NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

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Suggested citation format:

Glauber, J. W., and M. J. Miranda. 1989. "Subsidized Put Options as Alternatives to Price Supports." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL. [http://www.farmdoc.uiuc.edu/nccc134].

SUBSIDIZED PUT OPTIONS AS ALTERNATIVES TO PRICE SUPPORTS

Joseph W. Glauber and Mario J. Miranda*

Section 1742 of the Food Security Act of 1985 requires that the Secretary of Agriculture conduct a study of how producers of agricultural commodities can use futures and options markets to gain price stability and income protection. In addition, the 1985 Act requires that the Federal budget impact of using futures and options be examined in comparison to existing price support programs.

In this paper we examine the use of subsidized put options as an alternative to price supports for wheat, corn, and soybean producers. Under such a program, corn, wheat, and soybean producers would purchase put options at harvest to cover their production. The Government would reimburse producers the amount of the premium for a put option with a loan-rate-equivalent strike price. In addition, we consider a program which would allow upland cotton producers participating in the cotton marketing loan program to purchase at-the-money call options for the amount of their production. We examine the market and welfare effects of subsidized puts and calls for the 1989-98 crops.

Estimating the costs of using subsidized put options as alternatives to price supports poses a number of analytical problems. Full scale implementation of the program would likely have profound effects on agricultural markets. The removal of price supports from agricultural markets would free Government stocks for consumption purposes, thus affecting the level and volatility of prices for these commodities. Importantly, these changes would affect option prices and, as a consequence, the level of Government expenditures.

Thus, the use of current options markets to predict the costs of replacing price supports with subsidized put options could lead to substantial errors in the estimates (8). Preliminary research shows costs are likely to be underestimated unless changes in the underlying price distributions are taken into account.

Secondly, the removal of price supports would affect the price expectations of market participants. If we assume that producers, consumers and private inventory holders form rational

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price expectations, such policy changes could affect supply and demand decisions. A model is needed that accounts for how price expectations would change with the implementation of new price support policies.

The approach taken here draws on the recent literature on the economics of storage (2,5,8,10,11,12,13,14). In particular, emphasis is given to the stochastic and dynamic aspects of production, the formulation of price expectations, and the role of private and Government storage.

The paper is organized as follows. In the first section we present a model of a market for an annually produced storable commodity. In section II we presents a method to solve for market equilibria. In section III, we use simulation analysis to compare such subsidized put options to conventional price support and deficiency payment programs. In the final section, we discuss policy recommendations based on preliminary results of our research and outline avenues of future research.

The Market Model

In this section we present a dynamic and stochastic model of an agricultural commodity market in which private participants react rationally to the effects of various Government programs. Our market model for an annually produced, storable agricultural commodity comprises consumers, producers, private arbitrageurs, and the Government. Consumers base their decisions on current market price, producers on expected harvest price, and arbitrageurs on the difference between the current and expected future market prices. Under the current program, the Government offers corn, wheat, upland cotton, and soybean producers nonrecourse loans. Corn, wheat, and upland cotton producers are eligible for deficiency payments. In addition, the Government allows upland cotton producers to repay nonrecourse loans at the world price under a marketing loan.

As an alternative to the current Government program, we model a program that subsidizes the purchase of put options at harvest. Under such a program, corn, wheat, and soybean producers would purchase put options at harvest to cover their production. The Government would agree to reimburse producers the amount of the premium for a put option where the strike price equals the loan rate, adjusted for basis. Announcement of the loan-rate-equivalent strike price would be made prior to planting.[1] The options would expire after six months. At the end of six months, producers would either exercise the option if the cash price were below the strike price or let the option expire if the cash price were above the strike price.

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[1]The loan-rate-equivalent strike price would equal the national loan rate plus the expected basis between the average farm price and the futures price at maturity.

In the model, the subsidized put program would replace the conventional nonrecourse loan. The deficiency payment program would continue. Payments would be calculated, as before, on the basis of the difference (if positive) between the target price and the maximum of the market price or the loan rate.

Upland cotton producers currently receive the equivalent of a subsidized put option through the cotton marketing loan.[2] As an alternative, we consider a program that offers cotton producers at-the-money call options at harvest. The options would expire six months later. Producers would continue to be eligible for deficiency payments and marketing loans.

