Decoupled farm payments and the Role of Base Updating under uncertainty

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Abstract

In the context of the U.S farm policy, this paper analyzes the effect that expectations about base updating in future policies has on a farmer's acreage decision in the presence of price, yield and policy uncertainty. We consider a risk neutral farmer producing a single crop whose income consists of market revenue and government payments. We consider two policy regimes. Decisions made in the current policy regime are linked to government payments in the future policy regime through the possibility of a base update in the future regime. There is policy uncertainty about the possibility of a base update being allowed in the future. We combine stochastic dynamic programming with present value calculations to link current acreage decisions to future program payments. The average optimal planted acreage is non-decreasing in the subjective probability of the future base update. The maximum percentage increase in the average optimal planted acreage conditional on price and the certainty of the future base update occurring is 6%.

1. Introduction

The Uruguay Round Agreement on Agriculture (URAA) of the World Trade Organization (WTO) in 1994 was the first time that a major step was taken towards reducing the trade distortions caused by domestic agricultural subsidies. Domestic subsidies were classified into three categories or "boxes" according to the level of distortion that they caused. The amber-box contains the most distorting subsidies and are therefore required to be limited in use. The blue-box payments also cause some distortion but are required to be production limiting. The green-box contains subsidies that cause no or minimal distortion. The subsidies in the blue- and green-boxes are currently excluded from all WTO disciplines. Decoupled payments fall under the green-box and are defined as payments that are financed by taxpayers, are not related to current production, factor use, or prices, and for which eligibility criteria are defined by a fixed, historical base period. Since there are no restrictions on their use they have come to play an important role in providing support to farmers especially in industrialized countries.

Recently though, green-box subsidies, especially decoupled payments, have come under scrutiny. The WTO rulings against the United States in the cotton dispute (WTO (2004), WTO (2005)) has brought the direct payments under the spotlight. There is an ongoing debate over the impact that decoupled payments have on farmer decisions. The different "coupling" mechanisms of decoupled payments have been analyzed in the literature.

Hennessy (1998) and Sckokai and Moro (2002) find that in the presence of uncertainty, decoupled payments have wealth and insurance effects with the insurance effect dominating the wealth effect. Roe, Somwaru and Diao (2003) find that in the presence of segmented capital markets, decoupled payments have small effects that last only in the short run. Goodwin and Mishra (2006) examine the effect of decoupled payments on farmers' acreage decision. For the corn belt region, they find that decoupled payments have a small but positive effect on acreage of corn and soybeans. They also find that these payments lead to less land idling. Empirical results of El-Osta et al. (2004) and Ahearn et al. (2006) indicate that decoupled payments influence labor allocation decisions. Goodwin et al. (2003a), Goodwin et al. (2003b) and Roberts et al. (2003) find that decoupled payments increase land rents and land values as they are non-stochastic payments based on land.

In the context of U.S. farm policy, our paper focuses on how a farmer's expectations regarding future decoupled payments influence their decisions. The 2002 FSRI Act in the United States allowed base updating. Also some new commodities (soybeans, other oilseeds, and peanuts) were added under the direct payment program. These features create potential incentives for farmers to increase production, possibly creating a link between future payments and current production. While the 1996 FAIR Act did not allow for base updating, the 2002 FSRI Act did allow for base updating. If farmers expect that future Farm Bills might allow base updating, then they link an increase in current acreage to higher future government payments that are paid on base acres. Thus base updating may create incentives to expand production under the 2002 FSRI Act. On the other hand the effect of the uncertainty regarding future policies might depress the incentives associated with base updating. Uncertainty about the different payment rates could also influence producer decisions such as the area to be planted and input use. Sumner (2003), McIntosh et al. (2006) and Coble and Hudson (2007) have analyzed the effect of expectations about a future opportunity to update base. Complementary to Sumner (2003), McIntosh et al. (2006) and Coble and Hudson (2007), our approach formalizes and quantifies the influence of expected payments under future policy which might allow a base update on acreage decisions under current policy.

