

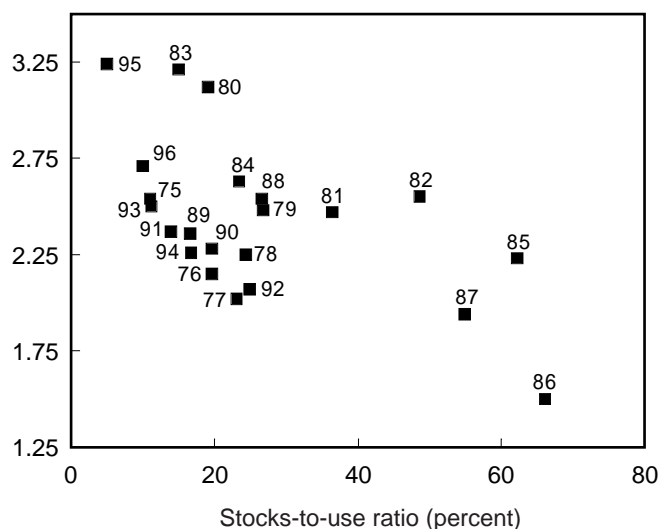
## Model Implementation

The functional form used to estimate equations 5b and 5c that relate annual prices of corn and wheat prices, respectively, to their stocks-to-use variables is logarithmic (double-log). With a negative coefficient on the stocks-to-use variable, this functional form provides a downward-sloping, convex-shaped relationship between the stocks-to-use ratio and prices. Most other explanatory variables used also are specified in logarithms. However, to address problems encountered in corn and wheat sector simulations using other estimated versions of the price models, the government-owned stocks variable in each equation was not transformed to logarithms. Also, a dummy variable for 1986 was added to the corn price equation to address a problem encountered regarding that year's having a particularly strong influence on the model's parameter estimates, as discussed below.

The models were estimated using annual (marketing year) data for 1975 to 1996. Figures 5 and 6 show corn and wheat prices plotted relative to their annual stocks-to-use ratios during the estimation period. The model specifications shown in equations 6a and 6b can be viewed as providing a basic pricing relationship between prices (p) and the total stocks-to-use ratio (K/U), which shifts upward and downward depending on the year-specific values of the other independent variables in the equations.

Figure 5  
Corn prices and stocks-to-use ratios, 1975-96

Dollars per bushel



Corn price model:

$$(6a) \quad \ln(p) = a + b \ln(K/U) + c(CCC/U) + d \ln(LR) \text{Dum7885} + e \text{Dum86}$$

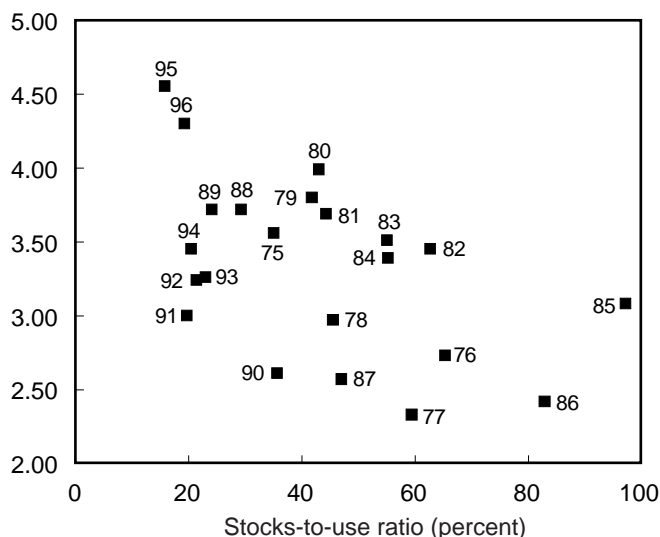
Wheat price model:

$$(6b) \quad \ln(p) = a + b \ln(K/U) + c(CCC/U) + d \ln(LR) \text{Dum7885} + f \ln(C4K/C4U) + g \ln(FS/U) + h \ln(PCS)$$

Variable definitions are summarized in table 1. As defined earlier, the variable p is the farm-level price, LR is the commodity loan rate, and K is total stocks. U represents annual utilization of the crop; Dum7885 represents a dummy variable equal to 1 in 1978-85 and equal to 0 in other years; Dum86 represents a dummy variable equal to 1 in 1986 and equal to 0 in other years; and CCC represents government-owned stocks. In the wheat equation, C4K and C4U represent stocks and use in the four main wheat-export competitors (European Union, Canada, Australia, and Argentina), FS represents wheat feed use in the summer quarter, and PCS represents the price for corn in the summer quarter. The terms a, b, c, d, e, f, g, and h are parameters to be estimated.

Figure 6  
Wheat prices and stocks-to-use ratios, 1975-96

Dollars per bushel



In equations 6a and 6b, total stocks (K) and government-owned stocks (CCC) are measured relative to an indicator of the “scale of activity” in the sector, represented by the realized level of demand, actual utilization (U). This adjustment is needed because of growth in the corn and wheat sectors over the last 25 years, so a particular level of stocks today represents a smaller portion of total use (or realized industry demand) than the same level of stocks in 1975. Each ratio is multiplied by 100 to express the result as a percentage. The first resulting ratio, K/U, is a stocks-to-use variable commonly used in price models, providing a summary measure of market supply and demand conditions and an indicator of relative market tightness for the commodity. The expected sign of the total stocks-to-use coefficient (b) is negative. In contrast, a larger government-owned stocks-to-use ratio (CCC/U) at the end of the year indicates that a greater share of stocks are not accessible to the marketplace, resulting in higher prices. Thus, the coefficient “c” for the government-owned stocks-to-use variable is expected to be positive.

