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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

## **Can Farm Program Budgetary Risks Be Shifted through Futures and Options Markets?**

by

Richard G. Heifner and Bruce H. Wright

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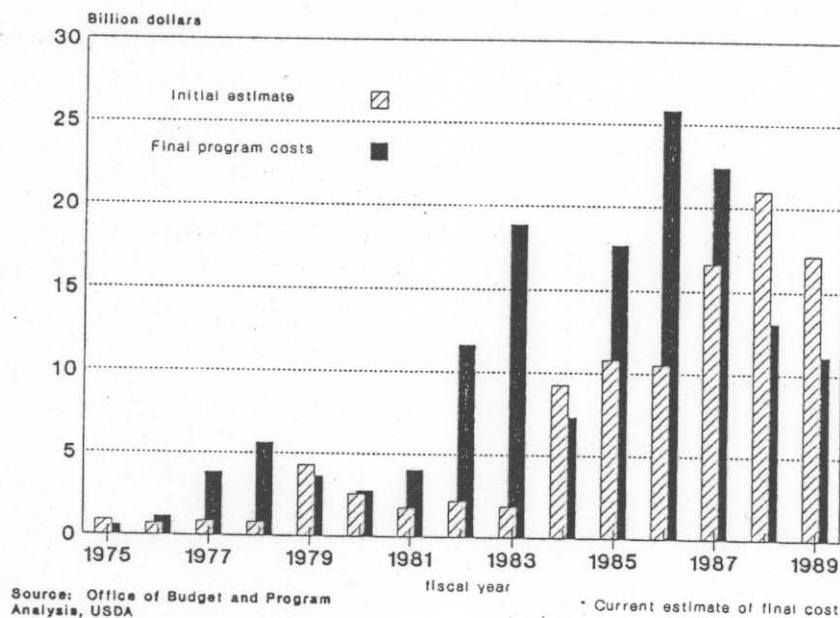
# CAN FARM PROGRAM BUDGETARY RISKS BE SHIFTED THROUGH FUTURES AND OPTIONS MARKETS?

Richard G. Heifner and Bruce H. Wright\*

The Federal Government absorbs many of the risks in farming through price support, deficiency payment, and crop insurance programs. These risks are reflected in farm program budgetary uncertainties. The magnitude of these budgetary uncertainties is illustrated by the fact that total CCC program costs have deviated from budget estimates by more than 5 billion dollars in 7 out of the last 10 years (figure 1). The feasibility of shifting CCC budgetary uncertainties from the Government to private traders through futures or options markets is evaluated in this paper.

Farm programs are commonly advocated for shifting risks in the opposite direction--from the private sector to the Government--to overcome presumed failures in private risk markets. In contrast, we begin with the presumption that private risk markets (particularly futures and options markets) are efficient risk-spreading or risk-absorbing mechanisms, possibly more efficient than the Federal Treasury. On this basis, shifting farm program budgetary risks to the private sector may be desirable, provided that the programs themselves are justified on other grounds, such as transferring income to farmers or serving as a necessary intermediary between farmers and the risk

Figure 1--CCC total program costs



\*Economists, Economic Research Service, U.S. Department of Agriculture. Conclusions stated in this paper are solely those of the authors and do not represent official U.S.D.A. policy or opinions.

markets. In this paper, we only explore the feasibility of shifting Federal budgetary risks to the private sector; we do not evaluate the desirability of such risk transfer or the effect on total CCC outlays.

### The Nature of Farm Program Budgetary Risk

Budgetary uncertainty occurs when actual expenditures cannot be predicted precisely as budgets are constructed. The degree of uncertainty is not directly observable and varies from year to year depending upon economic conditions. However, its magnitude can be gauged by observing historical differences between actual expenditures and estimates of expenditures made earlier in time.

Federal budgeting begins about 18 months before the fiscal year starts as departments and agencies within the Government prepare their budget recommendations for the administration. The President's budget is submitted to Congress in January about 9 months before the fiscal year begins and 21 months before it ends. Congress normally completes action on the budget by sometime in the summer. In recent years the budget frequently has not been passed before the October 1 beginning of the fiscal year. This necessitates the use of continuing resolutions.

Estimated and actual program costs by commodity for feed grains, wheat, soybeans, and cotton during fiscal years 1975 to 1989 are shown in figures 2 through 5. The estimated costs are those used to construct the President's January budgets. Both estimated and actual outlays and the differences between them tended to be much larger from 1981 to 1988 than during the preceding years. The largest estimation errors occurred for feed grains in 1982, 83, 86, and 87, but large errors have also occurred for wheat and cotton during the eighties.

In contrast to the risks on a commercial storage operation, which begin and end with the storage period, the risks borne by the Government in supporting farm prices are spread over a long and somewhat vaguely defined interval. The timing of the Government's risk exposure is affected by the growing season and the periods allowed for program signup, taking out loans, and determining deficiency payments (figure 6).

We view budgetary risk in terms of expected mean squared deviations between actual and expected costs, summed over appropriate time periods and discounted. We hypothesize that the budgetary risk borne by the Government in supporting the price for a particular year's crop follows a pattern similar to that depicted in figure 7. Initially, the enactment of legislation setting ranges for target prices and loan rates makes the Government a grantor of guarantees similar to put options, but with vaguely defined strike prices on an undefined quantity of product. Budgetary uncertainty may increase as the Government makes its price and income guarantees more specific while market conditions remain unknown. It decreases as yields, market prices, and farmer participation become known. Budgetary risk is high at the time when specific price support levels are announced and declines as farmers sign up, as yields are determined, and as farmers take out loans. For a large crop resulting in low market prices, large deficiency payments, and substantial Government takeovers, budgetary uncertainty is higher than for a smaller crop. The

