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**Long-Term Effects of the 1985 Farm Act
on Put Option Short Hedging
for Corn and Soybeans**

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Departmental Information Report

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Introduction

The introduction of options on agricultural commodity futures has proliferated the possibilities for price risk management strategies to both long and short hedgers. Early analyses of options as a short hedge alternative to futures for producers suggests put options provide a favorable price risk management strategy, especially when yield uncertainty is high (Lippke and Sporleder). Also, interest in the potential use of options as a substitute for price support programs has surfaced (Gardner, Schertz). The 1985 Farm Act contains a provision which encourages study and analysis of the potential of options as a price support vehicle.

Two obvious differences between options and price supports were identified initially by Schertz. One difference is that current participation costs are minimal to producers through compliance provisions such as acreage diversion. However, the costs of options to provide a floor price comparable to a prevailing loan rate may be substantial to producers.

A second difference is that price support programs influence long-run market clearing price levels, whereas farmers' use of put options to provide floor price protection does not. Government price support programs are partially motivated by an income transfer goal. To the extent the Government programs influence equilibrium market price for a commodity, feedback effects obviously exist on the magnitude of deficiency payments and direct government storage costs.

Federal farm bill provisions obviously influence equilibrium commodity

prices (Irwin). This paper focuses on the interaction between the 1985 Farm Act and the potential long-term use of put option hedging by agricultural producers. One possibility is for crop producers to participate in federal commodity programs and short hedge through the appropriate commodity options markets as a complement to their participation. A rational producer may participate in the farm program but examine the feasibility of using put options to secure a higher minimum price at harvest than the prevailing loan rate provided for that commodity.

Specifically, the aggregate impacts of the 1985 Farm Bill are estimated annually through 1990 for corn and soybeans. These results are then interpreted for their implication for put option short hedging as a potential complement to the loan program provisions for each commodity. That is, the influence of the 1985 Farm Act on long-term put option hedging is examined. Producers may participate in the program but also use short puts as a means of setting a more favorable floor price than is afforded by the 1985 Farm Act. Floor or minimum prices from various put strikes are estimated and examined relative to prevailing loan rates for each crop and year. The analysis highlights differences among the commodities analyzed.

Methods

The effect of 1985 Farm Act for corn and soybeans on annual equilibrium prices and real farm income is assessed through using the COMGEM macroeconomic model. COMGEM, a Commodity General Equilibrium Model, is an econometric model of the U.S. economy which examines agricultural prices and quantities in a systematic fashion.

COMGEM has a farm supply response and disappearance component for the major crop and livestock commodities (Penson, Hughes, and Romain). COMGEM was used in this study to project the effects of macroeconomic and farm policy

provisions on commodity price levels, supplies, total use, and ending stocks for corn and soybeans.

Put premiums and the minimum floor price implied from selected strike prices for each commodity were estimated using the *Grain Futures and Options Hedging Evaluator* (Sporleder, Smith, and Neils). This program calculates theoretical fair market put premiums using the standard Black commodity options pricing formula. The short-run interest rate chosen was the 3-month Treasury bill rate, projected by COMGEM. Put premiums for selected strike prices were estimated in each instance using 15-, 20-, and 25-percent futures price volatility for the appropriate contract.

For each commodity analyzed, the put premium is based upon purchase at planting and offset at harvest. The approximate put premiums are calculated annually for appropriate years from 1988 through 1990. For the analysis, the harvest month futures price at hedge placement for each commodity is assumed equivalent to the annual equilibrium cash market price generated by COMGEM, adjusted for a representative basis.

Impacts of Policy Assumptions

The target prices and loan rates for the 1985 Farm Act used in this analysis are calculated based upon formulas in the 1985 Act and would be similar to those reported by Glaser. Loan rates are based on the assumption that the Secretary of Agriculture would assure U.S. farm products are competitive in world markets (Knutson, et al, p.15). Set-aside levels are maintained throughout the study period at or near the 1987 level, depending on stock levels. Participation in the paid diversion program for corn and sorghum was assumed to be minimal.