A typical year t begins with a given supply s_t' held by private market participants and a given amount y_t' held by the Government. Initial private supply s_t' is composed of private carryover from the preceding year x_{t-1} and new production, which equals the acreage planted the preceding year a_{t-1} times a random per-acre yield, w_t:

$$(1) \qquad s_t' = x_{t-1} + a_{t-1} \cdot \tilde{w}_t.$$

Pipeline stocks are assumed constant from one year to the next and hence are not modeled explicitly. Initial Government stocks y_t' are composed of Government carryout from the preceding year y_{t-1}:

$$(2) \qquad y_t' = y_{t-1}.$$

The Government administers a buffer stock stabilization program in which it attempts to contain market price between two specified prices through open market operations. At the support price p_S, the Government offers to buy and store unlimited quantities of the commodity. At the release price p_R, it offers to sell any quantities in its possession.

Government purchases and sales alter the distribution of total supply between Government and private hands. Denoting by g_t the net amount purchased by the Government on the open market in year t, final available private supply in year t is

$$(3) \qquad s_t = s_t' - g_t$$

and the final level of Government stocks in year t is

$$(4) \qquad y_t = y_t' + g_t.$$

The Government does not purchase stocks if the market price

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[2]The marketing loan is equivalent to a subsidized put option in that producers are guaranteed the price protection provided by the loan rate while selling the crop at market prices.

exceeds the support level and does not sell if the market price lies below the release level:

$$(5) \qquad p_t > p_S \Rightarrow g_t \leq 0,$$

$$(6) \qquad p_t < p_R \Rightarrow g_t \geq 0.$$

Since the Government is willing to acquire unlimited stocks at the support price, the market price never falls below this level:

$$(7) \qquad p_t \geq p_S.$$

On the other hand, the Government can release only as much as it holds in the stockpile initially:

$$(8) \qquad g_t \geq -y_t'.$$

Thus, the market price can rise above the release level if the Government stockpile is depleted:

$$(9) \qquad p_t > p_R \Rightarrow g_t = -y_t'.$$

The Government also administers a program which provides farmers with free put options with the strike price set equal to the loan rate. Whenever the market price falls below the strike price p_T, farmers may exercise the put option and receive the strike price for the amount of their production. Under this policy, the effective farm price, f_t, equals the maximum of the market price and the strike price:

$$(10) \qquad f_t = \max\{p_t, p_T\}.$$

Arbitrageurs store an amount x_t of the final private supply s_t. Consumers purchase the remainder, $s_t - x_t$, at the market clearing price

$$(11) \qquad p_t = \pi(s_t - x_t).$$

Competition among private, risk-neutral arbitrageurs eliminates expected speculative profit opportunities. This yields the familiar complementarity conditions:

$$(12) \qquad \begin{aligned} &p_t \geq (1+r)^{-1} p^e_{t+1} - k_t; \qquad x_t \geq 0, \\ &x_t\,[(1+r)^{-1} p^e_{t+1} - p_t - kt] = 0, \end{aligned}$$

where $(1+r)^{-1} p^e_{t+1} - k_t$, the discounted harvest price minus the constant unit cost of storage, is the expected marginal revenue from storing the commodity. Arbitrageurs will not store if speculative losses are expected.

The acreage planted by producers depends on the price they expect for their product next year at harvest time:

$$(13) \qquad a_t = a(f^e_{t+1}).$$

Arbitrageurs and producers form their price expectations rationally:

$$(14) \qquad p^{e}_{t+1} = E_t p_{t+1}$$

$$(15) \qquad f^{e}_{t+1} = E_t f_{t+1}$$

We make the following additional assumptions: The random yields w_t are independently and identically distributed. The discount factor is less than one and the unit storage cost k is positive. The inverse consumption demand function is strictly decreasing in quantity demanded and the acreage supply function is increasing in expected price. The demand and supply functions, the distribution of random yields, and all other market parameters are time-stationary.

While the model possesses no closed-form analytical solution, it can be solved, for any specific parameterization, using recursive estimation and discretization techniques commonly to solve stochastic dynamic programming problems (7).