Figure 2--CCC feed grain program costs

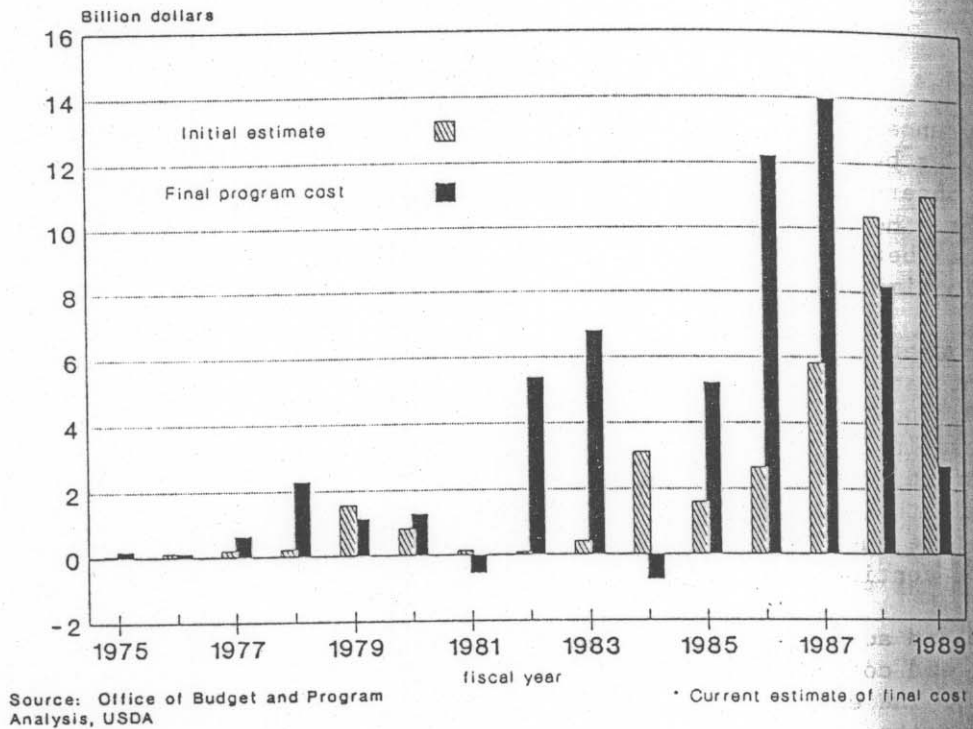


Figure 3--CCC wheat program costs

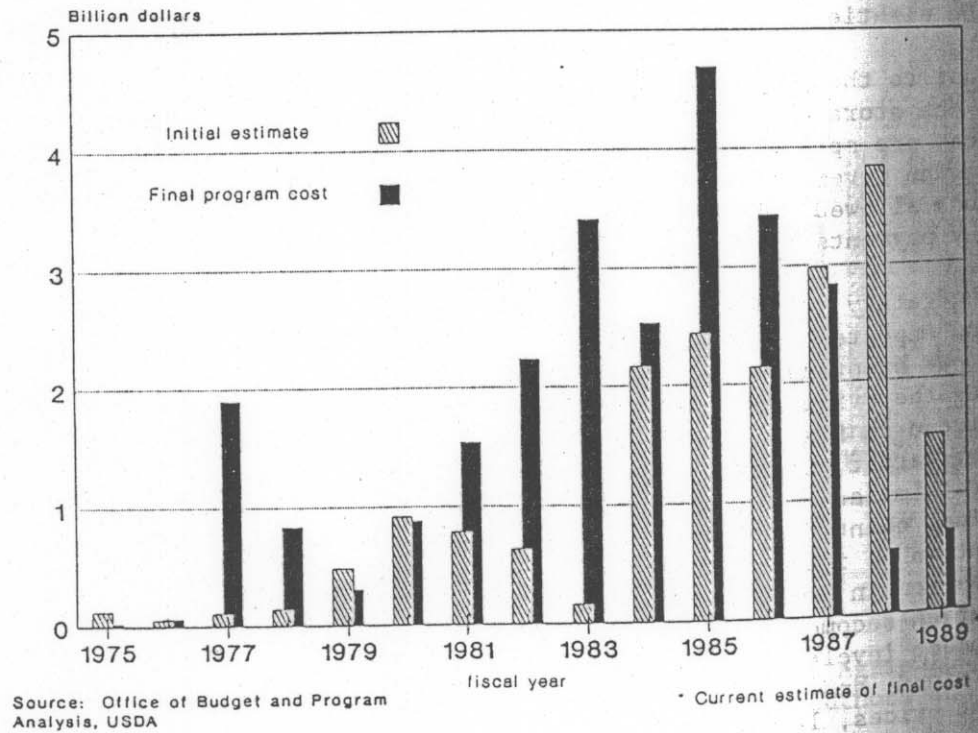
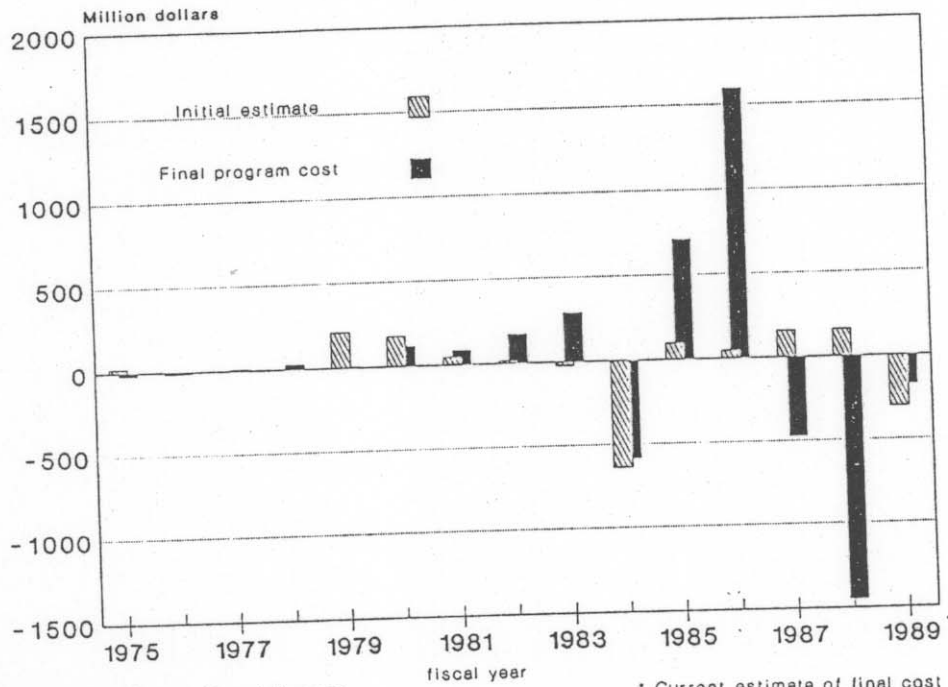
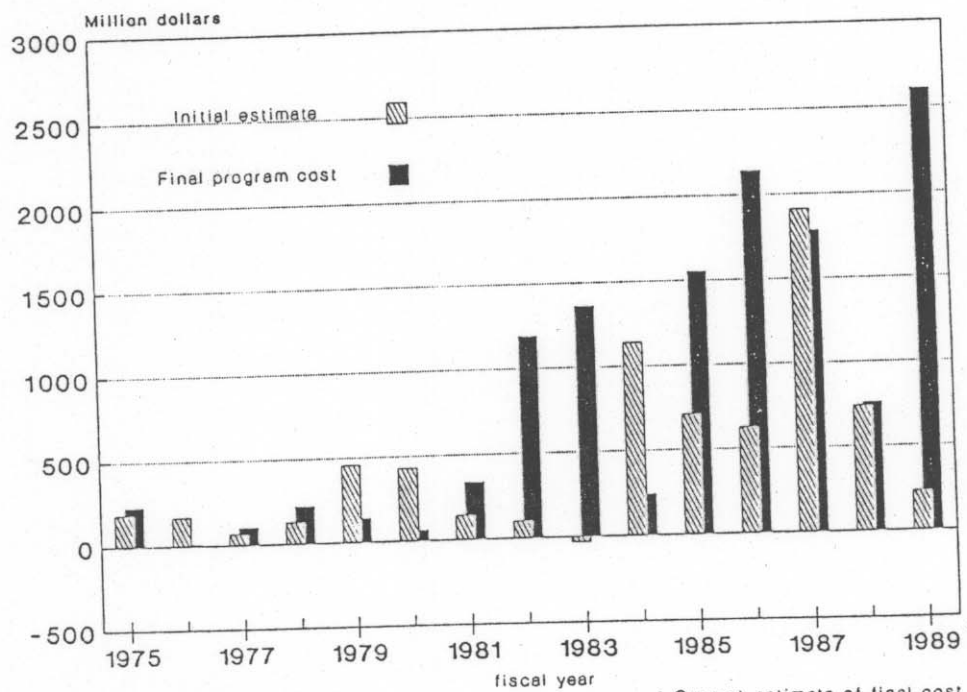