We analyze the impact of base updating on a farmer's acreage decision in the presence of price, yield and policy uncertainty. We consider a risk neutral farmer producing a single crop whose income consists of market revenue and government payments. Three government payments are considered; direct payments (DP), counter-cyclical payments (CCP) and loan deficiency payments (LDP). The farmer makes acreage planting decisions in the current policy regime, (2002-06) not knowing what policies will be in place in the future policy regime (the duration of the 2007 Farm Bill). If base updating is allowed in the future regime, then the new base acreage for DP and CCP, is considered to be the average of the planted acreage in the current regime. The subjective beliefs of the farmer formed under the current Farm Bill, regarding a future base update occurring, (δ), is discretized into five values, starting from 0 (no update) to 1 (certain update) in increments of 0.25. The farmer's problem is to maximize the present value of profits by choosing acreage during 2002-06 while taking into account expected future policy changes, including the possibility of a base update. Thus the farmer cares not only about his/her current income but also about the future stream of income.

The solution to the model provides the optimal planted acreage for each of the years 2002-06 and for each value of the subjective probability about the future base update. The results are presented in terms of the average of the optimal planted acreage, $\bar{A}$, over 2002-06. Under certainty that there is no future base update, this value is driven entirely by market conditions and current government programs, and establishes a "business as usual" baseline. Under certainty that there will be an opportunity to update base, this value is driven by market conditions and the expectation that base updating will be allowed for sure. $\bar{A}$ is then the new base acreage for DP and CCP. Similarly for intermediate values of δ, $\bar{A}$ is driven by the varying degrees of conviction regarding the possibility of a future base update. $\bar{A}$ is weakly increasing in δ. We then compute the percent increase in $\bar{A}$ for $\delta > 0$ relative to $\delta = 0$ to quantify the supply expansion effect of an expected base update. The results indicate that the maximum percentage increase in $\bar{A}$ is 6%. We also look into alternate assumptions regarding policy parameters to investigate the robustness of our main result. The paper is organized as follows. In the next section the literature on decoupled payments in the United States is reviewed. Section 3 discusses the model, section 4 describes the numerical analysis, section 5 presents the results and finally section 6 concludes.

2. Model

We follow Duffy and Taylor (1994) in formulating the acreage optimization problem for a risk neutral farmer. The farmer produces a single crop, corn, and faces price and yield uncertainty, with price and yield being negatively correlated. She earns income from the sale of her crop and government payments. Three government payments are considered; LDPs, DPs and CCPs. Of the three programs, DPs and CCPs depend on historical base acreage and historical yields[1]. CCPs are triggered by low prices, as are loan deficiency payments. Thus updating base acreage or historical yields affect the DPs and CCPs. The per-period profit of the farmer can be written as:

$$\pi_t = \tilde{P}_t \tilde{Y}_t A_t + max(LR - (\tilde{P}_t - 0.26), 0)\tilde{Y}_t A_t + 0.85D * BA * Y_d + 0.85 * max(CR, 0) * BA * Y_c - TC(A_t), \tag{1}$$

where $\tilde{P}_t$ is the stochastic price, $\tilde{Y}_t$ is the stochastic yield, A_t is the current acreage, LR is the loan rate, $\tilde{P}_t - 0.26$ represents the posted county average price[2], D is the DP rate, CR is the CCP

[1] In the years 1998-2001 farmers received payments termed as the Market Loss Assistance (MLA) payments because of low prices. These ad-hoc payments were made permanent in the 2002 FSRI Act and called the CCPs.

[2] Babcock and Hart (2005) find that on average the posted county average price (used for computing LDP rate) is less than the season average price by 0.26 in the case of corn.

rate which equals $TP - D - max(\tilde{P}_t, LR)$, where TP is the target price and TC is the total cost of production which is a function of current acreage. BA is the base acreage for the duration of the 2002 FSRI Act, and Y_d and Y_c are program yields for the DPs and CCPs respectively. Thus profit, π_t, is a function of $\tilde{P}_t$, $\tilde{Y}_t$ and A_t.

The farmer maximizes profits with respect to acreage over the period 2002-06 while taking into account the possibility of a base update being allowed in the 2007 Farm Bill. This implies that the farmer maximizes the expected present value of profits:

$$\max_{A_t} E\left[\sum_{t=0}^{4} \beta^t \pi_t(A_t, \tilde{P}_t, \tilde{Y}_t) + \beta^5(\delta VB + (1-\delta)VNB)\right], \tag{2}$$

where β is the discount factor and $\delta \in [0, 1]$ captures the farmer's subjective probability regarding an opportunity to update base in the 2007 Farm Bill. Five values of δ have been considered to capture the varying degrees of conviction that the farmer has regarding the future policy changes. $\delta = 0$ implies that the farmer is certain that base update will not be allowed in the 2007 Farm Bill. On the other hand $\delta = 1$ implies that the farmer is certain that base updating will be allowed in the 2007 Farm Bill. VB and VNB represent the future income stream for the farmer.