The macroeconomic environment projected by COMGEM to the end of the decade

reflects the assumption of continued high federal deficits and fast money growth. This strong monetary and fiscal policy stimuli leads to accelerated growth in real GNP and inflation. Real GNP expands between 5 and 6 percent per year, an inflation rate ranging between 6 to 7 percent, and a real prime interest rate approaching 8 percent by the end of the decade.

Equilibrium prices during the 1987-1990 period for corn and soybeans were projected by COMGEM under this general macroeconomic and farm policy environment (Tables 1 and 2). For corn, the set-aside levels are not sufficient to reduce production. Relatively high target prices are expected to continue building stocks even though target prices decline beginning in 1988. On the strength of increased demand and reduced production, cash price exceeds loan rates by 1989.

Soybeans are expected to enjoy export and domestic market growth which encourages some increased production. Stocks peak in 1987, but fall subsequently. The equilibrium cash price is expected to exceed the loan rate annually for 1988 and beyond.

Short Hedging with Put Options

Farm programs obviously affect on the need for short hedging by producers. One method of assessing this effect is to examine the extent to which short hedging by buying puts against a growing crop may complement or substitute for the loan provisions of the current farm legislation. Specifically, the focus here is on calculation of premiums for selected put strikes which provide the same or higher price floor than is afforded by the loan rate for each commodity.

Table 1:   Impacts on Corn of 1985 Farm Bill, Selected Items, 1987-90

| | Crop Year | | | |
	1987	1988	1989	1990
Acres Planted (mil.)	72.2	70.0	69.1	67.6
Acres Harvested (mil.)	65.0	63.0	62.2	60.8
Yield/A (bu.)	115.0	116.1	117.3	118.5
Beginning Stocks (bil.bu.)	5.61	6.12	6.16	5.82
Production (bil.bu.)	7.48	7.32	7.29	7.21
Total Supply (bil.bu)	13.09	13.44	13.45	13.03
Exports (bil.bu.)	1.57	1.74	1.90	2.04
Domestic Use (bil.bu.)	5.40	5.54	5.73	5.98
Total Use (bil.bu.)	6.97	7.28	7.63	8.02
Ending Stocks (bil.bu.)	6.12	6.16	5.82	5.01
Target Price ($)	3.03	2.97	2.88	2.75
Loan Rate ($)	1.82	1.74	1.64	1.56
Set-Aside	20	20	20	20
Farm Price ($)	1.56	1.72	1.81	1.98
Subsidy Cost ($ bil.)	7.25	7.37	6.41	4.62
Storage Cost ($ bil.)	0.80	0.81	0.79	0.71
Total Cost ($ bil.)	8.05	8.18	7.20	5.33
Net Cash Income ($ bil.)	3.55	4.68	3.40	1.96

Source: COMGEM, Agricultural and Food Policy Center, Texas A&M University
System.

Table 2:   Impacts on Soybeans of 1985 Farm Bill, with Selected Items, 1987-90

	1985 Farm Bill			
	1987	1988	1989	1990
Acres Planted (mil.)	61.0	61.4	61.7	61.9
Acres Harvested (mil.)	59.5	59.9	60.2	60.4
Yield/A (bu.)	31.7	32.2	32.8	33.4
Beginning Stocks (bil.bu.)	0.62	0.55	0.51	0.48
Production (bil.bu.)	1.89	1.93	1.97	2.02
Total Supply (bil.bu)	2.51	2.48	2.48	2.50
Exports (bil.bu.)	0.80	0.81	0.82	0.83
Domestic Use (bil.bu.)	1.16	1.16	1.18	1.19
Total Use (bil.bu.)	1.96	1.97	2.00	2.02
Ending Stocks (bil.bu.)	0.55	0.51	0.48	0.48
Loan Rate ($)	4.77	4.50	4.50	4.50
Target Rate ($)	--	--	--	--
Farm Price ($)	4.59	4.54	4.63	4.72
Subsidy Cost ($ bil.)	--	--	--	--
Storage Cost ($ bil.)	0.07	0.07	0.07	0.07
Total Cost ($ bil.)	0.07	0.07	0.07	0.07
Net Cash Income ($ bil.)	1.74	1.47	1.38	1.21

Source: COMGEM, Agricultural and Food Policy Center, Texas A&M University
          System.