Figure 4--CCC soybean program costs



Source: Office of Budget and Program Analysis, USDA

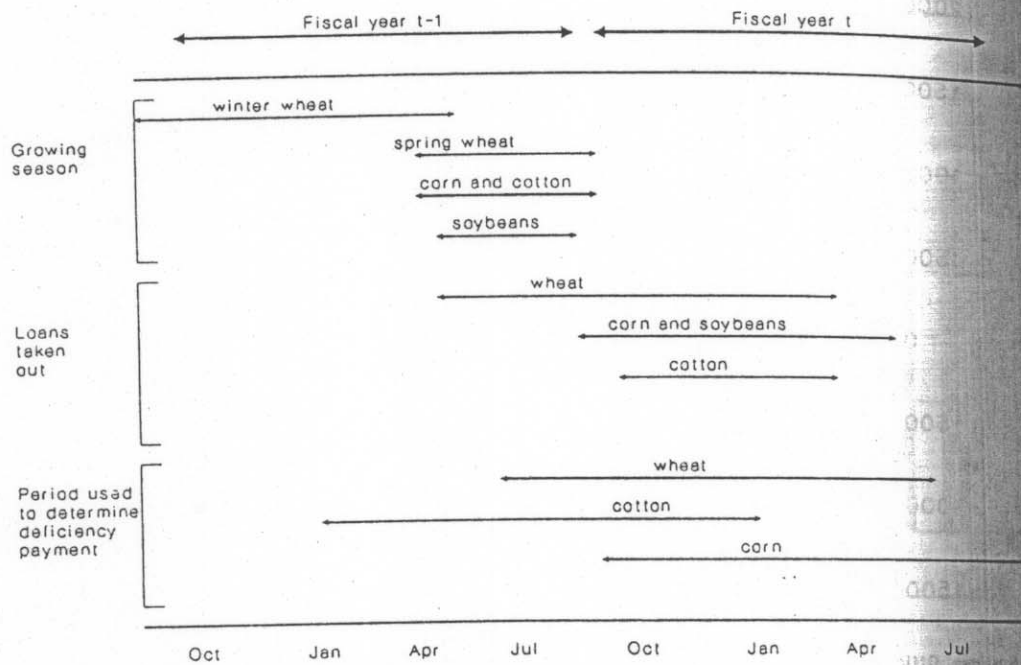
Figure 5--CCC cotton program costs



Source: Office of Budget and Program Analysis, USDA

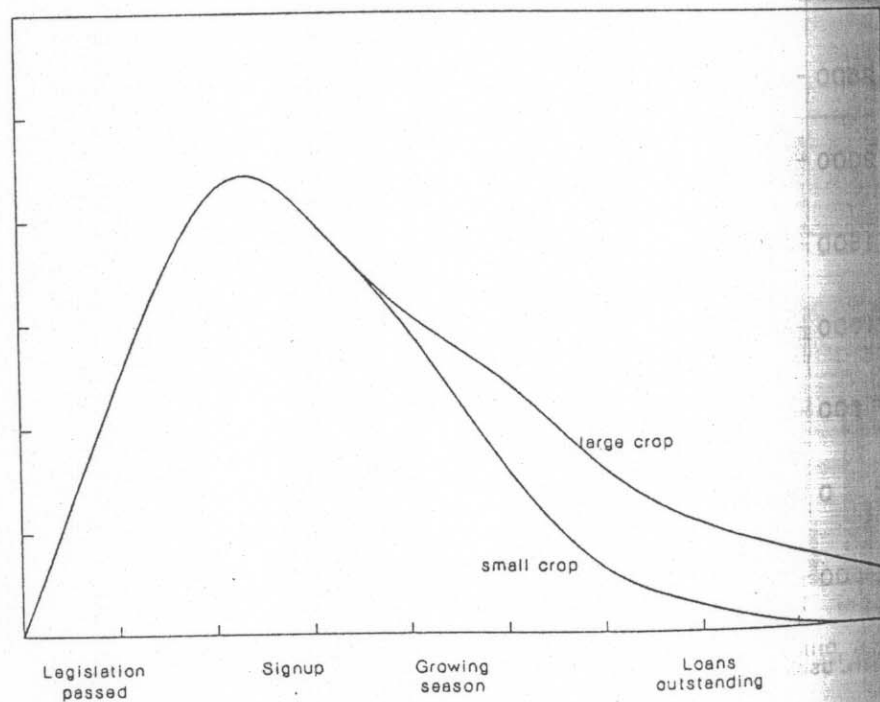


Figure 6--Calendar for Government's price risk exposure



Source: Agricultural Stabilization and Conservation Service USDA

Figure 7--Budget risk borne by the Government in supporting one year's crop



Government's budget uncertainties regarding the loan program end if and when the loans are redeemed by farmers. If the farmer forfeits the commodity, the Government's budget uncertainties continue. Its position changes from being, in effect, a grantor of put options to being long in the commodity. Since budgets reflecting expectations are developed only a few times each year, we cannot readily verify the seasonal pattern of uncertainty shown in figure 7.

The uncertainties associated with supporting farm incomes are pooled with other budgetary uncertainties in the overall Federal budget. Farm program costs have not exceeded 2.6 percent of total Federal outlays in any recent year (table 1). Moreover, the correlation between CCC budgeting errors and total Federal budgeting errors was slightly negative (-0.1) for 1980 to 1988 using real dollars.<sup>1/</sup> If CCC expenditures had been estimated without error from 1980 to 1988, the mean squared error in estimating total Federal expenditures would have changed little.<sup>2/</sup> Nevertheless, CCC budgeting accuracy is important in making decisions within agriculture.

Table 1--Budgeted and actual outlays for Government and CCC programs, fiscal years, 1975-1988.

	Total Government			CCC			CCC share b/
	Budgeted	Actual	Difference a/	Budgeted	Actual net	Difference a/	
	---Billion dollars---			---Billion dollars---			Percent
1975	304.4	332.3	27.9	.9	.6	-.3	.2
1976	349.4	371.8	22.4	.7	1.1	.4	.3
1977	394.2	409.2	15.0	.9	3.8	2.9	.9
1978	440.0	458.7	18.7	.8	5.6	4.8	1.2
1979	500.0	503.5	3.5	4.3	3.6	-.7	.7
1980	531.6	590.9	59.3	2.5	2.7	.2	.4
1981	615.8	678.2	62.4	1.7	4.0	2.3	.6
1982	739.3	745.7	6.4	2.2	11.6	9.4	1.6
1983	757.6	808.3	50.7	1.8	18.8	17.0	2.3
1984	848.5	851.8	3.3	9.2	7.3	-1.9	.9
1985	925.5	946.3	20.8	10.8	17.7	6.9	1.9
1986	973.7	990.3	16.6	10.5	25.8	15.3	2.6
1987	994.0	1003.8	9.8	16.6	22.4	5.8	2.2
1988	1024.3	1064.0	39.7	21.0	13.1	-7.9	1.2

a/ Difference is actual outlays minus budgeted outlays. Minus (-) indicates actual outlays were less than budgeted outlays.

b/ Actual CCC outlays as percent of actual total Government outlays.

Source: The President's Budget (various issues) and Office of Budget and Program Analysis, USDA.