VB is the value function for the stochastic dynamic programming (SDP) problem associated with base updating and other policy changes (SDP_{VB}). VNB is the value function for the SDP problem associated with no base updating in the 2007 Farm Bill (SDP_{VNB}). Thus the farmer is weighing the future income stream with δ. As the farmer's beliefs about the expected base update changes, land allocation decisions in 2002-06 are affected. Equation (2) also provides the link between acreage decisions in 2002-06 with future farm payments. This is because under base updating, the new base (which is the average of the acreage planted in 2002-06) affects VB.

The two SDP problems are solved for a five-year time horizon, representing the years 2007-2011, and a discrete state and control space. The control or decision variable is the current acreage, A_t, which is discretized into r values. The stochastic state variables are price and yield. Both the variables are discretized into t and s number of states respectively. Additionally, for SDP_{VB}, the state space also includes all the possible values for the new base. Since price and yield are stochastic, there is a probability associated with the realization of each of the possible t price and s yield states. The probability transition matrix, which is a $(t * s) \times (t * s)$ matrix contains these probabilities. An element $p^{i,j,k,l}$ of the probability transition matrix represents the probability of moving from a current price of i and a yield of j to a price of k and yield of l in the next period. We rewrite (2) as:

$$\max_{A_t} \sum_{t=0}^{4} \sum_{k=1}^{t} \sum_{l=1}^{s} \beta^t P^{i,j,k,l} \overrightarrow{\pi_t}(A_t, \tilde{P}_t, \tilde{Y}_{nt}) + \beta^5 \sum_{k=1}^{t} \sum_{l=1}^{s} P^{i,j,k,l} (\delta * \overrightarrow{VB} + (1-\delta) * \overrightarrow{VNB}). \quad (3)$$

The two SDP problems are:

$$VB_t(\tilde{P}_t, \tilde{Y}_{nt}, BA') =$$
$$\max_{A_t} \left[\sum_{k=1}^{t} \sum_{l=1}^{s} P^{i,j,k,l} \pi_t(\tilde{P}_t, \tilde{Y}_{nt}, A_t, BA') + \beta \sum_{k=1}^{t} \sum_{l=1}^{s} P^{i,j,k,l} VB_{t+1}(\tilde{P}_{t+1}, \tilde{Y}_{nt}, BA') \right],$$
$$t = 1, 2, ...5. \quad (4)$$

$$VNB_t(\tilde{P}_t, \tilde{Y}_{nt}) = \max_{A_t} \left[\sum_{k=1}^{t} \sum_{l=1}^{s} P^{i,j,k,l} \pi_t(\tilde{P}_t, \tilde{Y}_{nt}, A_t) + \beta \sum_{k=1}^{t} \sum_{l=1}^{s} P^{i,j,k,l} VNB_{t+1}(\tilde{P}_{t+1}, \tilde{Y}_{nt})\right], \quad t = 1, 2, ...5, \tag{5}$$

where BA' is the new base acreage for the DPs and the CCPs for 2007-2011 and is the average of the acreage planted during 2002-06. The option of not updating is also included amongst all the possible base values considered. Here BA' is treated as an endogenous state variable.

3. Numerical Solution

The numerical analysis is carried out at a national level using national season average price and yield. We also take into account payment limitations while computing profits[3]. We assume that the farmer receives DPs and CCPs on a base acreage of 1000 acres. $Y_d = 118$ bu/acre is the same as the program yield established in the Food, Agriculture, Conservation, and Trade (FACT) Act of 1990[4]. Farmers were given the opportunity to update their program yields for the CCPs. The following two methods were allowed: (i) 93.5% of the 1998-2001 average yield or, (ii) $Y_d + 70\% * ((1998 - 2001$ average) $-Y_d)$. If farmers choose not to update their yield then Y_d would be used. With $Y_d = 118$ bu/acre, method (ii) results in the highest Y_c and equals 130.48 bu/acre. $D = 0.28$ is assumed to remain the same for the 2007 Farm Bill.

