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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

## **The Effect of Marketing Loans on Agricultural Markets**

by

Joseph W. Glauber and M. J. Miranda

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## THE EFFECT OF MARKETING LOANS ON AGRICULTURAL MARKETS

J. W. Glauber and M. J. Miranda<sup>1</sup>

The Food Security Act of 1985 (FSA) gives the Secretary of Agriculture discretionary authority to implement programs to enhance competitiveness and to reduce surplus supplies for the major program commodities. One such program, the marketing loan, allows producers to repay nonrecourse loans at rates less than the original loan rate. Under a marketing loan with no minimum repayment rate, the loan rate no longer acts as a price floor because producers can sell crops with no reduction in receipts at prices between the loan rate and the loan repayment rate.

Marketing loans for rice and cotton are required by the FSA. Preliminary estimates suggest that marketing loans have dramatically increased U.S. exports of these commodities over 1985/86 crop-year levels and the United States has regained a portion of the world trade it had lost in recent years.

While the Secretary of Agriculture has authority to implement marketing loans for wheat, feed grains, and soybeans through 1990/91, they have not been implemented thus far. The success of marketing loans for rice and cotton has generated interest among policy makers who see marketing loans as a mechanism for increasing the competitiveness of wheat, feed grains, and soybeans.

This paper examines how a marketing loan program affects the marketing and production decisions of producers and how, in turn, these decisions affect market prices, price variability, and government outlays. Using a rational expectations model of the U.S. soybean market, we examine these effects and compare them to the nonrecourse loan program.

Two types of marketing loans are considered. The first allows producers to repay their loans at the world price. Such a program resembles the marketing loan program for soybeans as authorized under the FSA. The second allows producers to repay their loans at the greater of the world price or 70 percent of the loan rate. This resembles the program authorized for wheat and feed grains.

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<sup>1</sup> The authors are agricultural economist, Commodity Economics Division, U.S. Department of Agriculture; Assistant Professor of Business Administration, University of Connecticut. This research was supported through U.S. Department of Agriculture Cooperative Grant No. 58-3J23-6-00087.

The paper is organized as follows. Section I examines how marketing loans affect the price floor provided by nonrecourse loans. In Section II, a model of an annually produced, storable commodity is presented in which the government offers producers a price support program and a marketing loan program. In Section III, marketing loan programs are compared to nonrecourse loans using an estimated model of the U.S. soybean market. Price variability and the welfare effects of these programs are discussed. Lastly, policy implications are drawn in Section IV.

## I. The Effect of Marketing Loans on Price Floors

Figure 1a demonstrates how nonrecourse loans provide an effective floor for market prices. The horizontal axis represents the market price faced by producers in the absence of price supports. In this example, it is assumed that the loan rate for soybeans is \$5.02 per bushel and the variable costs of storing soybeans under loan for 9 months is 20 cents per bushel. The effective price floor faced by producers at harvest is thus \$4.82 per bushel. If prices exceed \$4.82, producers will sell their crop on the cash market. If the market price is less than this figure, they will take a loan with the intention of forfeiting the crop to the CCC.<sup>1</sup> As more soybeans are placed under loan, the free supply is restricted and the market price rises to \$4.82. Thus, the loan program provides an effective floor below which prices will not usually fall.

Under a marketing loan program, producers may repay their nonrecourse loans at rates less than the loan rate. Consider a program that allows producers to repay their loans at the greater of 70 percent of the loan rate or the world price. To simplify the discussion, we assume that the world price is equal to the market price. Figure 1b shows the effect of such a program on market prices and producer returns. For market prices between \$3.51 (70 percent of the loan rate) and \$5.02, the market price is the loan repayment rate. At these prices producers can place their crops under loan at \$5.02 per bushel, repay their loans at the market price, sell their crops on the cash market and be guaranteed a return no less than \$5.02 per bushel. Thus, they receive the loan rate without having to forego the 20 cents in storage payments. Furthermore, since crops are not removed from the the market, prices reflect market clearing levels.

For market prices less than \$3.51, the loan repayment rate is \$3.51. Producers can place their crop under loan, repay the loan at \$3.51 per bushel, and thus net \$1.51 per bushel in addition to the market price. For example, if the market price were \$3.40, producers could net \$4.91 by repaying their loans and selling on the cash market. While less than the loan rate, the return exceeds the expected return from placing the crop under loan and paying storage charges on the crop. Producers thus have strong incentives to redeem their loans. As a result, market prices are unaffected.