### Possible Methods for Shifting Budgetary Risk

Possibilities for shifting the commodity price risks currently borne by the Government to private traders include: (1) Government "hedging" its price support commitments directly in futures or options, or perhaps indirectly by purchasing special option-like contracts from dealers who would in turn offset their risks in the futures or options markets; and (2) subsidizing farmers' use of futures, options, or cash forward contracts in lieu of price supports and deficiency payments.

#### Government "Hedging"

In guaranteeing support prices or deficiency payments the Government, in effect, grants put options for the commodities covered. To offset the price risks involved the Government would need to either buy puts or sell futures, and hold these positions over periods that correspond to the periods of the price guarantees.

Houthakker proposed in 1967 that the Government buy and sell futures contracts to stabilize commodity prices. He intended for the Government to thereby influence interyear stock-carrying without actually holding commodities. In effect, the Government would be acting as a large, benevolent, price-manipulating speculator under his plan. In contrast, our topic concerns Government trading as a pure hedger to shift risks incurred in running existing farm programs.

Designing a program for the Government to hedge its price commitments is not an easy task. First, the 1-5 year price guarantees embodied in farm legislation clearly cannot be effectively hedged in futures contracts that trade only 12-15 months before maturity. Some new type of contract with longer maturity periods would be needed to hedge such long term price guarantees. Analysis of these possibilities is outside the scope of this study.

Prospects for hedging the Government's shorter-term commitments are more promising. For example, the Government might sell futures or buy put options as price support levels are announced, as the program budget is formulated, or as farmers sign up for the program. These positions would be carried and rolled over as necessary until the time for redeeming loans passed and the Government's price support commitments were fulfilled. If the crop turned out to be large and prices low, the Government could buy back the futures contracts, or sell its put options which would have appreciated in value, to raise money to help cover price support costs. If, instead, the crop turned out to be small and prices high, then price-support costs would be small, and the Government would either buy back the futures at a loss or let its put options expire unexercised and without value.

Arrangements for the Government to hedge indirectly might be devised if direct Government trading in the futures or options markets were deemed objectionable. For example, the Government might buy special option-like obligations from dealers using a competitive bidding process such as used for marketing Treasury debt instruments. The dealers could, in turn, hedge their commitments in the futures or options markets.



