Modeling Framework and Implementation

An analysis of the period 1998 to 2005 illustrates the effects of commodity loan programs with marketing loans. The analysis uses USDA's February 2000 baseline and simulations of a U.S. agricultural sector model, FAPSIM (see box, page 13).

The USDA 2000 baseline projects market prices that are lower than the corresponding loan rates (plus s) for the next several years, resulting in a continuation of marketing loan benefits for producers. FAPSIM was initially simulated to depict the 2000 USDA baseline scenario that incorporates the effects of marketing loans, including the higher level of per-unit revenues facilitated by marketing loans. These higher per-unit revenues were incorporated into the model's acreage response equations by augmenting the loan rate terms in net returns calculations by expected values for the additional per-unit revenues (s). The baseline scenario's assumed values for the expected additional per-unit revenues (table 1) were based on 1998 results (Westcott) and initial 1999 data. These values compare favorably for each crop with the realized additional revenues for 1999 shown in the table in the Marketing Loan Benefits box on page 8, with only the realized additional 1999 revenue for rice being much different from that assumed here for the baseline.[7] Figures 9-13 show the resulting average, effective, per-unit revenue floors for wheat, corn, soybeans, rice, and upland cotton along with the baseline loan rates. In each chart, the difference between the two lines represents the additional per-unit revenues facilitated by marketing loans.

Table 1—FAPSIM simulation assumptions for expected additional per-unit revenues (s) facilitated by marketing loans

Crop	Assumed expected average revenue above loan rate
	Dollars/bushel
Corn	0.25
Sorghum	0.10
Barley	0.70
Oats	0.15
Wheat	0.30
Soybeans	0.25
	Dollars/hundredweight
Rice	0.75
	Dollars/pound
Upland cotton	0.14

Acreage decisions are based on expected net returns, which include as their expected price term the higher of the lagged market price or the current loan rate augmented by the additional marketing-loan-facilitated revenue. That is, expected net returns are defined as follows:

$$NR_i^T = \max(p_i^{T-1}, LR_i^T + s) * \text{expected yield}_i^T - \text{variable production costs}_i^T$$

where NR represents expected net returns, p is price, LR is the loan rate, s is the additional, above-loan-rate per-unit revenue facilitated by marketing loans, subscript i denotes the commodity, and superscripts T and T-1 represent annual time periods. The acreage response functions used were of the form:

$$A_i^T = f\,[NR_i^T, NR_j^T, \text{other terms}]$$
$$= f\,[\max(p_i^{T-1}, LR_i^T + s), \text{expected yield}_i^T, \text{variable production costs}_i^T, NR_j^T, \text{other terms}]$$

where A represents acreage planted to a crop, subscript j denotes an alternative crop, and other variables are as defined above.[8]

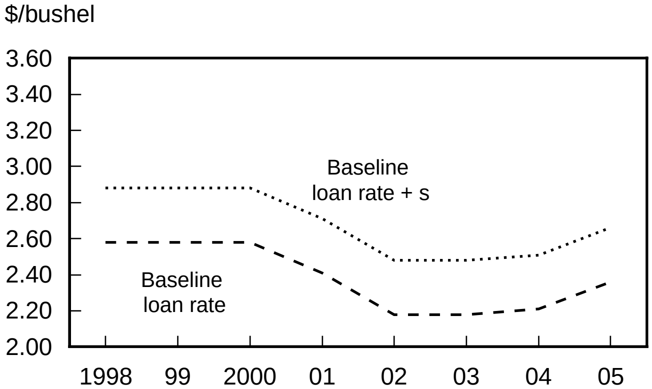
We then ran a second model simulation with FAPSIM, one with no commodity loan program. In this simulation, the terms $LR_i^T + s$ are removed from net returns, so that lagged market prices represent expected per-unit revenues used in the acreage decisions. This simulation provides a reference scenario from which to measure effects of commodity loan programs with marketing loans.