Corn

Over the period 1987-1990, the provisions of the 1985 Farm Act for corn relative to equilibrium cash price indicates loan rates above cash price for 1987 and 1988 (Table 1). The first year where short puts might complement participation in the farm program is 1989. For that year, a cash price of $1.81/bushel, compared to a loan rate of $1.64/bushel, is indicated by the COMGEM analysis.

Approximate put premiums were calculated for the 1989 and 1990 crops, assuming a hedge date of May 15 with a lift date of October 15, or a period of 153 days for the put hedge, with about 180 days from purchase until expiration. Three month Treasury bill rates for 1989 were estimated by COMGEM at 9.6 percent and 11.3 for 1990. These rates were used as the interest rate in the Black model for the appropriate year. A basis 5 cents under was assumed typical. Premiums and implied floor prices for various strikes assuming 15-, 20-, and 25-percent futures price volatility were estimated (Table 3). Implied floor price or minimum price is calculated in a standard manner as the strike price minus costs and basis. Costs are calculated to include the put premium, commissions, and the opportunity cost on commissions for the life of the hedge (Table 3).

Results indicate that a put strike of about $1.80 in 1989 would produce a floor price for corn of $1.67, about $0.03 more than the loan rate floor provided by the 1985 Farm Act (at 20 percent volatility, Table 3). For 1990, a strike of $1.70 is estimated to result in a floor of $1.63, or about $0.07 above the prevailing loan rate. The approximate premiums for these strikes were estimated to be $0.07/bushel for 1989 and $0.01/bushel for 1990. An at-the-money put strike of $1.90 is estimated to produce an $0.08 improvement over the loan for 1989 while an at-the-money strike for 1990 of $2.00 is

Table 4:   Soybeans: Approximate Put Premiums and Implied Floor Prices at Planting, For Selected Strikes, 1988 and 1989.

Assuming:

Nov/88 Futures Price on 06/01/88	($/Bu)	4.84		Nov/89 Futures Price on 06/01/89	($/Bu)	4.93		
Expected Basis at Harvest	($/Bu)	- .30		Expected Basis at Harvest	($/Bu)	- .30		
Short-Term Interest Rate	(%)	9.10		Short-Term Interest Rate	(%)	9.60		