Fig 1a Nonrecourse Loans

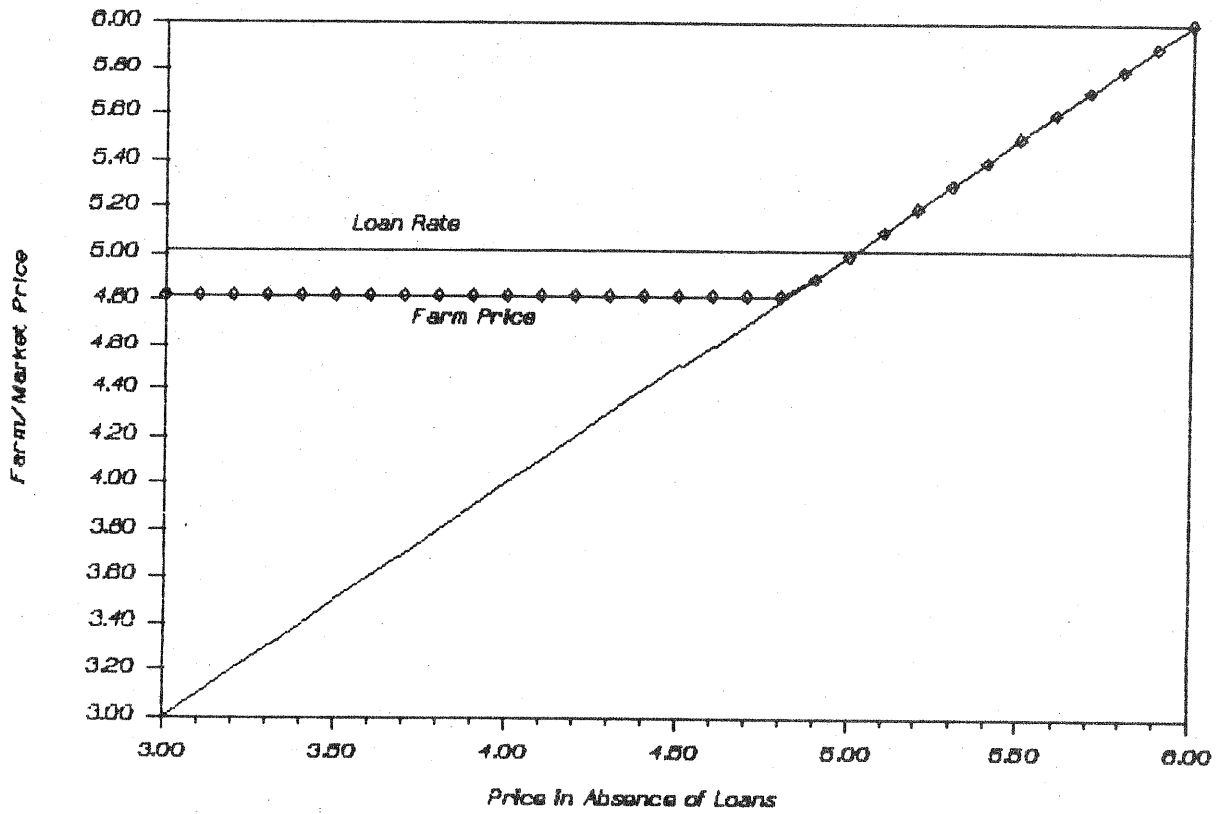
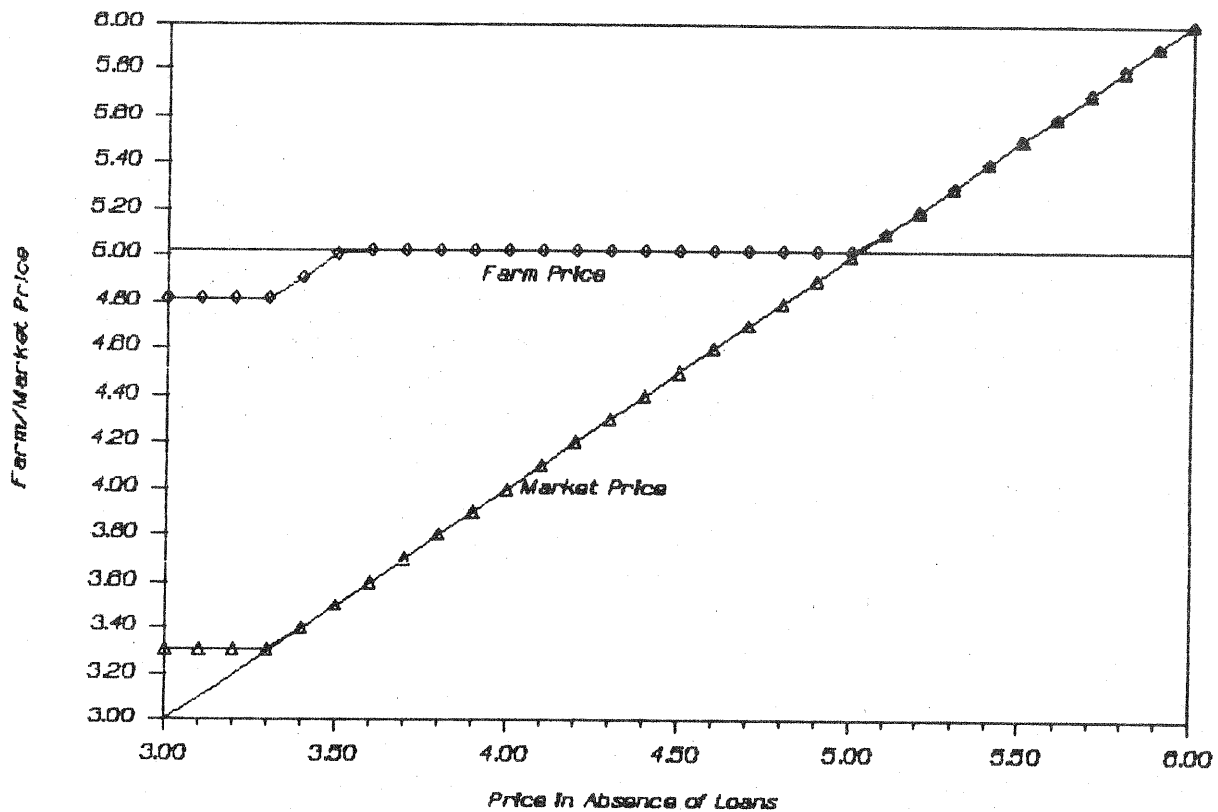