### Subsidizing Farmers' Use of Options or Futures

Instead of guaranteeing prices and incomes to farmers with nonrecourse loans and deficiency payments, and hedging its price commitments, the Government could avoid price risks by paying farmers to hedge for themselves. For example, price support loans might be replaced with subsidies to farmers for purchasing put options with strike prices equivalent to the loan rate. This could give participating farmers assured returns equivalent to the loan and help keep the Government out of the storage business. Similar results could be obtained by subsidizing farmers' sale of futures contracts.

A possible advantage of subsidizing farmer use of options or futures instead of Government trading is that the Government would have a smaller direct role in the marketplace. Decisions about the precise timing of trades would be left to farmers. The likelihood of bunching of trades would be reduced.

### Timing Trades to Shift Risks

The amount of price risk shifted to the marketplace by Government trading or subsidized farmer trading would depend critically on when the trades were made and over what intervals the positions were held. The short positions generally should be entered as early as possible to have the maximum risk-shifting effect. For example, the Government's risk at the beginning of the year would be less if farmers were required to buy put options early than if the Government stood by to pay for options purchased at harvest. Waiting until harvest would mean that the Government would sometimes have to pay large premiums for in-the-money puts to ensure the support price. The costs would be less variable from year to year if the puts were purchased at planting time or before.

The budget submitted to Congress by the President in January contains estimates of program expenditures for the fiscal year beginning the next October. This covers most of the price support costs for crops harvested during that calendar year. The end of the marketing year is at least 16 months away for wheat and 20 months away for the other crops when the January budget estimates are made, but the costs for loans and (regular) deficiency payments are determined before the end of the marketing year.<sup>3/</sup> Moreover, a major portion of the price uncertainties are associated with crop size, which is largely known by July for wheat and October for the other crops, 6 months and 10 months respectively after the January budget estimates. Thus, to estimate the potential for shifting Government risks, we assumed that the Government would take short positions in January in futures contracts that mature at harvest.

### Estimates of Risk-Shifting Effectiveness

If Government budgetary risks are to be shifted through futures or options transactions, then futures or options price changes must be correlated with the differences between budgeted and actual program costs. As a first approximation, we calculated the correlations between actual minus estimated outlays for the corn, wheat, cotton, and soybean programs and the returns from holding corresponding short futures positions from January until harvest for

fiscal years 1975 to 1988. The simple correlations for these relationships ranged from 0.13 for wheat to 0.51 for corn.

The years from the seventies, which generally reflected relatively small program expenditures and small differences between actual and budgeted program costs, were dropped for the second approximation. The relationships for fiscal years 1980-88 are plotted in figures 8 through 11 for feed grains (using corn futures), wheat, cotton, and soybeans respectively. The simple correlations range from 0.29 for soybeans to 0.72 for cotton. The results suggest that up to 50 percent of the errors in estimating costs might have been eliminated by shifting price risks to the marketplace for corn and cotton, 30-40 percent for wheat, and less than 10 percent for soybeans.

### Capacity of the Futures and Options Markets to Absorb the Risks Borne by the Government

We turn now to the question of whether sufficient long private speculation could be developed to absorb the agricultural commodity price risks now borne by the Government. Figures 12 through 15 show the quantities produced, covered by open futures contracts on all exchanges, and placed under loan for corn, wheat, soybeans, and cotton by crop year from 1954 to the present. Average open interest has typically ranged from 20 to 30 percent of production for soybeans, wheat, and cotton in recent years, and 8 to 15 percent of production for corn, much of which is fed on the farm where it is produced.

The sizes of the Government short futures positions that would have minimized the variance of budgeting errors were estimated by regressing actual minus expected outlays on the returns from the short futures positions (table 2). The resulting estimates of minimum-variance hedging levels are shown in table 3.

These estimates suggest that the Government would need to hold very large short positions, up to one-half to three-fourths of a normal U.S. crop, to minimize budgeting errors for the feed grain, wheat, and cotton programs. This is considerably more than average futures open interest in these commodities has been in the past. The magnitude of the risk premiums required to entice speculators to hold such large long positions is unknown.

Considerable reduction in uncertainty would be possible with smaller Government positions than those indicated above. Futures open positions have been much nearer to the quantities placed under loan than to the quantities produced. They have exceeded the quantities of soybeans placed under loan. Nonetheless, Government trading, or subsidized farmer trading, on the scale needed to shift to the marketplace price risks similar to those borne by the Government under current farm programs could pose many problems. It could change the character of the futures and options markets. Government trades would tend to be large and lumpy; they could constitute a major proportion of the trades during many time periods; and Government traders would have different motives than commercial traders. The efforts of private traders would be diverted from anticipating other demand and supply changes to anticipating Government actions. Any program to shift Government price risks to the marketplace should be introduced gradually to give the markets time to adjust.

Figure 8--Corn program cost deviations related to returns on short positions, fiscal years 1980-88

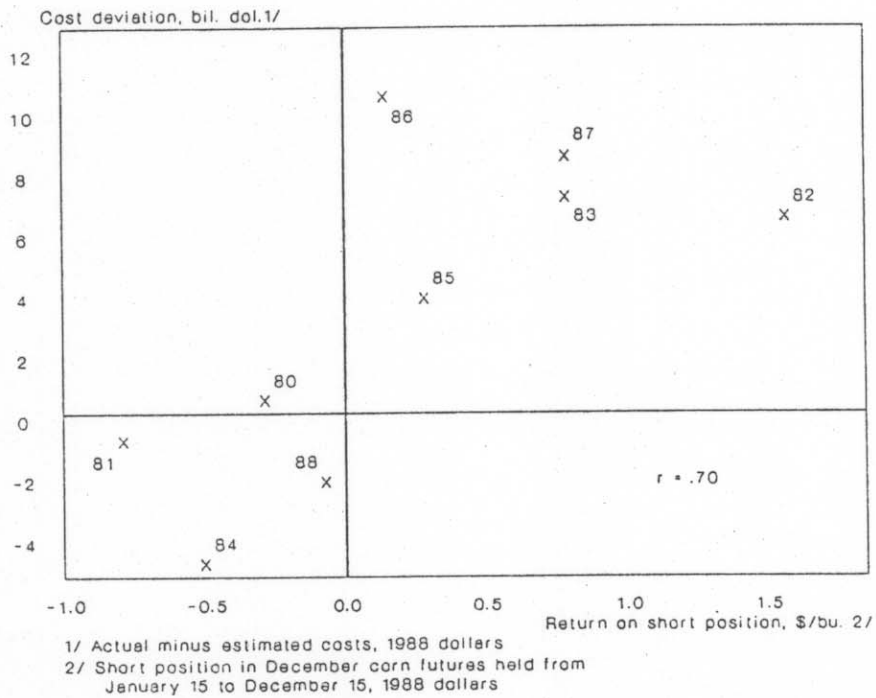


Figure 9--Wheat program cost deviations related to returns on short positions, fiscal years 1980-88