The functional form considered for the total cost, $TC(A_t)$, is $F + bA_t + cA_t^3$ where F is the fixed cost and b and c are constants. Given F, we calibrate b and c for a 1000 acre farm using the profit maximization condition and the acreage price elasticity [5].

[3] The 2002 Farm Act sets payment limits at \$40,000 per person per fiscal year for DPs, at \$65,000 for CCPs and at \$75,000 for LDPs. In our analysis the payment limitations are binding only for LDPs when $LR > \tilde{P}_t - 0.26$

[4] The 2002 FSRI Act did not allow a yield update for DPs.

[5] We use an estimate of acreage price elasticity equal to 0.412 (Lin et al. (1996)).

Both the price and yield state variables are discretized into eight values each, yielding a total of 64 states. A_t is discretized into eight values, starting at 900 acres with increments of 50 acres. Since the farmer can choose any one of the eight acreage choices in each of the five years, 2002-06, the total number of new base values is large (32,768). Thus the total number of states for SDP_{VB} is even larger ($32,768 * 64 = 20,97,152$). For SDP_{VNB} the total number of states equal 64.

The elements in the probability transition matrix are derived from the joint distribution of price and yield. We assume that price and yield follow a bivariate normal distribution[6] with negative correlation between price and yield. To compute the transition matrix, we also need to estimate the first and second moments of price and yield.

Expected yield depends on a trend variable and expected price depends on lagged price. Equations for expected price and yield are estimated as seemingly unrelated regressions using time series data for the period 1980-2005 (price and yield data were obtained from the National Agricultural Statistics Service (NASS)). Nominal prices have been deflated to 2005 prices using the GDP price deflator. The results of the estimation are obtained as[7]:

$$EY_t = 95.80 + 1.95 * T - 29.06 * D_y \tag{6}$$

where T is trend and D_y is a dummy variable which is equal to 1 for 1988 and 0 otherwise. The variance σ_Y^2 was estimated as 115.31.

$$EP_t = 0.83 + 0.65 * P_{t-1} + 1.35 * D_p \tag{7}$$

[6]The Shapiro-Wilk test was used to test whether the price and yield distributions follow a normal distribution. The null hypothesis of normality could not be rejected at the 5% level of significance

[7]All coefficients are statistically significant at the 5% level of significance.

where D_p is a dummy variable which is equal to 1 for 1983 and 1995 and 0 otherwise. The variance, σ_P^2 was estimated as 0.162. The dummy variables are employed for observations identified as outliers[8].

Yield is known to have an upward trend and it is important to capture this in the per-period profit. To capture the trend in yield in (1) and to allow the yield states to be constant over time, we transform yield to a standard normal variable while calculating the probability transition matrix. Actual yield in a particular year, t, can be written as a function of the normalized yield as $\tilde{Y}_t = \tilde{Y}_n * \sigma_Y + E(Y_t)$. Therefore the yield states are specified in terms of $\tilde{Y}_n$: -1.75, -1.25, -0.75, -0.25, 0.25, 0.75, 1.25 and 1.75. The following price states ($/bu) were chosen to represent the probable range of prices: 1.625, 1.875, 2.125, 2.375, 2.625, 2.875, 3.125 and 3.375. Probabilities are then derived from the joint distribution of price and normalized yield[9]. The probability transition matrix in our problem is driven by the price states. For example, the probability of attaining any one of the 64 states starting from the previous yield state of -1.75 and previous price state of 1.625 is equal to the probability of attaining any one of the 64 states starting from the previous yield state of 0.25 and previous price state of 1.625. This is because the transition to any state in the next period depends only on the current price state via (7). Yield in the next period is not affected by the yield in the current period. While calculating the probability transition matrix we also take into account the truncation caused by the loan rate on

[8]An alternate specification was also considered by deleting observations corresponding to the outlier years. Huber's M estimation was also used to identify outliers. In this case only outliers in the price series were detected, corresponding to the same two years. Two specifications of the EY_t and EP_t equations were estimated, one with a dummy variable for price and the second by deleting the observations for the outlier years. Finally we also estimated the two equations without treating for outliers. The results are robust to all the other specifications used.