Fig 1b Marketing Loans



How low must market prices fall before producers will forfeit their crops to the government rather than repay their loans? If the market price were \$3.31, producers could repay their loans and receive \$1.51, netting a return of \$4.82. This is the same return faced by producers who place soybeans under loan at \$5.02 per bushel and store the crop for 9 months. If market prices fall below \$3.31 producers would choose to forfeit their crops to the CCC. The marketing loan effectively places a floor under market prices at \$3.31.

## II. Modeling the Endogenous Effects of Marketing Loans

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. The government operates a public buffer stock to stabilize market price. In addition, the government provides marketing loans to producers when market prices fall below the loan rate.

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,  $\bar{w}_t$ :

$$(1) \quad s_t = x_{t-1} + a_{t-1} \cdot \bar{w}_t.$$

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  $y_{t-1}$ :

$$(2) \quad y_t = y_{t-1}.$$

The government administers a price support 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. 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

$$(3) \quad s_t = s_t - g_t$$

and the final level of government stocks in year  $t$  is

$$(4) \quad y_t = y_t + g_t.$$

The government does not purchase stocks if the market price exceeds the support level and does not sell if the market price

lies below the release level:

$$(5) \quad p_t > p_s \Rightarrow g_t \leq 0,$$

$$(6) \quad p_t < p_s \Rightarrow g_t \geq 0.$$

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

$$(7) \quad p_t \geq p_s.$$

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

$$(8) \quad g_t \geq -y_t.$$

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

$$(9) \quad p_t > p_s \Rightarrow g_t = -y_t.$$

The government also administers two types of marketing loan programs. The first program allows producers to repay their loans at the lesser of the loan rate (plus interest) or the market price. The farm price thus becomes:

$$(10) \quad f_t = \max\{p_t, p_s\}.$$

Such a program is similar to a deficiency payment program without production controls (Glauber et al.).

Under the second program, the government allows producers to repay their loans at the greater of the market price or a percentage of the loan rate  $\theta p_s$ . The return to producers is expressed:

$$(11) \quad f_t = \max\{p_t, \min\{p_s, p_t + (1-\theta)p_s\}\}.$$

Private inventory holders 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

$$(12) \quad p_t = \pi(s_t - x_t).$$

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

$$(13) \quad \begin{aligned} p_t &\geq \delta p_{t+1} - k_t; & x_t &\geq 0, \\ x_t [\delta p_{t+1} - p_t - k_t] &= 0, \end{aligned}$$

where  $\delta p_{t+1} - k_t$ , 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<sup>2</sup>:

$$(14) \quad a_t = \alpha(f_{t+1}).$$

Arbitrageurs and producers form their price expectations rationally on the basis of current market information:

$$(15) \quad p_{t+1} = \phi_p(x_t, a_t, y_t)$$

$$(16) \quad f_{t+1} = \phi_f(x_t, a_t, y_t)$$

We make the following additional assumptions: The random yields  $\tilde{w}_t$  are independently and identically distributed. The discount factor  $\delta$  is less than one and the unit storage cost  $k$  is positive. The inverse consumption demand function  $\pi$  is strictly decreasing in quantity demanded and the acreage supply function  $\alpha$  is increasing in expected price<sup>3</sup>. The demand and supply functions, the distribution of random yields, and all other market parameters are time-stationary.

