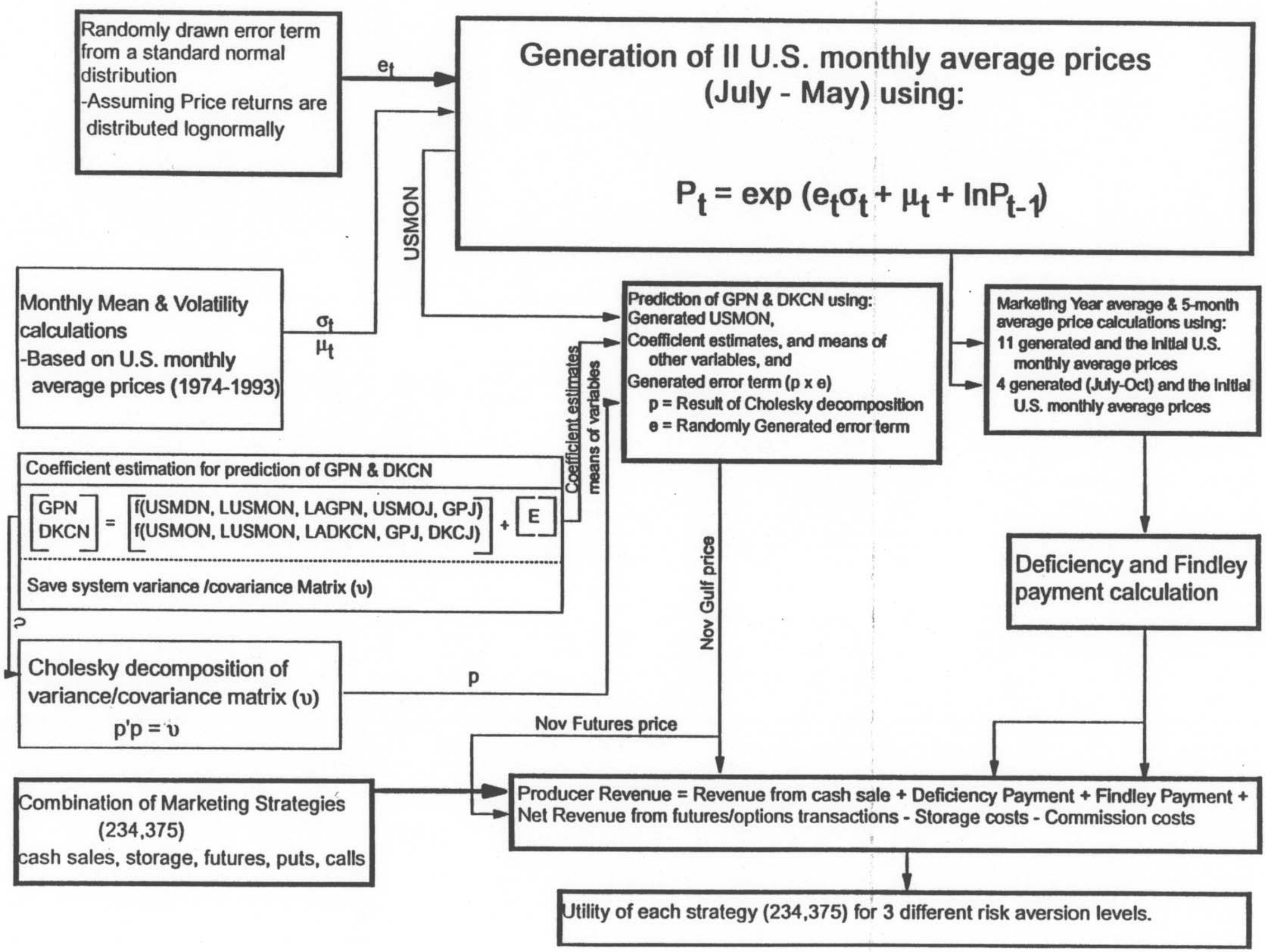

Table 1: Optimal Post-Harvest Marketing Strategy for a Wheat Producer: Low Risk Aversion; 10% Interest Rate

	Participation in Government Program Target Price = $4.00/bu	Participation in Government Program Target Price = $3.17/bu.	No Government Program (50% higher volatility)	No Government Program (100% higher volatility)
Expected Revenue	$40,143 ($4.01/bu)	$32,809 ($3.28/bu)	$32,229 ($3.22/bu)	$32,229 ($3.22/bu)
Range (lowest and highest returns in 2,000 years)	$3.22/bu. - $4.98/bu.	$2.37/bu. - $4.61/bu.	$1.76/bu. - $5.34/bu.	$1.44/bu. - $6.17/bu.
Standard Deviation	$2,492	$2,988	$5,045	$6,767
Risk-adjusted Return ($/bu)	$40,137	$32,800	$32,203	$32,184
Risk-reducing Benefits Lost by Reducing Deficiency Payment (compared to current program)	------	$3	$40	$59
Expected Deficiency and Findley Payments	$7,707	$553	$0	$0
Interest on Deficiency and Findley Payments	$187	$7	$0	$0
Percent Sold at Harvest	0	0	0	0
Futures Contract				
Put ($0.10 out-of-the-money)				
Call ($0.10 in-the-money)				

is particularly true when the target price is high (e.g. $4.00) and the expected deficiency payment is large. Thus, reducing the target price and, with it, the deficiency payment, may reduce producers' use of futures and options.