Simulation Results

In the simulation analysis that follows, we examine three demand scenarios. A range of elasticities was selected to reflect the broad range of empirical estimates in the literature (1). Elasticities for the baseline scenarios differ for corn, wheat, soybeans, and upland cotton (table 1). For example, a 1-percent increase in the corn price will cause a 0.3-percent decrease in domestic corn use and a 0.9-percent decline in corn exports.

In the low demand responsiveness scenario, a 1-percent increase in price will result in a 0.25-percent decrease in domestic and and a 0.30-percent decrease in export demand. Lastly, in the high demand responsiveness scenario, the domestic demand elasticity equals -0.50 and the export elasticity equals -1.25.[3]

Acreage elasticity estimates are given in table 2. A range of elasticity estimates was used in the simulation analysis, but results were shown to be insensitive to changes in the choice of supply elasticity, particularly for program crops like corn, wheat, and upland cotton.

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[3]Intercepts for the demand equations were calibrated using expected market demands for the 1989 crop year. These were assumed constant over the 1989-98 period (see appendix tables1-4).

Table 1--Demand Elasticities 1/

Crop	Domestic	Export
Baseline scenario		
Wheat	-0.42	-0.54
Corn	-0.30	-0.90
Soybeans	-0.45	-0.80
Upland cotton	-0.40	-0.65
High demand scenario	-0.50	-1.25
Low demand scenario	-0.25	-0.30

1/ Percent change in supply or demand due to a 1-percent change in price.

Table 2--Supply Elasticities

Crop	Elasticity
Wheat	0.31
Corn	0.35
Soybeans	0.40
Upland cotton	0.30

Table 3--Yields 1/

Crop	Base Yield	High Yield	Variability
	Bushels/acre		Percent
Wheat	38	42	6.7
Corn	118	135	8.4
Soybeans	33	37	7.7
	Pounds/acre		
Upland Cotton	620	665	11.0

1/ Base yields reflect 1989 yields. High yields reflect expected 1998 yield values. Variability is given as the standard error of the yield trend equation divided by mean yield.

U.S. yields are assumed to be normally distributed with known mean and variance. Table 3 gives the means for the baseline case and the high yield scenario and yield variability. Yield variability is calculated by dividing the standard error of the yield trend equation by mean yield.

We assume that Government programs over the period 1989-98 will resemble farm programs currently in place under the Food Security Act of 1985. For convenience, we label this program the "current program." Government program variables for the 1989 crops are given in table 4. It is assumed that under the current program, all Government payments are made in cash. No generic certificates are issued. Other Government programs, such as the Conservation Reserve Program, Paid Land Diversion Program, 0/92 and 50/92 provisions, the Export Enhancement Program, Disaster Assistance, and Federal Crop Insurance, are not treated explicitly in this model.

Simulations

Using current USDA estimates for ending stocks for the 1988 wheat, corn, soybeans, and cotton crops (table 5), simulations were run for the years 1989-98. For each year, the model calculated mean prices, demands, acreages, yields, production, and ending stocks. In addition, the model calculated the cost to the Government and benefits (or costs) of the program to consumers and producers. The variability of price, producer revenue and income, and Government costs were also estimated.[4]

Simulations were then completed for the option subsidy program using the same demand and supply parameters, and same initial stock conditions. Government stocks were assumed subject to the same release policy as under the current program. Separate simulations were also performed assuming no Government programs.[5]

The Market Effects of Subsidized Put Options

To examine the market effects of subsidized options we focus on market prices, demands, production, and carryout in 1998, the last year of our simulated history. This year was chosen for analysis, because it is influenced least by the effects of the 1988 drought (tables 5-8).

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[4]Cross-commodity effects are not measured in this analyis. Since deficiency payments were not affected by the option program, it was assumed that there would be little change in acreage allocation between the crops.

[5]In the purely competitive case, we assumed that the supply curves for wheat, corn, and cotton would shift to the right reflecting the elimination of all acreage reduction programs. (For further detail, see Glauber and Miranda, 1989).

