BRIEFING

Briefing No. 71

February 2005

Demand and Supply Factors in the Feed Grain Market: Effects on Corn Producers

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Objective

Analysis

for Informed

Decision Making

Introduction:

Corn is the major grain produced in the U.S. wheat and feed grains sectors. In 2003, U.S. corn production equaled 10.114 billion bushels, or about 76 percent of domestic wheat and feed grain production. Corn is also the leading cash crop, constituting about 71 percent of the $34.7 billion production value of wheat and feed grains in 2003. About 56 percent of corn production was used for feeding in the cattle, hog, lamb, and poultry sectors (USDA Agricultural Statistics 2004). Wheat for feed use was about 10 percent of wheat production in 2003. The other feed grains of oats, barley, and sorghum had about 45 percent (on average) of their production allocated to feed use in 2003.

In terms of 2003 disappearance, about 56 percent of corn was allocated to feed purposes, 24 percent was allocated to food, seed, and industrial (syrups, ethanol) use, and the remaining 20 percent was sold into the export market. The five largest U.S. export customers for corn in 2003 were Japan, Mexico, Taiwan, Canada, and Egypt, accounting for about 75 percent of total U.S. exports.

Corn's economic role as the largest cash grain crop is apparent, but its role in the secondary markets of livestock production is also crucial. Demand and supply factors that determine corn prices impact livestock and poultry feeding costs and prices and production in the livestock-meat and poultry industries. Moreover, corn's marketing and agribusiness effects are not trivial, generating employment and income through storage, transportation, processing, and product distribution and retailing.

In this briefing the economic factors underlying corn demand and supply and their effects on corn prices, production, and production revenues are analyzed. An econometric model is used to estimate price, production, and revenue effects due to changes in production technology, fertilizer costs, price supports through marketing assistance loans, corn exports, and competition from sorghum and soybeans. This information is important to corn growers because of their vested interest in United States Department of Agriculture (USDA) farm commodity programs, international trade policies, domestic energy costs, and public and private research such as grain

genetics and farming practices. These domestic and trade policies play a major role in influencing grain market prices and returns to producers.

Corn Model

Several economic variables expected to determine the demand, supply, and price of corn are specified in the econometric model. Statistical estimation of model demand and supply coefficients serves two purposes in the analysis of the corn market. One is estimation of the demand and supply elasticities, which measure the effects in percentage terms of changes in economic variables on corn price and production (acreage times yield). For example, if the USDA were to project carryover (stocks) of corn to increase by 10 percent, an expected percentage change in corn price can be predicted. Another purpose of these elasticities is to estimate changes in corn prices and production based on historical changes in commodity (or other) national policies. For example, nonrecourse corn loan rates set by the USDA for the past thirty years (under various configuration of the commodity policy) have varied from $1.05/bu to $2.65/bu (current dollars). These loan rate variations likely affected producer returns through production, marketing, and price changes. Estimating and interpreting such impacts can be a guide to price support policies in future commodity program legislation.

The data period used for the econometric model was 1970-2003. Variables expected to determine corn demand (or price) along with their economic effects are: (1) corn production, with increases in production expected to have a negative effect on price; (2) corn stocks, with increases over prior

levels expected to have a negative effect on price; (3) corn exports, with increases in exports expected to have a positive effect on price; (4) sorghum price, with increases in sorghum prices relative to prior levels expected to have a positive effect on corn price (sorghum is a demand substitute in feed rations); and (5) livestock prices of beef and pork. The last factor indicates increases in demand prices for cattle and hogs by livestock finishers (hence, more animal units fed) leads to an increase in demand and price of feed corn.

The economic variables hypothesized to determine corn supply (or production) are: (1) the market price of corn, which for an increase would have a positive effect on production; (2) the corn nonrecourse loan rate, for which an increase would have a positive effect on production; (3) fertilizer price, of which its increase would have a negative effect on production; (4) technology such as increased yields, that would have a positive effect on production; and (5) the price of soybeans for which an increase would have a negative effect on corn production. Corn and soybeans are production substitutes in the corn-soybean producing areas. An increase in soybean price relative to the corn price would shift acreage away from corn to soybeans.