Strike Price	Put Premium	Commission + Opp. Cost + Basis	Implied Floor Price	Premium as % of Implied Floor Price	Strike Price	Put Premium	Commission + Opp. Cost + Basis	Implied Floor Price	Premium as % of Implied Floor Price
($/Bu)	($/Bu)	($/Bu)	($/Bu)	(%)	($/Bu)	($/Bu)	($/Bu)	($/Bu)	(%)
=======	=======	============	========	=========	======	=======	============	========	========
Volatility of Futures Price = 15 percent.									
4.25	0.01	0.3065	3.93	0.25	4.25	0.01	0.3066	3.93	0.25
4.50	0.05	0.3079	4.14	1.21	4.50	0.03	0.3073	4.16	0.72
4.75	0.13	0.3105	4.31	3.02	4.75	0.10	0.3097	4.34	2.30
5.00	0.26	0.3148	4.43	5.88	5.00	0.21	0.3135	4.48	4.69
5.25	0.44	0.3208	4.49	9.80	5.25	0.37	0.3191	4.56	8.11
5.50	0.66	0.3281	4.51	14.63	5.50	0.58	0.3265	4.59	12.63
					5.75	0.82	0.3349	4.60	17.84
Volatility of Futures Price = 20 percent.									
4.00	0.01	0.3065	3.68	0.27	4.00	0.01	0.3066	3.68	0.27
4.25	0.04	0.3075	3.90	1.02	4.25	0.03	0.3073	3.91	0.77
4.50	0.09	0.3092	4.10	2.19	4.50	0.07	0.3087	4.12	1.70
4.75	0.18	0.3122	4.26	4.23	4.75	0.15	0.3114	4.29	3.50
5.00	0.32	0.3168	4.36	7.33	5.00	0.27	0.3156	4.41	6.12
5.25	0.49	0.3224	4.44	11.04	5.25	0.42	0.3209	4.51	9.31
5.50	0.68	0.3287	4.49	15.14	5.50	0.61	0.3275	4.56	13.37
5.75	0.91	0.3363	4.50	20.21	5.75	0.82	0.3349	4.60	17.84
6.00	1.07	0.3436	4.59	23.33					
Volatility of Futures Price = 25 percent.									
3.75	0.01	0.3065	3.43	0.29	4.00	0.02	0.3069	3.67	0.54
4.00	0.03	0.3072	3.66	0.82	4.25	0.06	0.3083	3.88	1.55
4.25	0.07	0.3085	3.87	1.81	4.50	0.12	0.3104	4.07	2.95
4.50	0.14	0.3108	4.05	3.46	4.75	0.20	0.3132	4.24	4.72
4.75	0.24	0.3141	4.20	5.72	5.00	0.32	0.3174	4.36	7.34
5.00	0.37	0.3185	4.31	8.58	5.25	0.48	0.3230	4.45	10.79
5.25	0.53	0.3237	4.40	12.06	5.50	0.65	0.3289	4.52	14.38
5.50	0.72	0.3300	4.45	16.18	5.75	0.85	0.3359	4.56	18.62
5.75	0.93	0.3370	4.48	20.75	6.00	1.07	0.3436	4.59	23.33

estimated to yield a $0.29/bushel improvement over loan, both calculated at 20 percent December futures price volatility.

Soybeans

Over the period 1987-1990, the provisions of the 1985 Farm Act for soybeans relative to equilibrium cash price indicates loan rates above cash price only in 1987 (Table 2). For soybeans, short puts potentially could complement farm program participation each year from 1988. For 1988 a cash price of $4.54 is used, compared with $4.63 for 1989 and $4.72 for 1990 (Table 2). The loan rate for each year is $4.50.

Approximate put premiums were calculated for the 1988 through 1990 crop seasons, assuming a hedge date of June 1 with a lift date of November 10, or a period of 131 days for the put hedge, with about 135 days from purchase until put expiration. The three month Treasury bill rate for 1988 was estimated by COMGEM at 9.1 percent, with 1989 and 1990 years the same as before. A basis of 30 cents under was assumed typical for soybeans. Premiums and implied floor prices for various November soybean put strikes were estimated over the same range of price volatility used for corn. Implied floor prices were calculated in the same manner as for corn.

Results for soybeans for 1988 suggest that few strikes will likely provide a floor roughly equivalent to the $4.50 loan rate across any of the three futures price volatilities assumed (Table 4). The best floor for the 1988 crop is $4.51 at a strike of $5.50, assuming 15 percent volatility. Greater volatility would require a higher strike.

For 1989, the picture changes (Table 4). A floor of $4.51 is estimated to be available from puts for the 1989 crop at a strike of $5.25, assuming 20 percent November futures price volatility. At 25 percent volatility, the floor for this strike falls to $4.45.

Table 3: Corn: Approximate Put Premiums and Implied Floor Prices at Planting, For Selected Strikes, 1989 and 1990.

