A Pricing Model

The general framework used here relating prices to ending stocks is derived from an equilibrium model for competitive markets with inventories (Labys, 1973). For annually produced commodities, such as corn and wheat, supply is a function of the previous year's price. Demand is a function of prices in the current period and the previous year. Lagged prices are particularly important for crops used for livestock feeding, as livestock production decisions made in previous periods in response to prices in those periods affect livestock inventories, and thus feed demand, over a number of years. Export demand would also be a function of lagged prices to reflect foreign supply response. In its simplest form, without the government price support program, stocks are a function of price. The market-clearing, equilibrium condition determines the price at which supply equals demand plus stocks (equations 1-4).

(1) $S = f(p_{t-1}, z)$ (Supply function)

(2) $D = g(p, p_{t-1}, z)$ (Demand function)

(3) $K = h(p, z)$ (Stocks function)

(4) $S - D - K = 0$ (Equilibrium condition)

S is supply, D is demand, K is ending stocks, p is market price, and z is a set of exogenous variables. The subscripted price variables represent prices in the previous year (t-1). All other variables are for the current year. Supply is positively related to expected price while demand and stocks are negatively related to price.

In equilibrium, prices can be determined from the inverse of the stocks function. This provides a price determination equation, with prices negatively related to stocks.

(5) $p = h^{-1}(K, z)$ (Price equation; inverse stocks function)

Adjustments to the Basic Model

The basic pricing model presented in equation 5 provides a starting point for introducing adjustments that shift the pricing relationship. Adjustments are included for both corn and wheat to account for government loan program and stockholding policies. Additional adjustments are included for wheat to account for global market factors as well as wheat feed use and related cross-commodity pricing considerations. These adjustments result in year-specific upward and downward shifts of the basic functional relationship between ending stocks and prices.

Introducing the government price support loan program adds to the stocks function by incorporating the commodity loan rate (LR) to the function, as represented in equation 3a.

(3a) $K = h(p, LR, z)$ (Stocks function with government loan program)

The government loan program provides an additional feature to stockholding behavior that depends on the loan rate incentive to use the loan program.

With this alternative stocks function, the inverse stocks function gives the following price determination equation.

(5a) $p = h^{-1}(K, LR, z)$

To reflect the different effect that government-owned stocks have on price determination, an additional term representing government stocks (CCC) is added, as shown in equation 5b.

(5b) $p = h^{-1}(K, CCC, LR, z)$

Prices are negatively related to total stocks, but positively related to government-owned stocks, as year-ending stocks held by the government generally have not been available to the marketplace. That is, larger total stocks would be associated with lower prices, but for any given level of total stocks, larger government-owned stocks push prices up. Prices are also positively related to the loan rate in those years that loan rates were relatively high and the FOR isolated stocks from the marketplace.

Additional Considerations for the Wheat Price Model

Two additional adjustments are added to the pricing model for wheat. First, the role of the global wheat market in price determination is added. Although the United

States is the world's leading wheat exporter, its role is not nearly as dominant as is the case for corn. As a result, domestic U.S. wheat prices are influenced to a greater degree by world market conditions beyond what is reflected in U.S. wheat supply, demand, and resulting stocks information. To reflect this global market effect, a variable representing stockholding in four major competitors (European Union, Canada, Australia, and Argentina) is added to the wheat price model. For any given level of wheat stocks in the United States, larger stocks in the major competitor countries shift prices lower.

The second wheat price model consideration is a statistical measurement issue regarding wheat prices for different uses. The farm-level wheat price to be used as the dependent variable in the model is implicitly a weighted average of prices in different uses. While food use represents most domestically used wheat, feed use of wheat can be important in some years. Wheat competes with feed grains particularly well in the summer, when wheat has been harvested but most feed grains have not. When wheat prices are relatively low and wheat is used heavily for feed, more of this lower end-use value is implicitly reflected in the season-average price. Also, when low wheat prices lead to large wheat feeding, typically in the summer, the wheat price tends to be influenced by prices of competing feed grains, particularly corn.

To represent this wheat-pricing consideration, two variables are added to the basic model. First, summer-quarter wheat feed use as a share of total annual wheat use is an indicator of the importance of wheat feeding implicit in the season-average price for wheat.[7] Larger summer-quarter wheat feeding when wheat prices are low gives more implicit weight to wheat prices at a feed value, lowering the season-average price. Second, the summer-quarter corn price provides a measure of the level of cross-commodity pricing influence provided from competing feed grains. The higher the price of corn in the summer, the higher the price of wheat used for feed, and thus the higher the overall season-average wheat price.[8]

Equation 5c adds these wheat price considerations to the general pricing model. The price equation for wheat now includes variables C4K for competitor stocks, FS/U for summer-quarter feed share of annual use, and PCS for the price of corn in the summer quarter. These variables shift the wheat price determination function up or down to reflect the effects of these factors.

$$(5c)\quad p = h^{-1}(K, CCC, LR, C4K, FS/U, PCS, z)$$

[7] Summer-quarter wheat feeding is used in this measure because that is when most actual wheat feeding occurs. In other quarters, actual wheat feeding is smaller so the "feed and residual" category includes a greater share of statistical measurement errors (or residuals) from other categories of supply and demand. In fact, feed and residual in other quarters of the year is frequently negative.

[8] Marketing years for corn and wheat differ because of differences in harvesting dates. As a result, the same summer quarter occurs in different marketing years for corn and wheat. The summer-quarter corn price is from the last quarter of the corn marketing year, but it affects the wheat price in the (first quarter of the) next wheat marketing year. Despite this apparent lag from one marketing year to the next, the effect is concurrent.