Another factor hypothesized to have influenced corn production are the commodity provisions of the Federal Agricultural Improvement and Reform Act (FAIR) Act of 1996. This legislation eliminated the annual acreage conservation reserve and fully decoupled current commodity production from acreage bases. Thus, any corn production effect of the FAIR Act likely involves the full decoupling of base for current

crop production (Smith and Glauber). USDA acreage data show that planted corn acreage increased, on average, from 74.14 million acres in the 1988 to 1995 period prior to the FAIR Act to an average of 78.65 million acres in the 1996 to 2003 period.

Demand and Supply Effects

Issues pertinent to feed grain producers often relate to policy. One consistent component of federal commodity policy (first legislated in the 1930s) has been price supports in the form of nonrecourse loans. These loans permit participating crop producers with loan quality production to establish a minimum or floor price equal to the loan rate, thereby reducing marketing risk (Knutson, Penn, and Boehm). The corn loan rate, subject to economic and political influences, increased from a 1970-1972 average of $1.05/bu to a 2001-2003 average of $1.95/bu, or 85.7 percent. However, in real or inflation-adjusted terms (1982-84constant dollars), the corn loan rate declined from $2.60/bu to $1.08/bu, or by 58.5 percent during this period.

U.S. grain trade policies are critical to domestic prices received by producers since grain imports and exports affect total supplies and disappearance. For several decades, the United States expanded its corn exports due to liberalized trade and increases in livestock production in importing countries. Corn exports increased from an average of 0.86 billion bushels in 1970-1972 to an average of 1.77 billion bushels in 2001-2003, or a 106.2 percent increase. However, bulk corn exports peaked at 2.42 billion bushels in

1979. Since then, an increasing portion of U.S. corn exports have consisted of processed products.

U.S. imports, domestic exploration, and consumption of energy are basic demand and supply factors that determine energy prices. For grain producers, fuel and fertilizer costs are important components of variable costs of operation. Costs of anhydrous ammonia (used in fertilizer production) are highly correlated with natural gas prices, and gas prices have substantially increased since the mid 1990s because of declining inventories and increasing energy consumption. Fertilizer prices increased from $37.33/ton in 1970-1972 to $118.33/ton in 2001-2003, or about 217 percent. However, real fertilizer prices decreased from $92.48/ton to $67.55/ton, or 29.1 percent during this period.

Technology changes involving corn genetics (new hybrids), machinery capital, and new farming practices have contributed to increased U.S. corn production. Trends in crop yields normally reflect technology changes. Yield growth was substantial for corn, i.e., from 1970-1972 to 2001-2003 yield per harvested acre increased from 85.9 bushels to 136.6 bushel, or a 59.0 percent increase. Technology adoption that reduces unit costs of production may also increase planted acres.

The corn sector also depends upon the economic well being of the livestock industry. For example, if cattle and hog livestock prices increase due to an increase in retail meat demand, then the additional animal units fed would increase the demand and price of feed corn. But from 1970-1972 to 2001-2003 real beef slaughter price decreased by 48.6 percent and real pork slaughter price decreased by 60.1 percent.

Beef prices declined during this period because of decreasing retail beef demand and increasing beef and competing (pork and poultry) meat supplies. Pork prices declined because of increasing pork and competing (beef and poultry) meat supplies, but pork demand remained relatively constant (Marsh 2003). Increases in pork supplies are primarily attributed to reduced unit production costs from the relatively recent, but rapid vertical integration in the hog-pork industry.