[9]An element of the transition matrix, $p^{i,j,k,l} = \int_{\underline{k}}^{\bar{k}} \int_{\underline{l}}^{\bar{l}} f(P, Y_n; \rho) dY_n dP$, where $f(\cdot)$ is the probability density function of a bivariate normal distribution and ρ is the correlation coefficient between price and yield. Price state $k \in (\underline{k}, \bar{k})$ and yield state $l \in (\underline{l}, \bar{l})$. The price and yield states have been constructed as mid-points of intervals. The first price interval starts at $ 1.5/bu and goes upto a maximum of $ 3.5/bu in increments of 25 cents. The first normalized yield interval starts at -2 bu/acre and goes upto a maximum of 2 bu/acre in increments of 0.5 bu/acre.

the joint distribution of price and yield[10]. We use numerical integration to compute the probability transition matrix.

SDP_{VB} and SDP_{VNB} are solved using backward recursion. The terminal value functions, VB_6 and VNB_6 are initially assumed to be zero. We then solve for VB_1 and VNB_1 and substitute these back as VB_6 and VNB_6[11] and solve again for VB_1 and VNB_1. These are the values that enter in (3). Finally we calculate the present value of expected profits as defined in (3) for each possible base value. The farmer maximizes the expected present value over all base values.

In the discussion above, we assume that the policy parameters in the 2002 and 2007 Farm Bills remain the same and the farmer is faced only with uncertainty about the expected future base update (denoted as case (i)). We also consider two other cases with respect to the expected policy changes in the 2007 Farm Bill. These also include the uncertainty regarding an expected base update. Under case (ii), the loan rate and the target price are reduced over the period 2007-11 and there is no uncertainty regarding these rates. Under case (iii), the loan rate and the target price are reduced over the period 2007-11 and there is uncertainty regarding the reduction in the rates as well as base updating. The reduced rates for 2007-2011 are listed in Table 2[12]. We solve SDP_{VB} and SDP_{VNB} for case (ii) in a similar way as we did for case (i). Case (iii) is a combination of case (i) and case (ii), i.e. it is a combination of VB from case (ii) and VNB from case (i). Thus for $\delta = 0$, the expected present value of profit is equal under cases (i) and (iii); and for $\delta = 1$, the expected present value of profit is equal under cases (ii) and (iii).

[10]Calculation of the truncated mean and variance of prices and yields is based on (Greene 2002, chap. 22).
[11]We do this to get an estimate of expected future income.
[12]The reduced rates are taken from FAPRI (2005). These rates have been reduced to meet the October 2005 U.S proposal in the WTO agricultural negotiations.

4. Results

Since the transition matrix depends entirely on the price states, the final payoffs are are also entirely dependent on the price states. For example the payoff from a yield state of -1.75 and price state of 1.625 is equal to the payoff attained from a yield state of 0.25 and a price state of 1.625. We therefore present the results for the eight price states. The solution to the farmer's problem is conditional on the price state in the year 2001 and the farmer's subjective probability about the expected base update. The solution to the problem is the optimal planted acreage to be planted in each of the years 2002-2006.

The supply response is measured in terms of the average of the optimal planted acreage for the years 2002-06, $\bar{A}$. We present $\bar{A}$ for each of the price states and all values of δ in Table 3 for case (i). With a few exceptions, $\bar{A}$ strictly increases as δ increases. For price state \$1.625/bu and $\delta = 0.25$ and 0.5, price state \$1.875/bu and $\delta = 0$ and 0.25 and price state \$2.125/bu and $\delta = 0$, it is optimal for the farmer not to make any changes to the acreage, i.e., the farmer should continue to plant 1000 acres in each of the years 2002-06. This result is driven by low prices. Figure 1 plots $\bar{A}$ against the price states for each value of δ. As δ increases, $\bar{A}$ shifts outwards. Figure 2 measures the supply response to the expected base update. When $\delta = 0$, $\bar{A}$ is determined by market conditions and farm programs in place in 2002-06. Thus, $\bar{A}$ at $\delta = 0$ is the benchmark to which we compare the $\bar{A}$ for $\delta > 0$. $\bar{A}_{|\delta>0} - \bar{A}_{|\delta=0}$ measures the supply effect[13] of the expected base update. We also compute the percent increase in $\bar{A}$ for $\delta > 0$ relative to $\delta = 0$. These are presented in Table 4. For price states, \$1.625, \$1.875 and \$2.125/bu farmers receive both DPs and CCPs. There is therefore a link between an expected base update and future DPs and CCPs. The maximum percent increase is 6% for \$2.125/bu and $\delta = 1$. It decreases to 4% as

[13] Here supply effect represents the expansion in acreage when δ increases.