Conclusions

The biggest loss to producers from reducing deficiency payments is in reduced revenue. Although the deficiency payment helps reduce revenue risk, marketing strategies are available that can reduce risk within a marketing year nearly as well as the deficiency payment program can.

For a producer with a low level of risk aversion, reducing the target price or eliminating the government deficiency payment program does not affect the optimal post-harvest wheat marketing strategy of storing the wheat and selling it in November.

For a producer with a medium level of risk aversion, reducing the target price leads to increased hedging. Contrary to conventional wisdom, however, for a producer with a medium or high level of risk aversion and/or one who faces a high storage cost, reducing the target price or eliminating the deficiency payment entirely can actually reduce risk. Such a producer sells wheat at harvest, which eliminates all revenue risk. A deficiency payment would increase the producer's uncertainty about his final revenue, since the value of the deficiency payment is not known until the end of the marketing year. Reducing or eliminating the deficiency payment reduces or eliminates this risk. Of course, it also reduces or eliminates a producer's expected revenue.

Thus, while some producers will find it advantageous to hedge if target prices and government price supports are reduced, others may not. Some likely will reduce risk by selling at harvest instead of storing for later sale.

Finally, it should be noted that this study has examined post-harvest marketing strategies within a marketing year. It has not considered the effects on year-to-year variation in prices, and the associated risk in long-term investment decisions, of reducing or eliminating target prices.

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Endnotes

1. Deficiency Payment = max[max(Target Price - (5-month average price + 0.10), Target Price - MYA), 0].

2. Although some research suggests that prices are not distributed lognormally, lognormality is assumed here for convenience.

3. U.S. monthly average prices and volumes sold are from USDA. Futures and cash prices are from Technical Tools.

4. Empirically, this is accomplished by setting the June 20 futures price equal to the mean of the distribution of November 30 futures prices, and by setting initial options premiums equal to their computed value over the period of simulation.

5. Certainty equivalent, is expected utility minus a risk premium (Robison and Barry; Cox and Rubinstein, p.320). The utility function used here, following Cox and Rubinstein and Turvey and Baker, is $U = (1/1\text{-}d)R^{1-d}$, where d is the coefficient of constant relative risk aversion. Certainty equivalent with this specification is $[(1\text{-}d)\ U]^{1/(1-d)}$. Three levels of risk aversion are considered: low risk aversion is assumed to be characterized by an Arrow-Pratt (AP) absolute risk aversion parameter of 0.000002; medium risk aversion, AP = 0.0001; high risk aversion, AP = 0.0003. The coefficient d is standardized to these values at the wealth the producer would receive by selling all wheat at harvest by multiplying each AP value by that wealth (e.g., $d = AP \cdot A_h \cdot P_{cl}$).

6. This reduces the intrinsic value of the deficiency payment "option" and increases its time value, since it is nearly "at-the-money".

7. In actuality, however, the data indicate that on average the futures price rose 3 cents per bushel from June 20 to November 30. In some years the price dropped, and in some years the price rose, but if a producer had purchased a futures contract on June 20 and sold it on November 30 every year from 1974 to 1993, the average profit would have been 3 cents per bushel. Since there is no assurance that this will continue, and because even if it did continue there would be some years when such a strategy would lose considerable amounts of money, we are not recommending such a risky strategy. However, if a producer believes that futures prices will rise following harvest, a less risky strategy is to buy call options at harvest. For the initial cost of the premium, the producer can profit if prices rise, but will not lose any additional money if prices drop. This strategy would be considered speculation, not hedging, by the Internal Revenue Service.

8. If the producer was not able to met the Flex Acres from other base acres, so that a portion of the acres assumed here were used for Flex Acres, the standard deviation of returns for the scenarios with participation in the government program would be higher than reported here.

9. The actual strategies chosen are sensitive to the assumptions about interest rate, storage costs, and other parameters of the model. But the expected values of the top strategies are similar enough that even when the optimal strategies may differ, the certainty equivalent return does not change substantially. This suggests that the simulation reflects a market that is reasonably consistent with the law of one price. As a consequence, producers are unlikely to find marketing strategies that perform substantially better on average than selling wheat at harvest, unless they have extra year-specific information.