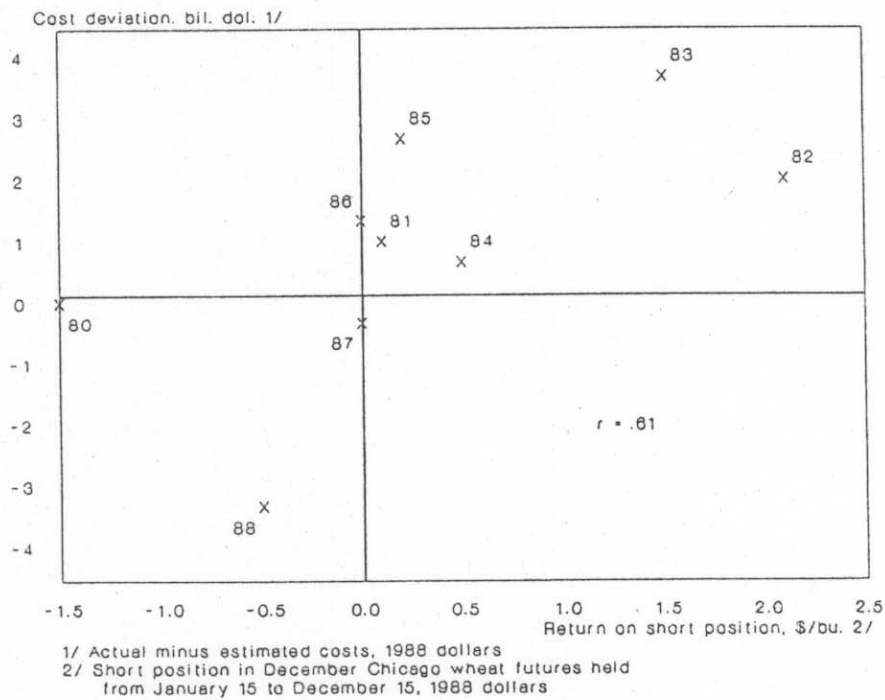


Figure 10--Soybean program cost deviations related to returns on short positions, fiscal years 1980-88

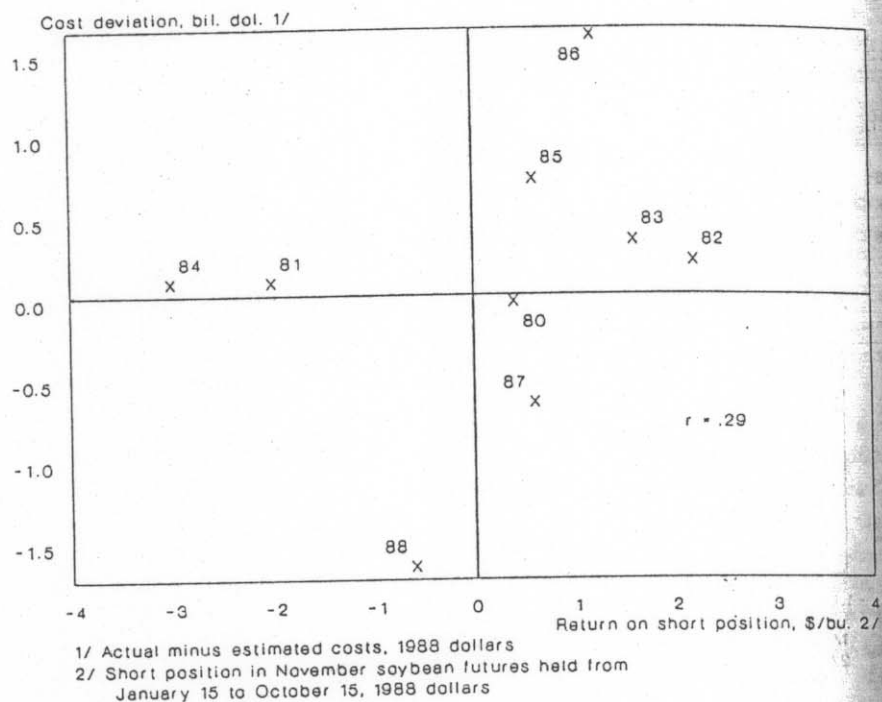


Figure 11--Cotton program cost deviations related to returns on short positions, fiscal years 1980-88