Table 4 Government program variables, 1989 crop year

Parameter	Crops			
	Corn	Soybeans	Wheat	Cotton
		Dol./bu.		Cents/lb.
Loan rate 1/	1.65	4.77	2.06	55.0
Target price	2.84	---	4.10	73.4
Release price	2.84	5.40	4.10	73.4
Annual storage cost	.36	.36	.36	4.8
		Percent		
Acreage reduction requirement	10	---	10	25
Annual interest rate	4	4	4	4

1/ For cotton, producers may repay their loans at the world price (marketing loan, Plan B).

Table 5--1988 Ending Stocks

Ending stocks	Wheat	Corn	Soybeans	Cotton
		Mil. bu.		Mil. lbs.
Farmer-owned Reserve	275	650	---	---
CCC Inventory	150	250	---	---
Free Stocks	103	546	---	---
Total	528	1,446	125	5,712

Source: USDA, World Agricultural Supply and Demand Estimates, WASDE-224, November, 1988.

In general, market prices are slightly lower under a subsidized put option program. This is particularly true for the low demand elasticities and high yield scenarios. However, when market prices are high relative to the loan rate there is little effect. For wheat, mean market prices are well above the loan rate ($2.06 a bushel) even under the high yield scenario. When prices are high there is little incentive to place crop under loan. The value of a put option with an at the loan-rate-equivalent strike price is close to zero (table 7). As a result, a subsidized put program has no effect on wheat market prices.

Although market prices for corn and soybeans would be lower, production levels would be about the same because Government program payments keep producers' incentive prices high.

Both domestic and export demands for corn and soybeans are generally higher under a subsidized option program, reflecting lower market prices. While stock levels are generally lower under a subsidized put option program, the composition of stocks is changed. Under the current program, price supports discourage private stockholding. However, with the removal of the effective price floor under a subsidized put option program, speculative opportunities increase. Private stock levels for corn and soybeans showed sharp increases with the elimination of price supports.

For corn and soybeans, market prices are more variable with subsidized put options, as expected (table 9). Removal of price supports caused market price variability (the standard deviation of prices relative to the mean) to jump from 14.0 percent to 18.6 percent in the case of corn, and from 9.7 to 11.5 percent in the case of soybeans. Notice that in the case of soybeans, subsidized puts increased market price variability slightly more than the no program case. Wheat prices were unaffected by a subsidized put program, primarily because of the low loan rate relative to the mean market price.

Farm prices (market prices plus Government payments) would be generally unaffected for corn, wheat and cotton because of the deficiency payment program that guarantees producers the target price. For soybeans, the price received by farmers, including program payments, was slightly destabilized by a subsidized put option program. Price supports stabilize prices by providing a

Table 5--Effects of subsidized puts on market variables for soybeans in year 10 under various market scenarios

Item	Baseline		High elast.		Low elast.		High yield	
	Current	Put	Current	Put	Current	Put	Current	Put
				Dollars per bushel				
Price								
Market	5.36	5.36	5.43	5.43	5.23	5.09	4.98	4.65
Farm	5.36	5.39	5.43	5.43	5.23	5.31	4.98	4.97
Option premium								
Put	.00	.03	.03	.03	.00	.21	.00	.30
Call	.57	.59	.63	.63	.44	.52	.20	.19
				Million acres				
Acreage	58.1	58.3	58.4	58.4	57.6	57.6	56.5	56.4
				Bushels per acre				
Yield	33.1	33.1	33.1	33.1	33.1	33.1	37.1	37.1
				Billion bushels				
Production	1.92	1.93	1.93	1.93	1.90	1.92	2.10	2.10
Demand								
Domestic	1.24	1.24	1.23	1.23	1.23	1.24	1.28	1.32
Export	.69	.69	.70	.70	.67	.68	.73	.77
Total	1.93	1.93	1.93	1.93	1.90	1.92	2.10	2.10
Storage								
Private	.002	.021	.007	.007	.001	.058	.000	.017
Government	.058	.000	.000	.000	.286	.000	1.122	.000
Total	.060	.021	.007	.007	.287	.058	1.122	.017

Table 6--Effects of subsidized puts on market variables for corn in year 10 under various market scenarios