The interaction term of the loan rate (LR) times the dummy variable (Dum7885) represents the combined effects of the loan program and the FOR on corn and wheat prices from the late 1970’s through the mid-1980’s. The loan-rate variable used in the model includes the higher FOR loan rates available to corn and wheat producers in 1980 through 1982. The years 1978-85, chosen for the interaction term, cover the period when the commodity loan program, in conjunction with the structure of the FOR program, had a

significant influence on price levels in the sector. Loan rates were relatively high in those years and the multi-year FOR program, with high release prices, isolated those reserve stocks from the market. The price-supporting aspects of the loan program in the late 1970’s through the mid-1980’s imply that the expected sign for the coefficient (d) for the loan-rate interaction term is positive.

This model specification for the loan rate contrasts with the approach frequently used in the past of defining the dependent variable as price minus loan rate. For many of those earlier models, the years 1978-85 (when high loan rates and the structure of the FOR program affected price determination) were a larger part of the sample period used for model estimation. Those years represent only 8 of the 22 observations of the sample period used here, which covers 1975 to 1996. Thus, rather than including the loan rate in the dependent variable, it seems more appropriate now to include the loan rate as a separate independent variable for the years when high price supports and the FOR affected prices, providing a policy-shift effect on price determination in those years. With this specification for the loan rate, the dependent variable is the farm-level price.

The corn price equation includes a dummy variable for 1986. In an initial specification without the dummy variable, the Cook’s D statistic (Cook) for that year was 2.66, suggesting that 1986 had a strong influence on the model’s parameter estimates. In particular, the influence on the coefficient of the government-owned stocks vari-

**Table 1— Summary of variable definitions**

Variable name	Definition
C4K	Ending stocks of wheat for four main export competitors (EU, Canada, Australia, and Argentina)
C4K/C4U	Stocks-to-use ratio (percent) for wheat for the four main wheat export competitors
C4U	Annual use of wheat, including exports, for four main wheat export competitors
CCC	Government-owned stocks, corn or wheat
CCC/U	Government-owned stocks relative to total use, corn or wheat, percent
Dum7885	Dummy variable equal to 1 in 1978-85 and equal to 0 in other years
Dum86	Dummy variable equal to 1 in 1986 and equal to 0 in other years
FS	Domestic feed use of wheat, summer quarter
FS/U	Summer-quarter wheat feed use as a share of total annual use of wheat, percent
K	Total year-ending U.S. stocks for corn or wheat
K/U	U.S. stocks-to-use ratio, corn or wheat, percent
LR	Commodity loan rate, corn or wheat
p	Farm-level price for corn or wheat
PCS	Price for corn in the summer quarter
U	Annual U.S. utilization, including exports, corn or wheat

able was largest. By using the 1986 dummy variable, the statistically large influence of that year on the parameter estimates is removed, improving the coefficient estimate for government-owned stocks and its corresponding t-statistic.

In the wheat equation, competitor stocks (C4K) are divided by competitor use (C4U). As for the domestic stocks variables, this division adjusts for the growth in the size of those countries' wheat sectors over the estimation period. The ratio is then multiplied by 100 to express the result as a percentage. Wheat use for the EU in this variable nets out intra-EU trade to avoid double counting. The competitor stocks-to-use variable is intended to represent the effects on U.S. wheat prices of conditions in the international marketplace beyond the effects captured through U.S. exports. A larger competitor stocks-to-use ratio would tend to push international wheat prices lower, exerting downward pressure on U.S. prices as well, so the expected sign on the coefficient (f) of the competitor stocks-to-use ratio is negative.

The variables used to represent the feed use effect on wheat prices—summer-quarter wheat feeding as a share of annual wheat use and summer-quarter corn price—would be expected to have opposite effects on wheat prices. As such, their combined relationship could be specified as a ratio. However, since the ratio of the two variables has no particular economic meaning, there is no reason to expect (and thus restrict) their effects on wheat prices to be equal and opposite. Thus, each variable is used separately in the specification of the wheat price model, with an expected negative sign for the coefficient (g) of the feed use share, and an expected positive for the coefficient (h) of the summer-quarter corn price.

The summer-quarter feed-use share variable in the wheat equation was defined as a percentage of total annual wheat use. An adjustment to this measure then is made to accommodate the logarithmic transformation used. This adjustment is needed because summer-quarter feed use can be 0 or negative, and the logarithm is defined only for positive numbers. In fact, the lowest observation in the estimation period for summer-quarter wheat feed (and residual) use was -3 million bushels. To adjust for this, 3 million bushels were added to the summer-quarter wheat feeding data, and then 1 percent of use was added to the numerator each year. Thus, for its lowest value, adjusted summer-quarter wheat feeding used in the model is 0, the adjusted ratio (with 1 percent of use added) equals 1 percent, and logarithm of 1 equals 0.

Farm-level prices used to estimate the model are marketing year averages collected by USDA's National Agricultural Statistics Service (NASS) and re-published by the Economic Research Service in the *Feed Situation and Outlook Yearbook* (April 1999) and the *Wheat Situation and Outlook Yearbook* (March 1999). Data for U.S. stocks, utilization, loan rates, and summer-quarter corn prices, and data for competitor stocks and use for wheat also are from those two yearbook publications. U.S. stocks and utilization data reflect the historical revisions published by NASS in December 1998 (*Field Crops—Final Estimates, 1992-1997* and *Stocks of Grains, Oilseeds, and Hay—Final Estimates, 1993-1998*). FOR loan-rate data for 1980-82 are from Lin, Glauber, Hoffman, Collins, and Evans. EU wheat-use adjustments to subtract intra-trade are based on data from various monthly issues of *Grain: World Markets and Trade* as well as estimated historical data provided by the Foreign Agricultural Service.