[7] Rice marketing loan benefits for the 1998 crop were negligible since rice prices were higher in that crop year. Rice marketing loan benefits were assumed at 75 cents per hundredweight above the loan rate for rice, based on benefits for the 1999 crop known at the time the baseline projections were made. Although realized benefits were subsequently higher, the assumption of 75 cents above the rice loan rate used in the baseline scenario corresponds more closely with producers' expectations at the time of planting.

[8] Effects of payment limitations are not explicitly included in the model. Any such effects are likely to be small, particularly with the availability of commodity certificates starting in early 2000.

Figure 9

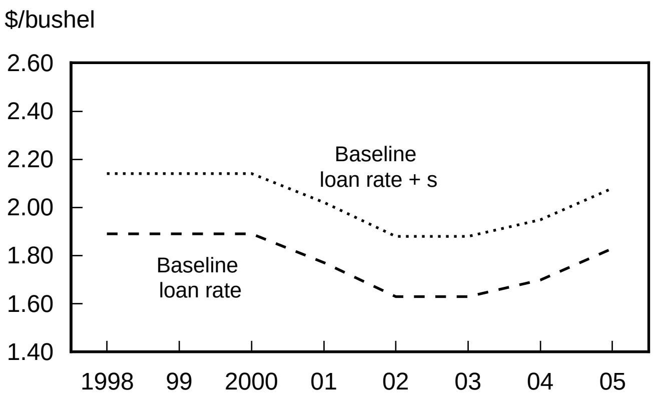
Wheat loan rates and effective per-unit revenue floor



Sources: February 2000 USDA baseline projections and Economic Research Service, USDA.

Figure 10

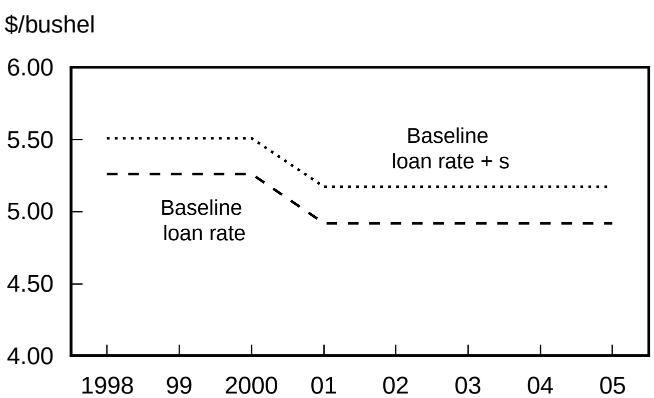
Corn loan rates and effective per-unit revenue floor



Sources: February 2000 USDA baseline projections and Economic Research Service, USDA.

Figure 11

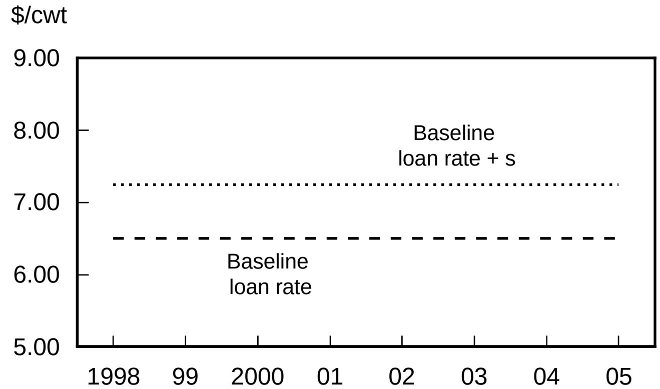
Soybean loan rates and effective per-unit revenue floor



Sources: February 2000 USDA baseline projections and Economic Research Service, USDA.