The presence of complementarity conditions in (13) defies simple algebraic derivations of equations (15) and (16). Instead, they must be estimated numerically using contraction mapping techniques (see Miranda). Because the functions are conditional on the underlying market parameters, we must reestimate them for each policy considered. While costly, the method allows us to derive rational price expectation functions that reflect the new policy environment. In this sense, price expectations are truly rational and do not suffer from the so-called Lucas critique endemic to most econometric models.

### III. The Effect of Marketing Loans on Market Prices

To simulate the effect of marketing loans we use a model of the U.S. soybean market estimated by Glauber.<sup>4</sup> For selected price support levels we derive the expected price functions in (15) and (16) as outlined in Miranda. Simulations were performed for a price support program where the release price is set at 120 percent of the support price, a marketing loan program that allows producers to repay at the market price (Program A), and a program that allows producers to repay at the greater of the market price or 70 percent of the loan rate (Program B). Steady state central moments were then calculated for the endogenous variables.

In the absence of government programs, mean competitive price is \$5.71. For low levels of loan rates, price support programs have negligible effects on farm price (figure 2a). (Recall that for price supports mean farm price should equal mean market price). As loan rates are increased, they provide the market with a floor and shift the distribution of prices



rightward. The increased loan rates causes a positive shift in production (figure 2d) while consumption falls accordingly (figure 2c). Government stocks grow (figure 2e) and private carryout falls (figure 2e) as the former is substituted for the latter. At support prices in excess of \$5.13, government stock levels explode in the long run. These results support the chronic buildup of government stocks for program commodities such as wheat and feed grains where the loan rate has been set at high levels relative to the competitive mean price.

For most levels of loan rates, farm prices under marketing loans are higher than that for price supports because farmers do not have to pay storage payments to receive the loan rate. Market prices are lower, however, because producers are encouraged to market their crop. The increased production response causes mean market prices to fall and consumption to rise accordingly.

For extremely high support rates, producers operating under marketing loan Plan B find it more advantageous to forfeit their crop. Over these loan rates the probability of market prices falling below 70 percent of the loan rate is much larger than for lower loan rates. Figure 2f shows that for support prices in excess of \$5.90, loan forfeitures increase dramatically and private carryout declines.

Figures 3a and 3b show how market and farm price variabilities are affected by marketing loans. Notice that price supports are more effective than marketing loans in reducing farm price variability. This is not surprising given the stabilizing nature of price band programs. The ability of price supports to reduce price variability depends primarily on whether there are ample stocks available to release upon the market in the event of high prices.

Marketing loans reduce farm price variability by guaranteeing a minimum price at least equal to the loan rate minus the cost of storage. The only way such programs act to moderate high prices in years of low yields is through encouraging greater planted acreage. Furthermore, for most levels of support prices, both Plan A and Plan B actually destabilize market prices. For high loan rates, market price variability under Plan B falls as mean crop forfeitures rise.

Figures 4a, 4b, and 4c show the welfare effects of marketing loans. 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 (farm price times production) minus the compounded costs of production (the area under the expected acreage supply function times yield). Government expenditures include marketing loan outlays, net government outlays for price supports, and storage payments on government stocks.

Notice that producers do marginally better under a marketing loan program than under a price support. This is due, in part, to the storage savings offered under the marketing loan. In general, consumers lose under a price support program because such programs tend to raise mean market price. On the other hand, consumers benefit from marketing loans because of the fall in market price caused by the removal of the price floor provided by the loan program.

On average, government expenditures are similar for the three programs. For loan rates in excess of \$5.13 government storage costs become increasingly large for price supports as stockpile levels explode. The same is true under Plan B for very high loan rates. Deadweight loss (not shown) is positive for all government programs considered here, but is greatest for price support programs of loan rates in excess of \$5.13.

#### IV. Conclusions

In this paper we have modeled the effect of marketing loans for a wide range of loan rates. Our analysis shows that marketing loans tend to increase farm prices while decreasing market prices. In addition, marketing loans encourage the redistribution of stocks from public to private hands. The marketing loan program is not as effective as price supports in stabilizing farm prices, and may have a destabilizing effect upon market prices. This could have important consequences for feed lot operators, first handlers, and other downstream participants in the marketing chain who might be adversely affected by increased market price variability.