Comparative Impacts

Changes in real corn price, quantity produced, and real total revenue attributable to long-term changes in the economic variables during the 1970-1972 to 2001-2003 period are presented (Table 1). The effects of declines in real sorghum and soybean prices, which decreased by 66.5 percent and 62.8 percent, respectively are presented. Estimated changes in total revenue for corn are based on deviations from average total revenue of corn production, which was $20.01 billion for the 1970-2003 period.

The largest impact on the corn sector occurred from its foreign trade component (Table 1). The 106.2 percent increase in corn exports amounted to an increase of $9.84 billion, or 49.2 percent of average total revenue. The second largest impact occurred from technology changes, which added $6.16 billion to the sector, or 30.8 percent of average total revenue.

Livestock prices had the third largest impact on revenues in the corn sector. But the change in livestock prices had a negative effect on corn growers. The average decline of 54.3 percent in real beef and pork slaughter prices decreased revenue in the corn

sector by $4.92 billion, or 24.6 percent of average corn revenue in the 1970-2003 period. Following close to the effect of livestock prices was the negative impact of declining real sorghum and soybean prices. These prices declined by an average of 64.6 percent, over the period, and resulted in decreasing corn-sector revenue by $3.66 billion, or 18.3 percent of annual average corn revenue during the 1970-2003 period.

Corn loan rate and the price of fertilizer had opposite effects on revenues in the corn sector. The 58.5 percent decrease in the real loan rate reduced corn revenue by $1.79 billion, while the 29.1 percent decrease in real fertilizer price increased corn revenue by $1.72 billion. The key reasons for the revenue changes were the 1.06 billion bushel reduction in corn production from the loan rate and the 1.39 billion bushel increase in corn production from the fertilizer price. In each case, the production changes more than offset corn price changes in the opposite direction (Table 1).

Model results indicated the effects of the FAIR Act increased corn production by about 12 percent from 1996 to 2003, largely due to the decoupling of crop production from crop base. But, the variable's economic effect was not statistically significant and the effect was not included (Table 1).

Conclusions

Results from the econometric model indicate that corn loan rates established through domestic commodity policy, international trade, and energy costs significantly affect corn

producer returns. Corn's competitive relationship with other grain substitutes in demand and production and the effects of technology are also critical. Of nearly equal importance is the economic health of the livestock industry, a substantial component of the demand for feed grains. Livestock prices accounted for about 18 percent of the corn revenue changes caused by the six variables found to have statistically significant impacts on corn sector revenues (Table 1).

The variables analyzed in this briefing are not all inclusive, i.e., other factors such as feed wheat, barley, and ethanol use may also influence producer revenues in the corn sector. But for the variables considered, in spite of corn income reductions from declines in the real loan rate, sorghum and soybean prices, and livestock prices, the corn sector managed a net revenue gain of $7.35 billion relative to its average real revenue of $20.01 billion for the 1970-2003 period. The positive contributors were expanded exports, lower real energy costs, and technological advancement.

References

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Table 1. Effects of Changes in Economic Factors on the Corn Sector, 1970-2003

			Factors Changed			
Variable	Loan Rate	Exports	Fertilizer Price	Grain Prices	Livestock Prices	Technology
Change	(↓58.5%)	(↑106.2%)	(↓29.1%)	(↓64.6%)	(↓54.3%)	(34 years)
Corn Price	$0.16/bu	$0.60/bu	-$0.18/bu	-$0.75/bu	-$0.38/bu	-$0.63/bu
Corn Prod.	-1.06 bil bu	1.39 bil bu	1.23 bil bu	0.65 bil bu	-0.89 bil bu	5.38 bil bu
Corn Rev. (Percent)	-$1.79 bil (8.95)	$9.84 bil (49.17)	$1.72 bil (8.59)	-$3.66 bil (18.27)	-$4.92 bil (24.59)	$6.16 bil (30.78)

Note: The percentage reduction (64.6%) in the "Grain Prices" column is the average percentage reduction in real sorghum and soybean prices. The percentage reduction (54.3%) in the "Livestock Prices" column is the average percentage reduction in real slaughter beef and pork prices.