Assuming:

Dec/89 Futures Price on 05/15/89	($/Bu)	1.86	
Expected Basis at Harvest	($/Bu)	- .05	
Short-Term Interest Rate	(%)	9.60	

Dec/90 Futures Price on 05/15/90	($/Bu)	2.03	
Expected Basis at Harvest	($/Bu)	- .05	
Short-Term Interest Rate	(%)	11.30	

Strike Price	Put Premium	Commission + Opp. Cost + Basis	Implied Floor Price	Premium as % of Implied Floor Price	Strike Price	Put Premium	Commission + Opp. Cost + Basis	Implied Floor Price	Premium as % of Implied Floor Price
($/Bu)	($/Bu)	($/Bu)	($/Bu)	(%)	($/Bu)	($/Bu)	($/Bu)	($/Bu)	(%)
Volatility of Futures Price = 15 percent.									
1.60	0.01	0.0567	1.53	0.65	1.80	0.01	0.0568	1.73	0.58
1.70	0.02	0.0571	1.62	1.23	1.90	0.03	0.0577	1.81	1.66
1.80	0.05	0.0583	1.69	2.96	2.00	0.07	0.0596	1.87	3.74
1.90	0.10	0.0603	1.74	5.75	2.10	0.12	0.0621	1.92	6.26
2.00	0.16	0.0628	1.78	9.00	2.20	0.19	0.0654	1.94	9.77
2.10	0.24	0.0660	1.79	13.38	2.30	0.27	0.0693	1.96	13.77
2.20	0.34	0.0701	1.79	19.00	2.40	0.37	0.0741	1.96	18.92
Volatility of Futures Price = 20 percent.									
1.50	0.01	0.0567	1.43	0.70	1.70	0.01	0.0568	1.63	0.61
1.60	0.02	0.0571	1.52	1.31	1.80	0.03	0.0577	1.71	1.75
1.70	0.04	0.0579	1.60	2.50	1.90	0.06	0.0592	1.78	3.37
1.80	0.07	0.0591	1.67	4.19	2.00	0.09	0.0606	1.85	4.87
1.90	0.12	0.0611	1.72	6.98	2.10	0.15	0.0635	1.89	7.95
2.00	0.18	0.0636	1.76	10.25	2.20	0.21	0.0664	1.92	10.92
2.10	0.26	0.0669	1.77	14.66	2.30	0.29	0.0702	1.94	14.95
2.20	0.34	0.0701	1.79	19.00	2.40	0.37	0.0741	1.96	18.92
Volatility of Futures Price = 25 percent.									
1.50	0.01	0.0567	1.43	0.70	1.60	0.01	0.0568	1.53	0.65
1.60	0.03	0.0575	1.51	1.98	1.70	0.03	0.0577	1.61	1.86
1.70	0.06	0.0587	1.58	3.79	1.80	0.05	0.0587	1.69	2.96
1.80	0.10	0.0603	1.64	6.10	1.90	0.08	0.0601	1.76	4.55
1.90	0.15	0.0624	1.69	8.89	2.00	0.12	0.0621	1.82	6.60
2.00	0.21	0.0648	1.73	12.17	2.10	0.17	0.0645	1.87	9.11
2.10	0.28	0.0677	1.75	15.98	2.20	0.24	0.0678	1.89	12.68
2.20	0.35	0.0705	1.78	19.67	2.30	0.31	0.0712	1.92	16.16

The analysis suggests that, for the 1990 crop, at-the-money put options at planting provide a floor slightly exceeding the prevailing loan rate (Table 5). The strikes and associated premiums estimated for 1990 indicate a floor of $4.68 at a $5.75 strike and 15 percent volatility. With a greater volatility of 20 percent, the floor available through puts at planting is estimated at $4.67 at a $5.75 strike. This situation would require purchasing a deep in-the-money put where the premium associated with the $5.75 strike is $0.74, or nearly all intrinsic value. Similarly, for the 25 percent volatility, a floor of only $4.63 is indicated for a strike of $5.75 and associated premium of $0.78.