δ decreases to 0.5. For $2.125/bu, the percent increase is the highest for all values of $\delta > 0$. For price states, $2.375, $2.625, $2.875, $3.125 and $3.375, only DPs are made to farmers and therefore the results for these price states captures the supply effect of the expected base update for the "decoupled" DPs. Averaged over the five price states, the percent increase in acreage for $\delta = 1$ is about 4%. When δ falls to 0.5 it decreases to less than 3%.

Under cases (ii) and (iii), the expected present value of profits are lower compared to case (i). Also for $\delta = 1$ the expected present value is equal for cases (ii) and (iii); for $\delta = 0$, the expected present value is equal for cases (i) and (iii). Even though the expected payoffs are lower under cases (ii) and (iii), there is no change in $\bar{A}$. This can be attributed to the fact that the reduction in the payoffs are not large enough to affect the optimal planted acreage.

We also conduct sensitivity analysis for a change in the acreage price elasticity. Results for an acreage price elasticity of 0.6 are presented in Tables 5 and 6, and Figures 3 and 4. $\bar{A}$ increases for all values of δ. Comparing Tables 4 and 6 shows that increasing the acreage price elasticity does not have dramatic effects on the acreage supply response to the expected base update. The effect of an expected base update on current acreage remains small.

5. Conclusion

DPs in the 2002 FSRI Act fulfill many of the eligibility criteria of the decoupled payments as defined in the URAA. But the planting restrictions imposed on base acres and the base update allowed in the 2002 FSRI Act disqualify these payments as green-box. The United States is negotiating to place the DPs in the green-box in the Doha round of the WTO.

There is a voluminous literature analyzing the effects of decoupled payments in the United States (the PFC payments in the 1996 FAIR Act and the DPs in the 2002 FSRI Act) on farmer decisions. The literature on decoupling indicates that decoupled payments do have coupling effects, albeit small in magnitude, with the exception of the effect on land values.

Our paper adds to the current literature on the role of base updating by presenting a formalized model to examine the role of base updating in a farmer's decision making process. We analyzed the effect of an expected base update in the 2007 Farm Bill on a farmer's current acreage decision, in the presence of price and yield uncertainty. Price and yield are discretized into eight states each, to approximate the uncertainty faced by the farmer. We measure the change in acreage supply response to an expected base update as the farmer's expectation of the future update changes, which is captured by $\delta \in [0, 1]$. We find that the maximum percent increase in the average of the optimal planted acreage over 2002-06 is 6% conditional on price $= \$2.125$/bu and $\delta = 1$. At prices $= \$1.625, \$1.875$ and $2.125/bu, CCPs are positive and therefore any opportunity to update base increases both the DPs and the CCPs. The average of the optimal planted acreage is weakly increasing in δ.

Our results indicate that expectations about future policies influence producer decisions. These results have important policy implications for the WTO negotiations in the Doha round. At present, the proposals of the U.S. and EU, or even the Harbinson proposal for the Doha round do not contain any changes to the green-box payments. But our results suggest that the green-box criteria for decoupled payments must be made very clear, with no room for ambiguities. It should be made clear that allowing base update or including new commodities in the program violate the criteria of decoupled payments being paid on fixed historical base, although this effect is small. Once a base update is allowed, decoupled payments should no longer be classified as green-box payments.

Lastly, we would like to point out that our analysis is conducted in the short-run. In the long-run, costs are flatter and we expect the acreage response to be higher. Therefore we expect a larger acreage expansion as the probability of a future base update increases. Our analysis is conducted for a single program crop, corn. We therefore consider our results to be an upper bound on acreage expansion. A possible avenue of future research could be to extend this model to include two crops.