Item	Baseline		High elast.		Low elast.		High yield	
	Current	Put	Current	Put	Current	Put	Current	Put
				Dollars per bushel				
Price								
Market	1.91	1.85	1.89	1.87	1.97	1.78	1.66	1.38
Farm	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84
Option premium								
Put	.00	.07	.00	.02	.00	.14	.00	.28
Call	.25	.25	.23	.23	.31	.27	.01	.01
				Million acres				
Acreage	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8
				Bushels per acre				
Yield	118.4	118.4	118.4	118.4	118.4	118.4	135.5	135.5
				Billion bushels				
Production	8.03	8.03	8.03	8.03	8.03	8.03	9.19	9.19
Demand								
Domestic	5.92	6.00	5.98	6.01	5.88	6.07	6.15	6.55
Export	1.94	2.03	1.99	2.01	1.88	1.96	2.17	2.64
Total	7.85	8.03	7.97	8.03	7.77	8.03	8.31	9.19
Storage								
Private	.000	.005	.000	.003	.000	.076	.000	.002
Government	2.762	.000	1.626	.000	3.709	.000	9.906	.000
Total	2.762	.005	1.626	.003	3.709	.076	9.906	.002

Table 7--Effects of subsidized puts on market variables for wheat in year 10 under various market scenarios

Item	Baseline		High elast.		Low elast.		High yield	
	Current	Put	Current	Put	Current	Put	Current	Put
				Dollars per bushel				
Price								
Market	3.57	3.59	3.60	3.60	3.47	3.52	2.95	2.95
Farm	4.10	4.10	4.10	4.10	4.11	4.21	4.10	4.10
Option premium								
Put	.00	.00	.00	.00	.00	.00	.00	.00
Call	1.46	1.46	1.48	1.48	1.36	1.40	.85	.85
				Million acres				
Acreage	67.1	67.1	67.1	67.1	67.2	67.7	67.1	67.1
				Bushels per acre				
Yield	38.1	38.1	38.1	38.1	38.1	38.1	42.1	42.1
				Billion bushels				
Production	2.56	2.56	2.56	2.56	2.56	2.58	2.82	2.82
Demand								
Domestic	1.13	1.13	1.12	1.12	1.13	1.13	1.22	1.22
Export	1.44	1.44	1.43	1.43	1.45	1.45	1.60	1.60
Total	2.57	2.57	2.56	2.56	2.58	2.58	2.82	2.82
Storage								
Private	.001	.010	.001	.005	.000	.036	.000	.009
Government	.407	.400	.500	.500	.262	.000	.500	.000
Total	.408	.410	.501	.505	.262	.036	.500	.009

Table 8--Market effects of the marketing loan on cotton in year 10 under various market scenarios

Item	Baseline	High elasticity	Low elasticity	High yield
		Cents per pound		
Price				
Market	67.5	63.3	75.1	60.0
Farm	76.4	73.5	81.4	74.1
Option premium				
Put	0.0	0.0	0.0	0.8
Call	15.1	11.0	22.3	8.7
		Million acres		
Acreage	9.3	9.2	9.5	9.2
		Pounds per acre		
Yield	623.8	623.8	623.8	669.0
		Billion pounds		
Production	5.808	5.743	5.918	6.174
Demand				
Domestic	3.164	3.195	3.179	3.318
Export	2.644	2.548	2.739	2.856
Total	5.808	5.743	5.918	6.174
Storage				
Private	.161	.060	.361	.146
Government	.000	.000	.000	.000
Total	.161	.060	.361	.146

Table 9--Effect of subsidized puts on the variability of price, farm income, and Government expenditures for baseline elasticities 1/

Variable	Crop			
	Corn	Soybeans	Wheat	Cotton
	Percent			
Market price				
Current program	14.0	9.7	11.9	16.9
Subsidized put	18.6	11.5	12.9	---
No program	18.6	11.4	13.1	17.4
Farm price 2/				
Current program	0.0	9.7	0.0	6.7
Subsidized put	0.0	10.8	1.1	---
No program	21.5	11.4	13.1	17.4
Producer revenue				
Current program	8.4	3.6	6.7	7.9
Subsidized put	8.4	3.8	5.9	---
No program	10.3	4.3	6.4	7.6
Government expenditures				
Current program	35.0	156.4	81.2	84.2
Subsidized put	41.4	152.3	81.9	---
No program	---	---	---	---

1/ Variability is measured as the standard deviation divided by the mean of the variable. 2/ Farm price equals the market price plus any Government program payments.

floor for market prices and by accumulating stocks that can be later released on the market when prices exceed release prices. While a subsidized put option program stabilizes farm prices by providing a minimum price, it has no effect on prices when prices are above the loan-rate-equivalent.