Conclusions

The analysis broadly suggests that current provisions of the 1985 Farm Act coupled with a continuation of expansionary macroeconomic policy have an extensive influence on the potential producer use of puts to short hedge and complement program participation. The situation changes significantly over the three crop years analyzed. For 1988, the analysis suggests that neither corn nor soybean producers would expect short puts to offer advantages substantially above the 1988 prevailing loan rates.

However, for the 1989 crop, the analysis suggests that corn producers would have a better chance of using puts as a complement to farm program participation. At-the-money puts would produce floor prices about $0.05 to $0.10/bushel above prevailing loan rates and in-the-money puts would provide slightly higher floors.

This compares to soybeans for 1989, where the analysis suggests that in-the-money puts might achieve no better than floor prices equivalent to loan rates. At-the-money puts in 1989 are associated with floors anywhere from

Table 5:   Soybeans: Approximate Put Premiums and Implied Floor Prices at Planting, For Selected Strikes, 1990.

Assuming:
Nov/90 Futures Price on 06/01/90	($/Bu)		5.02
Expected Basis at Harvest	($/Bu)	-	.30
Short-Term Interest Rate	(%)		11.30

Strike Price	Put Premium	Commission + Opp. Cost + Basis	Implied Floor Price	Premium as % of Implied Floor Price
($/Bu)	($/Bu)	($/Bu)	($/Bu)	(%)
======	=======	============	========	=========
Volatility of Futures Price = 15 percent.				
4.25	0.01	0.3067	3.93	0.25
4.50	0.02	0.3071	4.17	0.48
4.75	0.07	0.3091	4.37	1.60
5.00	0.16	0.3128	4.53	3.53
5.25	0.31	0.3190	4.62	6.71
5.50	0.50	0.3268	4.67	10.70
5.75	0.73	0.3363	4.68	15.59
Volatility of Futures Price = 20 percent.				
4.00	0.01	0.3067	3.68	0.27
4.25	0.02	0.3071	3.92	0.51
4.50	0.05	0.3083	4.14	1.21
4.75	0.12	0.3112	4.32	2.78
5.00	0.22	0.3153	4.46	4.93
5.25	0.36	0.3210	4.57	7.88
5.50	0.54	0.3285	4.63	11.66
5.75	0.74	0.3367	4.67	15.83
6.00	0.98	0.3465	4.67	20.97
Volatility of Futures Price = 25 percent.				
4.00	0.02	0.3071	3.67	0.54
4.25	0.05	0.3083	3.89	1.28
4.50	0.09	0.3099	4.10	2.20
4.75	0.17	0.3132	4.27	3.98
5.00	0.28	0.3178	4.40	6.36
5.25	0.42	0.3235	4.51	9.32
5.50	0.59	0.3305	4.58	12.88
5.75	0.78	0.3383	4.63	16.84
6.00	0.99	0.3470	4.66	21.23

$0.02 to $0.14/bushel below the loan rate, depending on volatility. Thus, the likelihood of soybean producers benefiting substantially from short puts is doubtful, given current provisions for the 1989 crop year and projected economic conditions.

For 1990, the situation improves for corn relative to 1989 but remains marginal for soybeans. At-the-money puts for 1990 corn are estimated to imply a floor price from $0.26 to $0.31/bushel above prevailing loan rates, depending on volatility. By contrast, in-the-money puts at a $5.50 strike would be required by soybean producers to imply a floor only $0.08 to $0.17/bushel above prevailing loan rates, depending on volatility.

Overall, the analysis suggests that the 1985 Farm Act and projected macroeconomic conditions have their greatest impact on soybean producers compared to corn producers. That is, soybean producers would be expected to have less chance of short hedging using puts to profitably complement program participation compared to corn producers.

This analysis obviously is limited by the need to make a number of major assumptions, both in estimating the 1985 Farm Act effects on commodity price, and on estimating the implied floor prices likely available from put options. Although the numbers may not prove to be correct in absolute magnitude, the relative effects on corn compared to soybeans should be reasonably accurate.

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