Figure 12

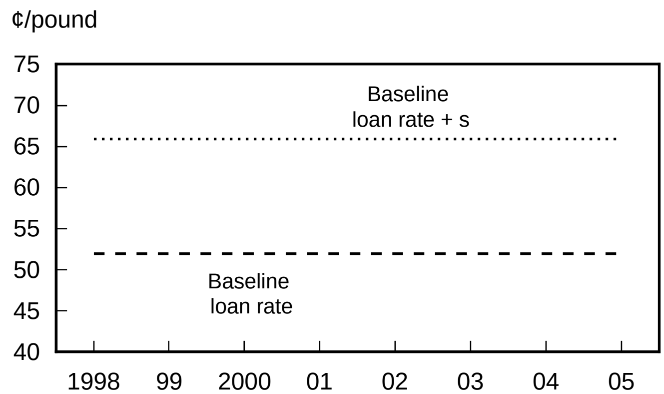
Rice loan rates and effective per-unit revenue floor



Sources: February 2000 USDA baseline projections and Economic Research Service, USDA.

Figure 13

Upland cotton loan rates and effective per-unit revenue floor



Sources: February 2000 USDA baseline projections and Economic Research Service, USDA.

The Model Simulation System—FAPSIM

The Food and Agricultural Policy Simulator (FAPSIM) is an annual econometric model of the U.S. agricultural sector. The U.S. Department of Agriculture originally developed the model during the early 1980's (Salathe, Price, and Gadson; Gadson, Price, and Salathe). Since that time, FAPSIM has been continually re-estimated and re-specified to reflect changes in the structure of the U.S. food and agricultural sector. The model incorporates over 700 equations. Here, we give only a brief discussion of its general structure and content.

FAPSIM contains three broad types of relationships: definitional, institutional, and behavioral. Definitional equations include identities that reflect mathematical relationships that must hold among the data in the model. For example, total demand must equal total supply for a commodity at any point in time. The model constrains solutions to satisfy all identities of this type.

Institutional equations involve relationships between variables that reflect certain institutional arrangements in the sector. This would include commodity loan rates, for example, that are announced annually for major crops, using fixed formulas established by U.S. farm programs.

Definitional and institutional equations reflect known relationships that necessarily hold among the variables in the model. Behavioral equations differ because the exact relationship among variables is not known and must be estimated. Economic theory determines the types of variables to include in behavioral equations, but theory does not indicate the precise relationship between the variables. Examples of behavior relationships in FAPSIM are the acreage equations for different field crops. Economic theory indicates that production should be positively related to the price received for the commodity and negatively related to prices of inputs required in the production process. Producer net returns are used in the FAPSIM acreage equations to capture these economic effects. The net returns measures also include policy features, such as marketing loan benefits, that can influence planting choices. Additionally, the acreage equations include net returns for other crops that compete with each other for land use.

For the most part, FAPSIM uses a linear relationship to approximate the general functional form for each behavioral relationship. All parameters in the linear behavioral relationships were estimated by single-equation regression methods. The large size of the model precludes the use of econometric methods designed for systems of equations. Ordinary least squares was used to estimate most of the equations. If statistical tests indicated the presence of either autocorrelation or heteroscedasticity in the error structure of an equation, maximum likelihood methods or weighted least squares were used.

Commodities included in FAPSIM are corn, sorghum, barley, oats, wheat, rice, upland cotton, soybeans, cattle, hogs, broilers, turkeys, eggs, and dairy. Each commodity submodel contains equations to estimate production, prices, and the different demand components. The submodels are then linked together through common variables that are important to the different commodities. The model solution computes the market prices that equilibrate supply and demand in all commodity markets simultaneously.

The ability of the FAPSIM model to simulate different policies lends itself to analysis of the commodity loan program with marketing loans. Further, the variables in the model reflect USDA's baseline projections, which are a Departmental consensus on a longrun scenario for the U.S. agricultural sector. The baseline projections are based on specific assumptions regarding the macroeconomy, international developments, weather, and agricultural policies. Thus, the baseline provides a well-defined scenario from which alternative scenarios can be compared. The analysis in this report is based on long-term projections from USDA's February 2000 baseline (USDA, OCE).