Subsidized option programs had little effect on those crops eligible for deficiency payments. Aggregate producer revenue for soybeans tended to be destabilized somewhat under a subsidized put program, reflecting the destabilizing effect of the program on farm prices.

The effect of subsidized options on the variability of Government costs differs by commodity. For wheat, the differences between the current program and a subsidized put program are insignificant because of the relative ineffectiveness of the price support program. In general, for those commodities where initial Government stock levels are large (corn), Government costs tend to be stable because storage costs account for such a large share of the total costs. For crops with negligible Government inventories and no deficiency payments (soybeans), Government costs are highly variable. Costs are large when market clearing are below the loan rate and negligible when prices are above the loan rate. For these crops, the simulation results suggest that Government payments can be stabilized with a subsidized put option program.

The Effect of Subsidized Put Options on Government Costs

The dynamic effects of Government intervention are very important. For example, in the early years of program operation a buffer stock tends to remove output from the market. Mean annual prices rise well above competitive levels, benefiting producers and hurting consumers and taxpayers. In contrast, the adjustment to long-run equilibrium for a program which subsidizes the purchase of put options is much more rapid since the Government does not intervene directly in the market. To capture these dynamic effects we estimate the discounted sum of mean annual gains (losses) over the period 1989-98.[6]

The costs of subsidizing puts are quite similar to costs under the current loan program (table 10). Under the baseline scenario, the savings from reduced wheat, corn, and soybean loan forfeitures and storage costs are estimated to be about $6.1 billion over ten years. However, increased outlays due to the purchase of option premiums would likely total about $5.9 billion over the same period. Thus, the difference between the net Government costs of subsidizing puts and the projected costs for

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[6]We assumed a real annual rate of interest at 4 percent.

Table 10--Net present value of Government costs of subsidized purchase of puts compared with current program for soybeans, corn, and wheat, 1989-98

Item	Scenario			
	Baseline	High elasticity	Low elasticity	High yield
	Million dollars			
Soybeans				
Savings				
Loan forfeitures	167.3	0.0	1,091.4	4,648.5
Storage payments	211.3	0.0	693.9	2,048.3
Subtotal	378.4	0.0	1,785.3	6,696.8
Put option outlays	722.6	0.0	4,401.7	7,051.0
Cost to Government	344.2	0.0	2,616.4	354.2
Corn				
Savings				
Loan forfeitures	2,618.9	1,038.1	3,959.6	12,608.6
Storage payments	3,081.9	1,296.7	4,695.2	14,573.5
Subtotal	5,700.7	2,334.8	8,654.8	27,182.2
Put option outlays	5,134.6	1,247.6	13,988.6	24,335.1
Cost to Government	-566.1	-1,087.2	5,333.8	2,947.0
Wheat				
Savings				
Loan forfeitures	0.0	0.0	0.0	0.0
Storage payments	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	0.0	0.0
Put option outlays	0.0	1,205.7	0.0	2,005.1
Cost to Government	0.0	1,205.7	0.0	2,005.1
Total				
Savings				
Loan forfeitures	2,786.2	1,038.1	5,051.0	17,257.1
Storage payments	3,293.1	1,296.7	5,389.1	16,621.8
Subtotal	6,079.2	2,344.8	10,440.1	33,879.0
Put option outlays	5,857.2	2,453.3	18,390.3	33,291.2
Cost to Government	-222.0	118.5	7,950.2	-587.8

the current loan program would likely be less than $500 million. By comparison, total program costs (including deficiency payments) for 1987 fiscal year alone were over $22.4 billion (USDA).

Budget costs are sensitive to the demand elasticities. The costs of subsidized options tend to increase relative to current program costs assuming less responsive demands. While savings from storage payments and reduced loan forfeitures increase by over 70 percent a low demand response, total outlays for option premiums increase by almost 215 percent. This is due, in part, to the increased price variability associated with low demand response.