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Table 1: Model Parameters

β	0.95
BA	1000 acres
Y_d	118 bu/acre
Y_c	130.48 bu/acre
F	\$ 208230
b	-23.47
c	0.00012

Table 2: Loan rates and Target price for 2002- 2011

	2002	2003	2004	2005	2006
LR	1.98	1.98	1.95	1.95	1.95
TP	2.60	2.60	2.63	2.63	2.63

	2007	2008	2009	2010	2011
LR	1.91	1.86	1.82	1.78	1.74
TP	2.59	2.56	2.52	2.48	2.45

Table 3: Average Optimal Planted Acreage

	δ				
Price State	0	0.25	0.5	0.75	1
1.625	990	1000	1000	1020	1040
1.875	1000	1000	1020	1040	1050
2.125	1000	1020	1040	1050	1060
2.375	1030	1050	1050	1060	1080
2.625	1050	1060	1070	1090	1100
2.875	1070	1090	1100	1100	1120
3.125	1100	1100	1120	1130	1140
3.375	1120	1130	1140	1150	1160

Table 4: Percent change in $\bar{A}$ relative to $\delta = 0$

	δ			
Price State	0.25	0.5	0.75	1
1.625	1.01	1.01	3.03	5.05
1.875	0.00	2.00	4.00	5.00
2.125	2.00	4.00	5.00	6.00
2.375	1.94	1.94	2.91	4.85
2.625	0.95	1.90	3.81	4.76
2.875	1.87	2.80	2.8	4.67
3.125	0.00	1.82	2.73	3.64
3.375	0.89	1.79	2.68	3.57

Table 5: Average Optimal Planted Acreage with Acreage Price Elasticity of 0.6

	δ				
Price State	0	0.25	0.5	0.75	1
1.625	1000	1010	1030	1050	1070
1.875	1010	1030	1050	1070	1090
2.125	1040	1050	1070	1090	1110
2.375	1060	1080	1100	1120	1130
2.625	1100	1110	1130	1140	1160
2.875	1130	1140	1160	1180	1190
3.125	1160	1180	1190	1210	1220
3.375	1190	1210	1220	1230	1250

Table 6: Percent change in $\bar{A}$ relative to $\delta = 0$ with Acreage Price Elasticity of 0.6

	δ			
Price State	0.25	0.5	0.75	1
1.625	1.00	3.00	5.00	7.00
1.875	1.98	3.96	5.94	7.92
2.125	0.96	2.88	4.81	6.73
2.375	1.89	3.77	5.66	6.60
2.625	0.91	2.73	3.64	5.45
2.875	0.88	2.65	4.42	5.31
3.125	1.72	2.59	4.31	5.17
3.375	1.68	2.52	3.36	5.04

Figure 1. Average Optimal Planted Acreage

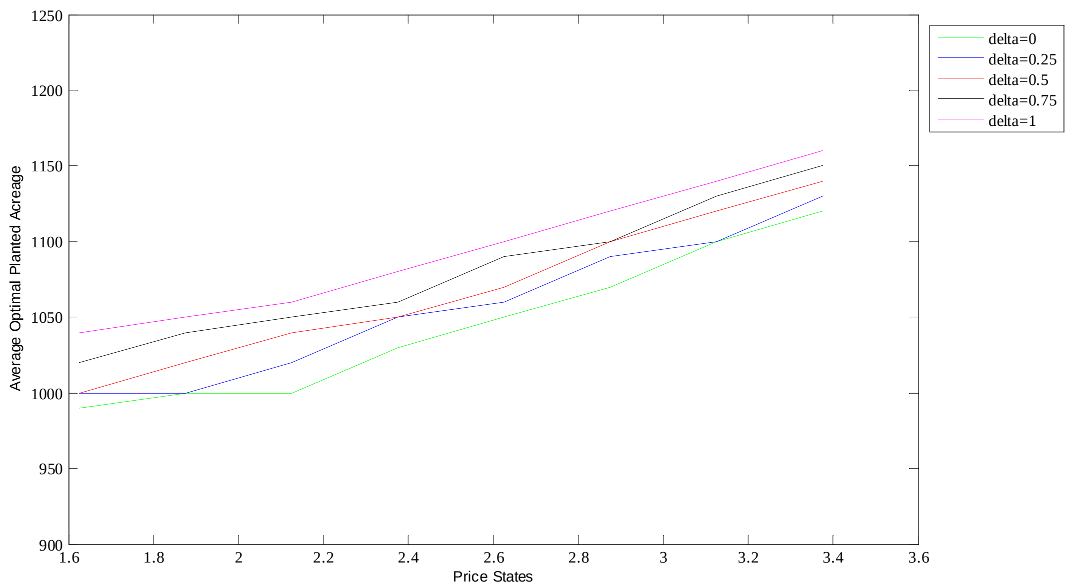

Figure 2. Difference between Average Optimal Planted Acreage at $\delta > 0$ over $\delta = 0$