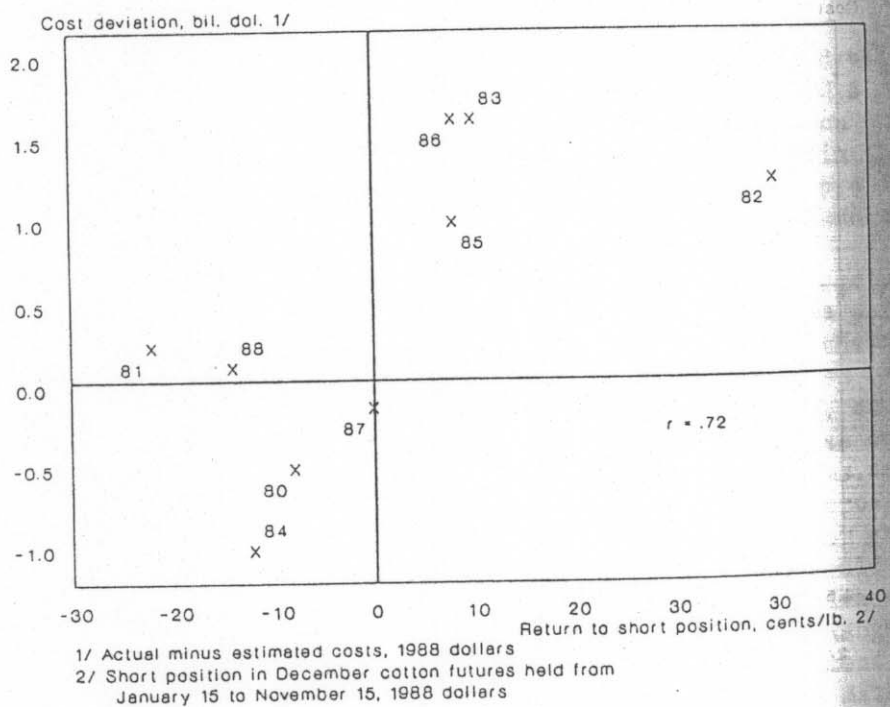




Figure 12--Corn production, put under loan, and in open futures positions

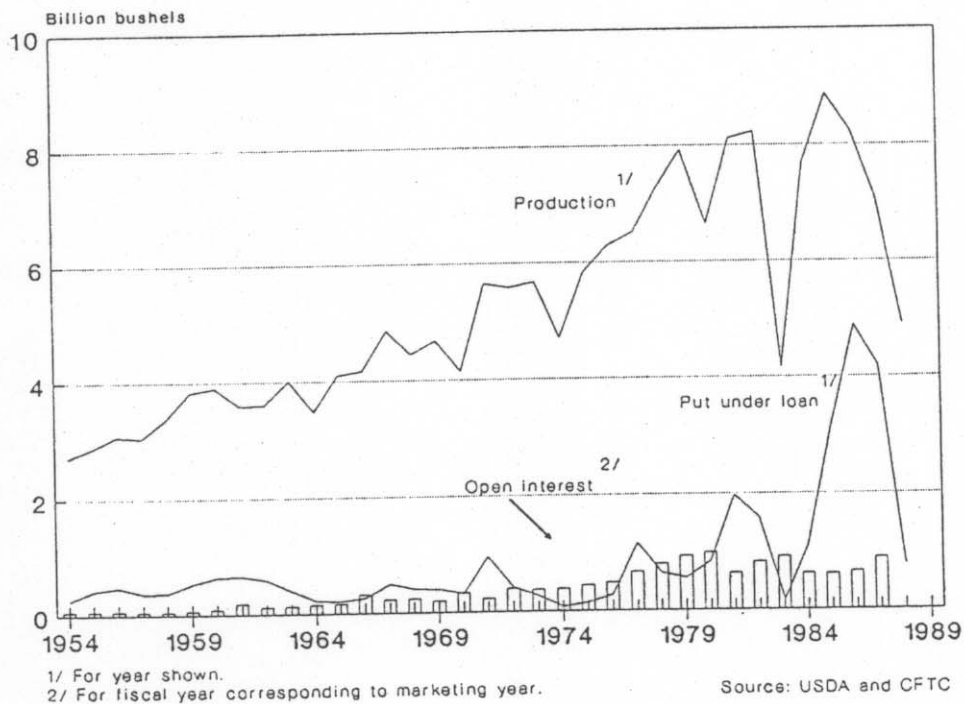


Figure 13--Wheat production, put under loan, and in open futures positions

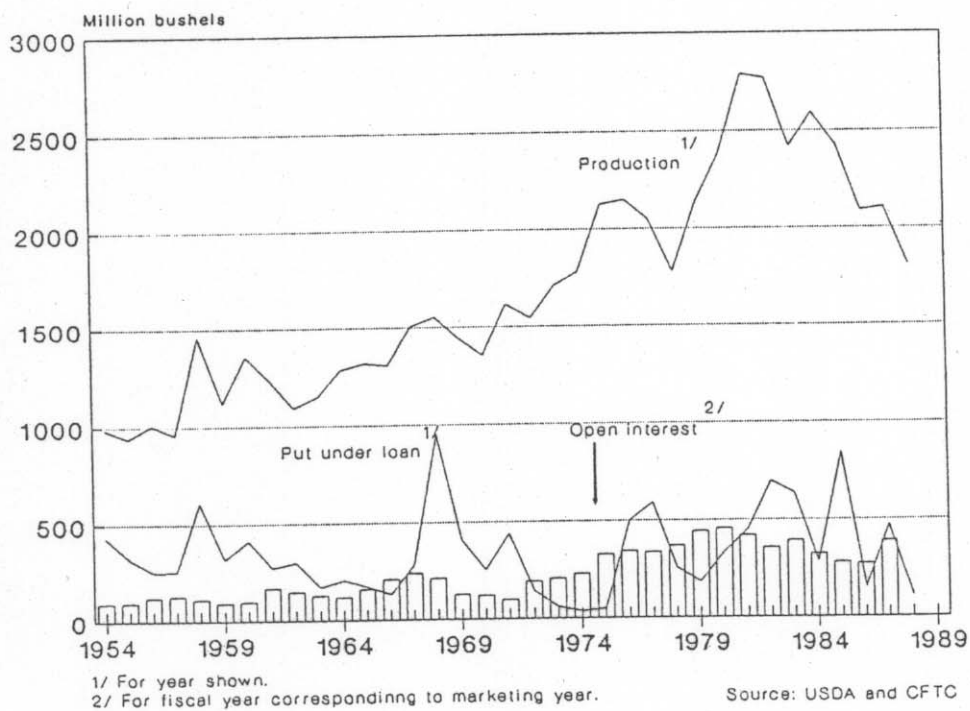


Figure 14--Soybean production, put under loan, and in open futures positions :