For more price-responsive consumer demand, Government costs remain small. Price variability is lower under more elastic demands. For soybeans, Government costs fall to zero as the probability of prices falling below the loan rate fall to zero. Under a high yield scenario, the probability of loan forfeitures increases for both corn and soybeans. Loan outlays plus storage costs are almost 6 times as high under the high yield scenario as under the baseline. However, with higher yields option prices rise as well (tables 5-6). As a result, put option outlays for corn and soybeans offset the loan and storage savings.

Costs for the subsidy purchase of at-the-money call options would likely range between $1.5 and $3.6 billion (table 11). Estimated premium costs increase as demands become more inelastic (table 8), reflecting the increase in price variability.

Not included in these cost estimates are brokerage fees and commissions. Assuming brokerage fees of $40 per each 5,000-bushel contract of corn, wheat, and soybeans, subsidized option programs could add an additional $740 million to Government costs. Brokerage fees for corn contracts would account for over half of this figure ($444 million).

Welfare Effects of Subsidized Put Options

How would producers, consumers, and taxpayers be affected by a subsidized put program?[7] In the aggregate, producers would likely be unaffected (table 12). Under either a subsidized put program or the current loan program, producers would be

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[7]We measure consumer gain as the mean change in Marshallian consumer surplus caused by the introduction of a farm program into a competitive market. Producer gain is measured as the mean change in producer quasi-rent. Quasi-rent is measured as producer revenue minus the compounded costs of production (the area under the expected acreage supply equation times expected yield).

Table 11--Costs of subsidized call options

Scenario	Million dollars
Baseline	2,296.9
High elasticity	3,582.8
Low elasticity	1,512.9
High yield	2,465.3

guaranteed the loan rate or the loan-rate-equivalent strike price for their crops. For those crops eligible for deficiency payments, target prices would likely continue to guide producer planting decisions.

Under a subsidized put option program, producers sell their crops on the market rather than forfeiting them to the Government. Consumers benefit because additional supplies are made available to the market. However, our estimates indicate that benefits to consumers would likely be small under the baseline scenario. Total foreign and domestic consumer gains are estimated at $5.4 billion over the period 1989-98. If foreign consumers are excluded, consumer gains would likely be about $3.9 billion.

Total welfare gains for the subsidized option program would approach $6 billion. If only domestic consumers are considered, total gains would likely exceed $4.3 billion.

In general, consumer gains are greater under market scenarios which lead to lower, more variable, prices. Thus, consumer gains are greatest under the low elasticity and high yield scenarios. For example, under the high yield scenario, consumers gains would likely exceed $31 billion, almost 6 times gains under the baseline scenario.

Table 12--Welfare effects of subsidized purchase of puts compared with current program for soybeans, corn, and wheat, 1989-98

Item	Scenario			
	Baseline	High elasticity	Low elasticity	High yield
	Million dollars			
Soybeans				
Government cost	334.2	0.0	2,616.4	354.2
Producer gains	238.6	0.0	355.5	-313.5
Consumer gains				
Domestic	261.3	0.0	2,420.8	4,431.6
Export	167.1	0.0	1,355.9	2,616.1
Welfare gains				
Total	322.8	0.0	1,495.8	6,380.1
Domestic	155.7	0.0	160.0	3,763.9
Corn				
Government cost	-566.1	-1,087.2	5,333.8	2,947.0
Producer gains	0.0	0.0	0.0	0.0
Consumer gains				
Domestic	3,648.1	905.4	10,219.0	16,085.9
Export	1,342.2	332.3	3,307.0	6,288.8
Welfare gains				
Total	5,556.4	2,324.9	8,192.3	25,321.7
Domestic	4,214.2	1,992.6	4,885.3	19,032.9
Wheat				
Government cost	0.0	1,025.7	0.0	2,005.1
Producer gains	0.0	0.0	0.0	0.0
Consumer gains				
Domestic	0.0	482.2	0.0	928.1
Export	0.0	645.3	0.0	1,224.9
Welfare gains				
Total	0.0	101.8	0.0	148.0
Domestic	0.0	-543.5	0.0	1,076.9
Total				
Government cost	-222.0	118.5	7,950.2	-587.8
Producer gains	238.6	0.0	355.5	-313.5
Consumer gains				
Domestic	3,909.4	1,387.6	12,639.8	21,445.6
Export	1,509.3	977.6	4,662.9	10,129.8
Welfare gains				
Total	5,879.2	2,426.7	9,688.1	31,849.8
Domestic	4,369.9	1,449.1	5,045.3	23,873.7