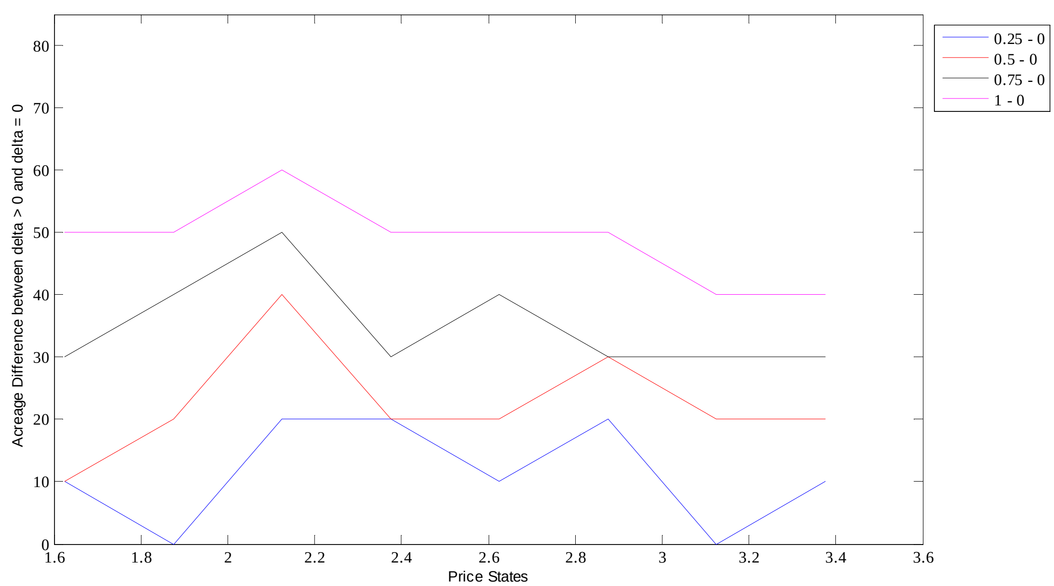

Figure 3. Average Optimal Planted Acreage with Acreage Price Elasticity of 0.6

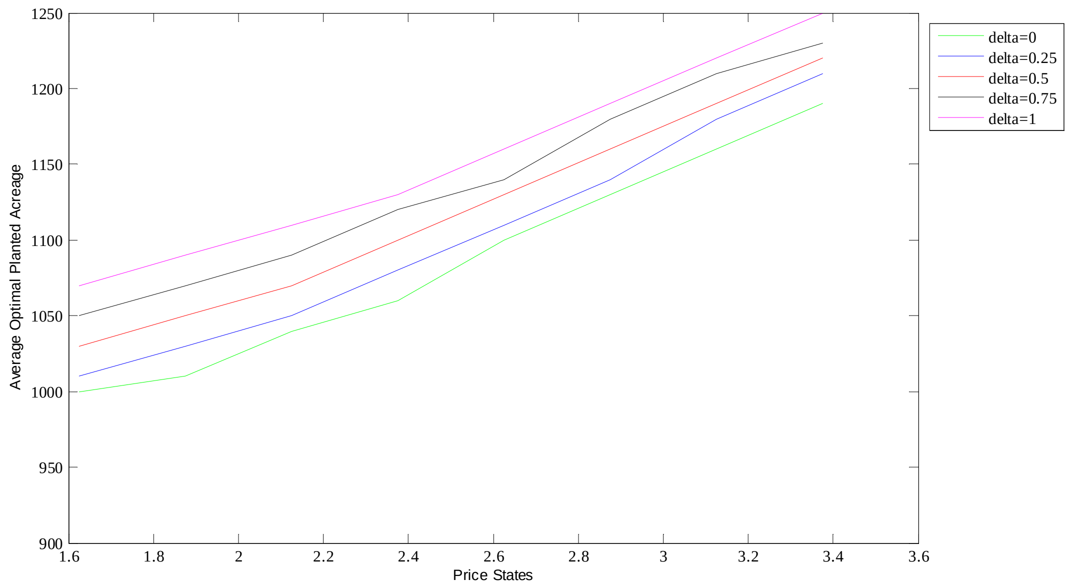

Figure 4. Difference between Average Optimal Planted Acreage at $\delta > 0$ over $\delta = 0$ with Acreage Price Elasticity of 0.6