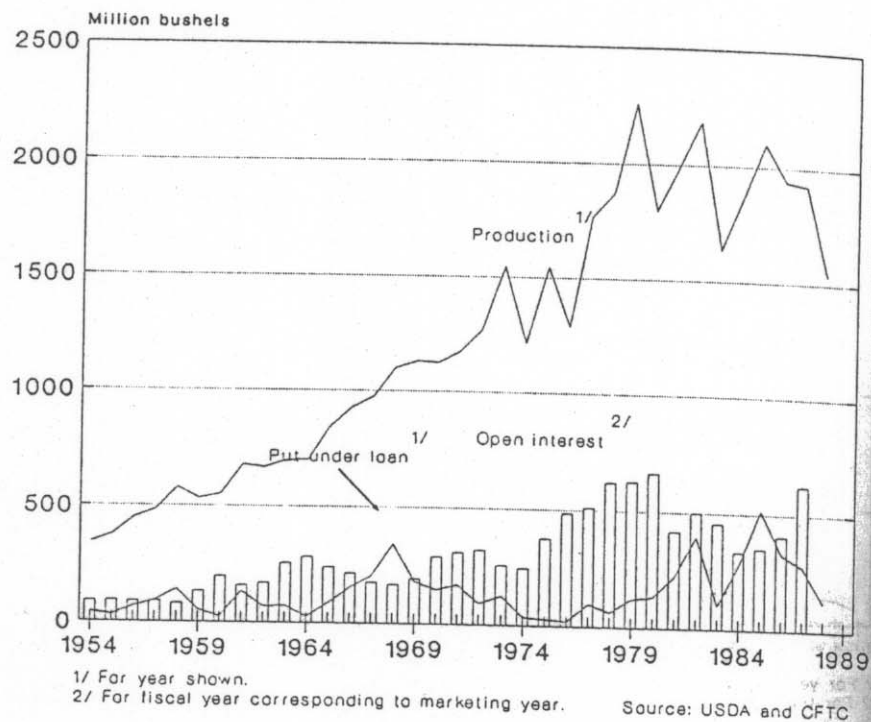


Figure 15--Cotton production, put under loan, and in open futures positions

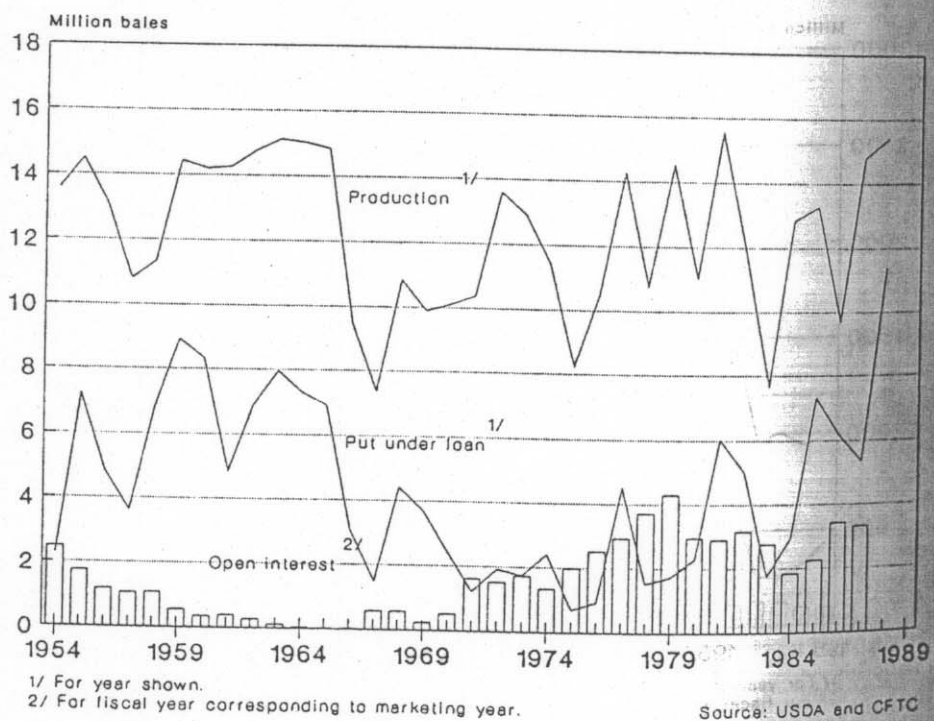


Table 2--Regression estimates of minimum-variance Government hedges, 1980-8a/

Commodity	Constant	Regression coef.	R <sup>2</sup>
Corn	2.29	4.962 (1.885)	.50
Wheat	0.52	1.155 (0.567)	.37
Cotton	0.45	0.0427 (0.0157)	.51
Soybeans	0.05	0.147 (0.183)	.08

a/ Dependent variables are actual minus budgeted program costs in billions of dollars. Independent variables are returns on short futures positions held from January 15 until harvest in dollars per bushel for the grains and soybeans and cents per pound for cotton. All data are in 1988 dollars. Standard errors are shown in parentheses.

Table 3--Minimum-variance Government hedging levels for 1980-88

Commodity	Minimum-variance hedge	Variance reduction
	Billion bushels	Percent
Corn	4.96	50
Wheat	1.16	37
Cotton	8.9 <u>a</u> /	51
Soybeans	0.15	8

a/ Million bales for cotton

### Conclusions

The correlations between actual minus estimated farm program expenditures and corresponding futures price changes during 1980 to 1988 suggest that farm program budgeting uncertainties could be reduced substantially by Government hedging. However, very large increases in private holding of long futures positions or granting of put options would be required and the resulting effects on total program costs cannot be foreseen. The impact on overall Federal budgetary uncertainty would be small. Similar reductions in farm program budgetary uncertainties might be obtained by replacing loan and deficiency payment programs with subsidies to farmers who sell futures or purchase put options early in the season. The potential for shifting such budgetary risks will probably be less in the future than during the 1980-88 period because price supports are expected to be lower relative to market-clearing prices.

### Footnotes

- 1/ Prices were deflated using the GNP implicit price deflator with 1987=100.
- 2/ Effects on estimates of the deficit, which depends on Government receipts as well as expenditures, are not evaluated here.
- 3/ Findley deficiency payments are determined at the end of the marketing year.

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