Our welfare analysis suggests that for loan rate levels below the critical value of \$5.13, total welfare loss is quite similar for all programs. Price supports benefit producers but consumers lose as a result of higher prices. Marketing loans tend to benefit consumers and producers, at the expense of the taxpayer. However, the benefits and costs of such an analysis must be treated with caution. Our estimates of consumer surplus may be overstated somewhat because foreign consumer surplus is included in the analysis. Additionally, no value is placed on government stockpiles. Thus, we may be overestimating the costs of the price support program. Lastly, our analysis omits any benefits that may arise from price stabilization.

Fig 2a Farm Price

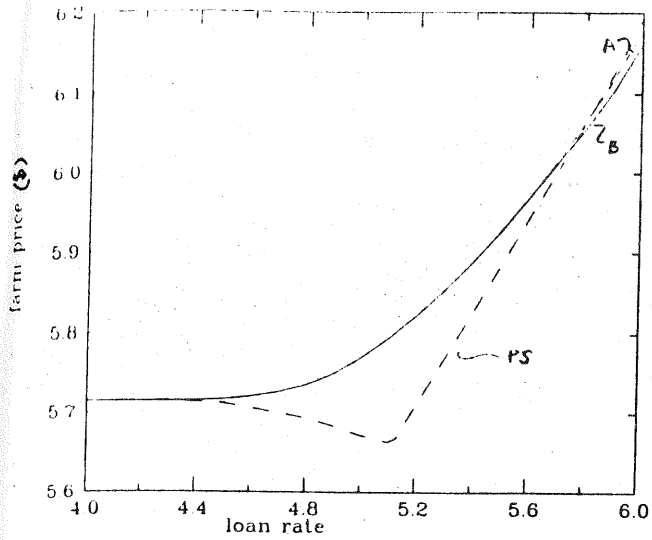


Fig 2b Market Price

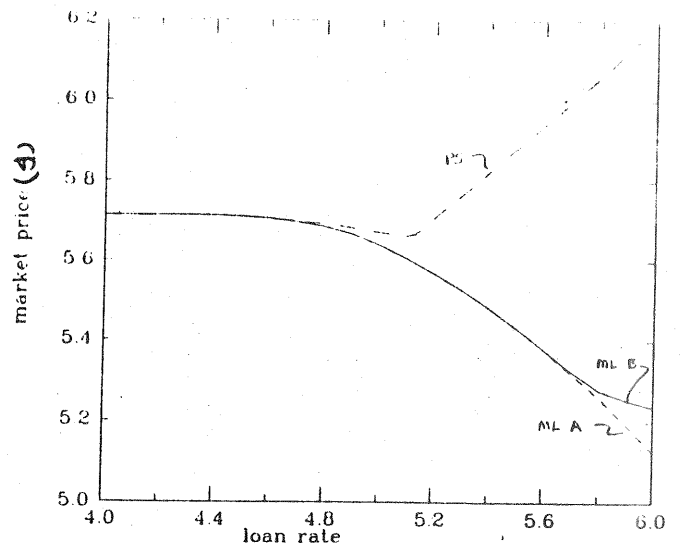


Fig 2c Consumption

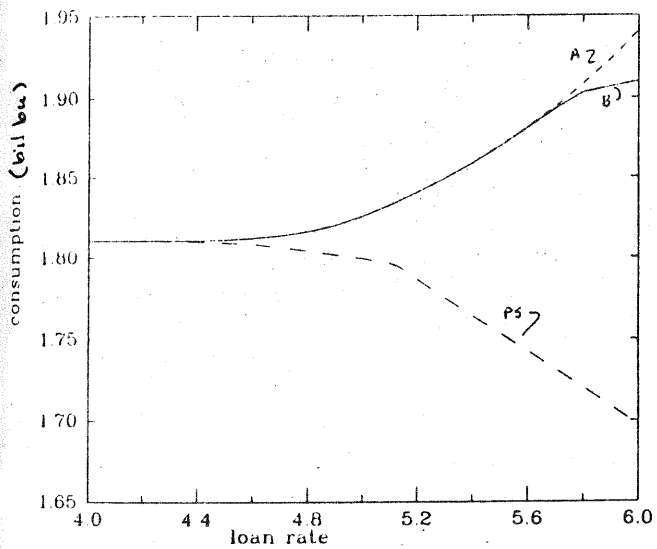


Fig 2d Production

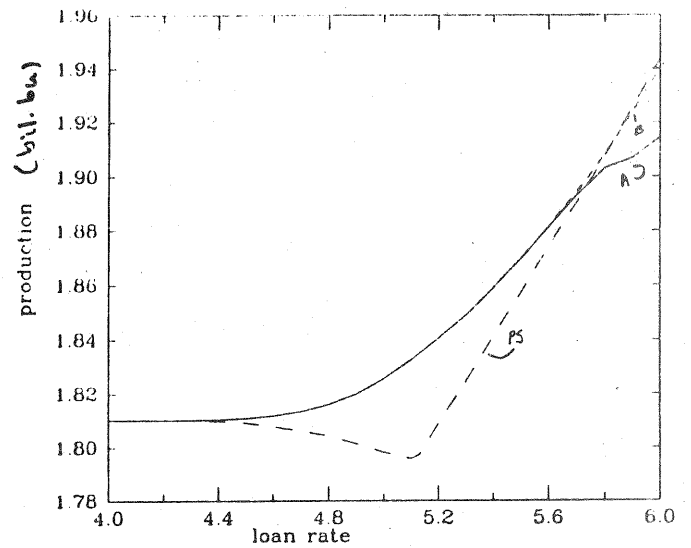


Fig 2e Private Carryout

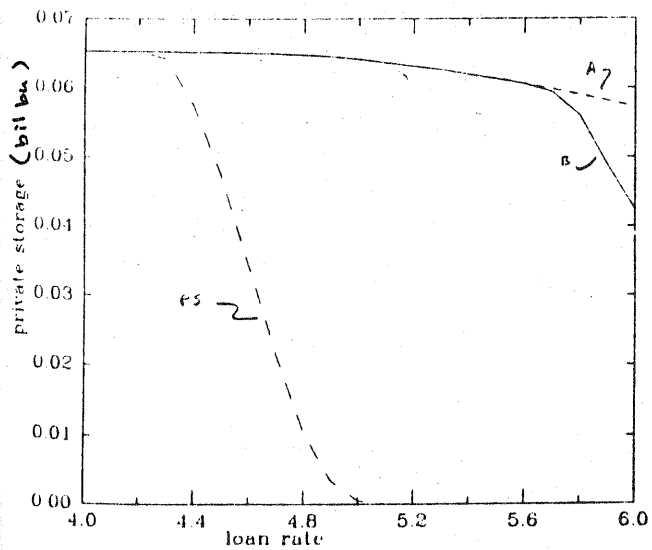


Fig 2f Government Stocks

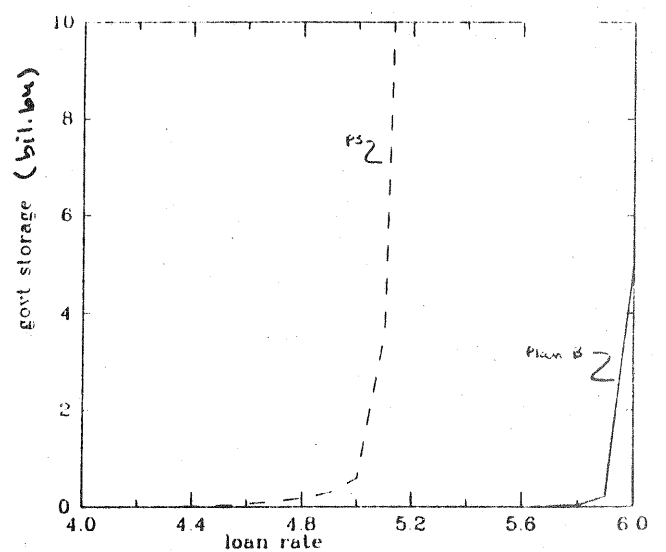


Fig 3a Farm Price Variability

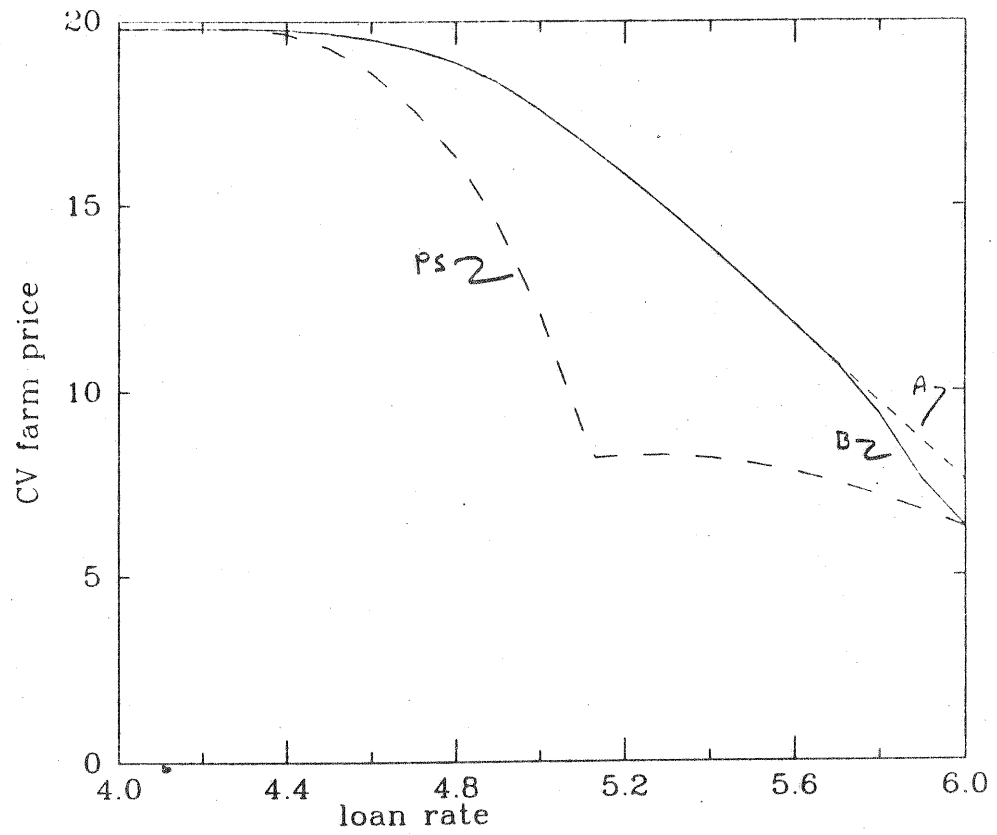


Fig 3b Market Price Variability

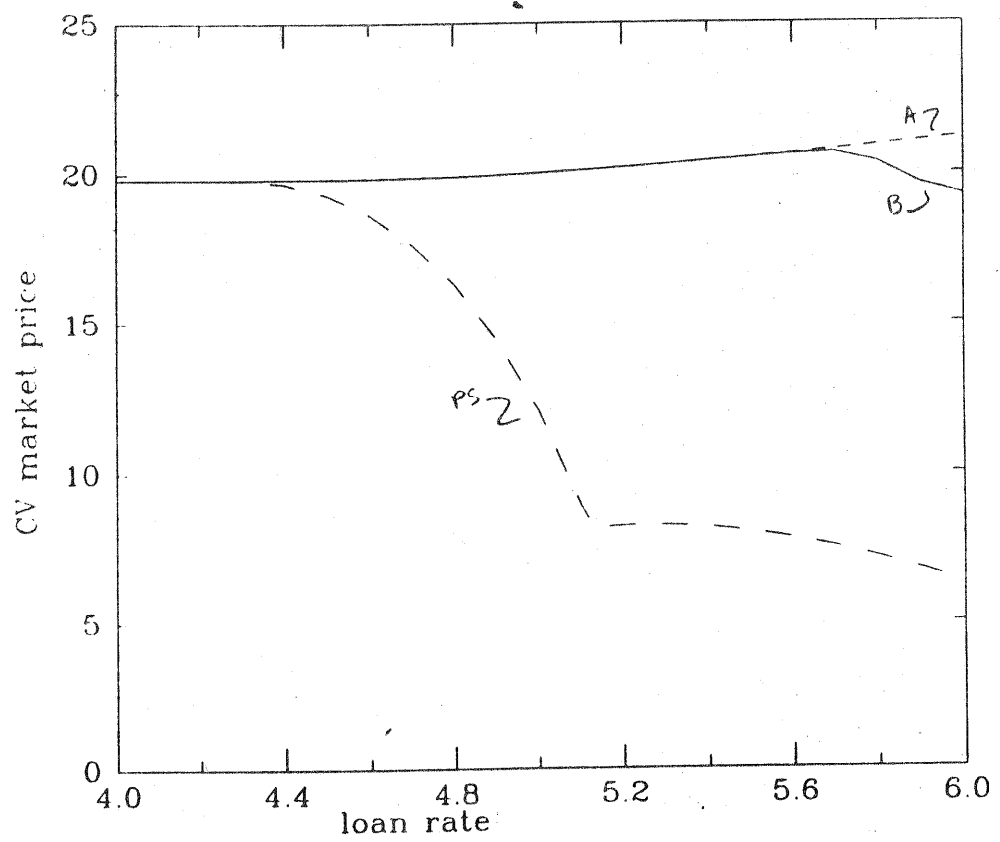


Fig 4a Producer Profits

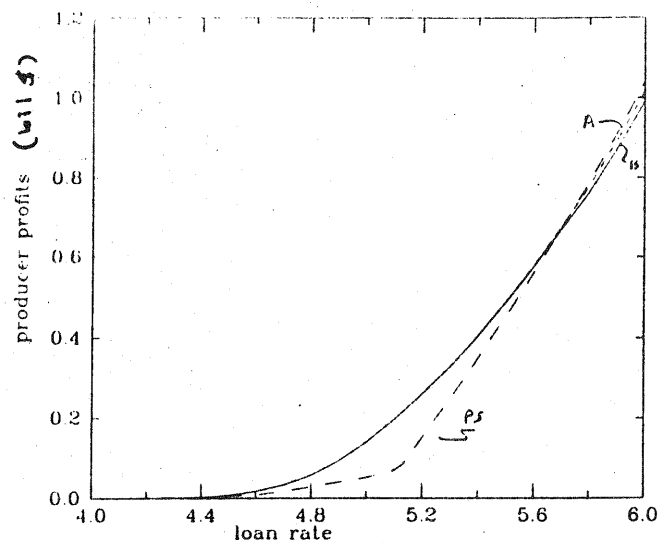


Fig 4b Consumer Surplus

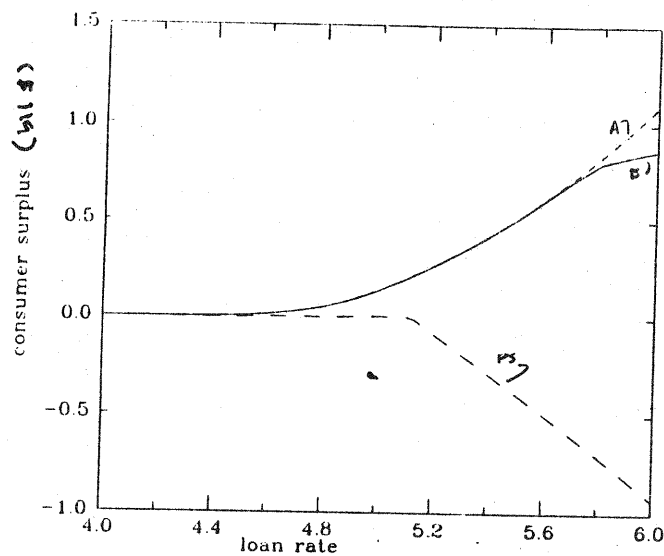
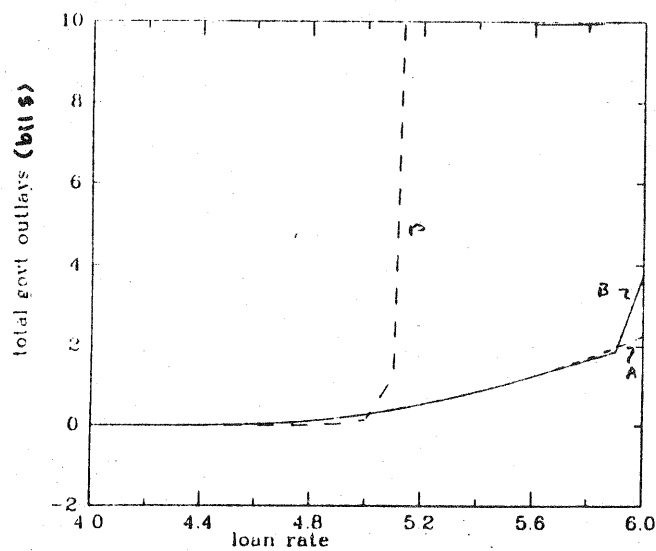


Fig 4c Total Government Outlays



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## ENDNOTES

1. This ignores the time value of the nonrecourse loan (Marcus and Modest).
2. We assume that producers form acreage planting decisions based on expected price. This assumes that the covariance between the expected price and the yield of firm  $i$  is zero. This is reasonable for crops that are grown under diverse weather conditions with wide geographic dispersion.
3. The market model can easily be generalized to include random consumption demand and acreage shocks; see Miranda (1986). Preliminary simulation experiments by the authors, however, indicated that the effects of these random shocks are negligible in comparison to the effects of yield variability.
4. The estimates used in the simulation experiments were adapted from an econometric model of the U.S. soybean market estimated by Glauber. The model includes a log-linear demand function with an own-price elasticity of  $-0.6133$ , a log-linear acreage supply function with an own price elasticity of  $0.8859$ . The values of the exogenous variables were set equal to their 1977-78 crop year values. In addition, it was assumed that yield satisfies
$$\log w = \log 29.4 + \mu,$$
where  $\mu$  is distributed normally with mean 0 and variance 0.1729. We assumed an annual storage cost of \$.36 per bushel and annual discount factor of 0.916.