Welfare Effects of Subsidized Call Options

In this model we have assumed that the cotton marketing loan program offers upland cotton producers the equivalent of a subsidized put option. Under the marketing loan program producers repay their loans at the adjusted world price (AWP) when the AWP is below the loan rate. In the simulation analysis, loan forfeitures under the marketing loan are zero. All of the crop is either milled domestically, exported, or held as free stocks by private warehousers. Under such a program, subsidized call options would have only a negligible effect on market prices. Subsidized call options would encourage producers to market their cotton at harvest. This could potentially affect the intraseasonal allocation of cotton, but, on average, we would expect annual prices to be unchanged. Thus, consumers would be unaffected by such a program. Producer gains would equal the size of the option subsidy, making net welfare gains inconsequential.

In practice, however, there may be little incentives for producers to redeem loans under a marketing loan, especially if storage costs are low, or producers expect spot prices to rise relative to the AWP. Attempts to adjust the AWP for upland cotton have largely been capitalized into larger equity payments for cotton producers (see Glauber 1988).[8]

Offering cotton producers subsidized at-the-money call options would likely encourage loan repayments. This would reduce loan forfeitures and offset some of the costs of the call option subsidy.

Conclusions

A number of conclusions can be drawn from the simulation analysis:

- In the aggregate, producers would be relatively unaffected by subsided option program compared to the current loan program. The loan rate and loan-rate-equivalent strike price would provide producers with similar income protection. Because of basis risk and yield risk, individual producers may be better off under one program than another.

- If only consumers are considered, subsidizing put options would likely be preferable to price supports. However, the gains are quite small--only $5.8 billion over 10 years.

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[8]Cotton producers can sell their nonrecourse loan obligations to warehousers and other merchants. This payment is know as an equity payment and reflects the value of redeeming the loan if prices rise above the loan repayment rate.

- Government costs tend to be higher under a subsidized option program for those commodities where demands are less price responsive. For commodities facing highly elastic export demands, costs may be lower than with price supports.

- Our results suggest that an options subsidy program would have little affect on the variability of market prices and could potentially increase price variability if price supports were removed. While producers would be insulated from market price variability, increased variability may affect decisions of processors and handlers further downstream in the marketing chain.

- Administrative costs may be higher under subsidized puts.

- Budget uncertainty may be less with subsidized puts.

Appendix table 1--Supply and demand parameters

	Soybeans	Corn	Wheat	Upland Cotton
Baseline				
Domestic demand				
Intercept	2.626	7.160	1.916	16.930
Elasticity	-0.450	-0.300	-0.420	-0.400
Export demand				
Intercept	2.616	3.420	2.846	40.260
Elasticity	-0.800	-0.900	-0.540	-0.650
Acreage supply				
Intercept	29.710	47.051	43.327	2.563
Elasticity	0.400	0.350	0.310	0.300
High elasticity				
Domestic demand				
Intercept	2.865	8.183	2.123	25.274
Elasticity	-0.500	-0.500	-0.500	-0.500
Export demand				
Intercept	5.725	4.321	7.066	445.745
Elasticity	-1.250	-1.250	-1.250	-1.250
Acreage supply				
Intercept	29.710	47.051	43.327	2.563
Elasticity	0.400	0.350	0.310	0.300
Low elasticity				
Domestic demand				
Intercept	1.854	6.925	1.541	9.281
Elasticity	-0.250	-0.250	-0.250	-0.250
Export demand				
Intercept	1.096	2.291	2.093	9.902
Elasticity	-0.300	-0.300	-0.300	-0.300
Acreage supply				
Intercept	29.710	47.051	43.327	2.563
Elasticity	0.400	0.350	0.310	0.300

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