Feed Grains, Ethanol and Energy – Emerging Price Relationships

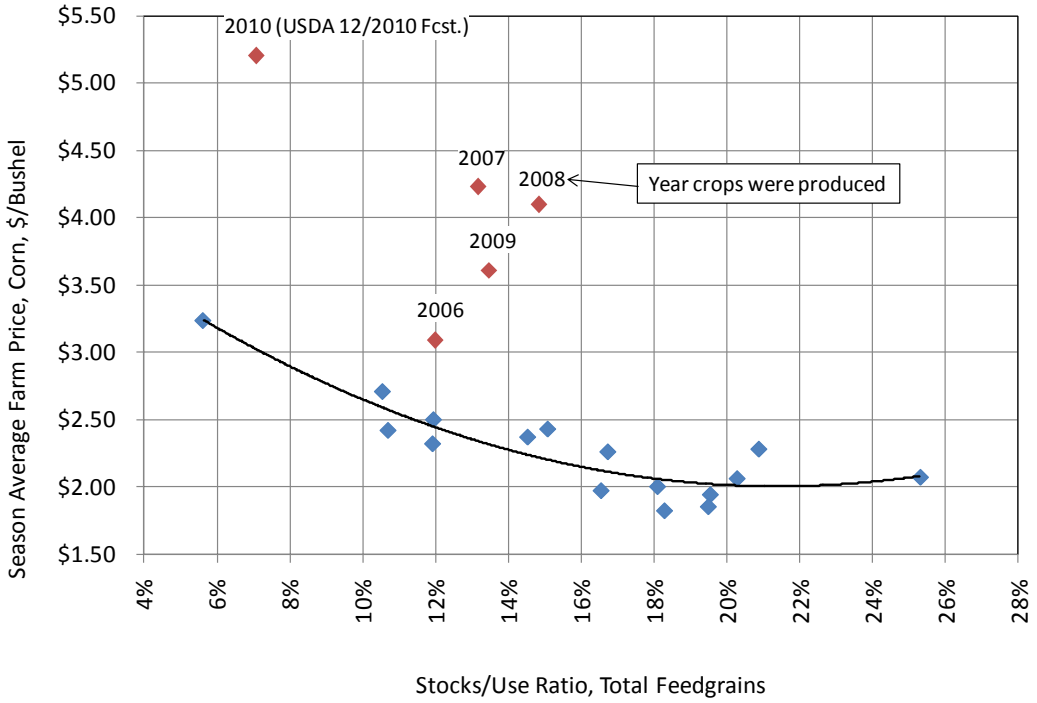
Dr. Tom Elam, President, FarmEcon LLC
Dr. Steve Meyer, President, Paragon Economics
12/13/2010

The November 25, 2010 edition of Feedstuffs contained an article on the effects of increased ethanol production on the feedgrains balance sheet. This article explores the corn price effects of the shift in corn demand that has resulted from the rapid increase in ethanol production since 2005.

Over the past four years there has been a fundamental shift in the demand/price relationship of U.S feedgrains. That shift may have several elements, but as we will show it is dominated by the increased use of U.S. corn for ethanol production. We will also show that the underlying relationship between corn prices and the stocks/use ratio for total feed grains has not changed.

The corn price shift is starkly evident in the simple graph below that shows corn prices versus the stocks/use ratio for total U.S. feedgrains (corn, sorghum, barley and oats). Labels indicate the years that the feedgrain crops were produced and harvested.

U.S. Season Average Corn Price vs. Feedgrains Stocks/Use Ratio
Crops of 1990 to 2010 (Sept. 1 Crop Years)



Data source: USDA, World Outlook Board

This relationship between the ratio of ending stocks to total use versus corn prices shows that prior to the 2006 feedgrain crop there was a stable relationship between how "tight" ending stocks were and the season average farm level corn price. From a very basic supply/demand balance viewpoint this makes perfect sense. As stocks declined relative to total usage, corn prices were bid up, providing farmers incentives to plant more feedgrains. High stocks relative to total usage indicated that less feedgrain production was needed, prices fell and plantings and production declined.

The line in the graph represents the plot of a regression equation that best fits the corn prices and stocks/use ratios from 1990 to 2005. The equation is shown below:

Regression for Season Average Corn Price, Feedgrain Crops of 1990-2005

Variable	*Coefficient*	*Standard Error*	*t Stat*
Intercept	4.281	0.329	13.024
Stocks/Use Ratio	-21.284	4.358	-4.884
Stocks/Use Ratio^2	49.766	13.889	3.583

Data source: USDA, World Outlook Board

The equation has an R^2 of 0.83, meaning that it explains 83% of the variation of corn prices over the 16-year period. All coefficients have theoretically correct signs and are statistically significant. As the stocks/use ratio increases the squared variable takes on more importance, and the impact of stocks/use on price decreases. This effect causes the fitted regression line to flatten as the stocks/use ratio increases.

Since 2006 the predictable relationship between the feedgrains stocks/use ratio and corn price has obviously changed. At all the actual stocks/use ratios since 2005, the season average corn price has been substantially higher than the 1990-2005 relationship indicated. This change in the price vs. stocks/use ratio relationship coincides almost precisely with changes in federal biofuels policies. So, we attempted to quantify the impact of the significant demand shift for ethanol that the Renewal Fuel Standard (RFS) mandated for the 2006-2009 feedgrain crops.

While fuel ethanol has been produced from corn for well over 30 years, it was only after the RFS was created in 2005, and increased in 2007, that corn use for ethanol production became a major factor in U.S. corn demand. To estimate the impact of that increase in ethanol's use of corn, we created a threshold variable that was calculated as ethanol production in excess of 4 billion gallons per crop year. We used 4 billion due to the fact that production first exceeded that level in 2005, the year the original RFS was created.

We also believe that higher corn use for ethanol has made corn prices sensitive to energy prices. We observed that in recent crop years corn prices appeared to be positively correlated to ethanol and gasoline prices. That relationship did not exist prior to 2005. In fact, from 1990 to 2005 the correlations between corn price and ethanol price, and corn price and gasoline price, were actually negative. We also observed that the positive correlations with corn prices emerged only as ethanol prices went above about $2 per gallon. The correlations are shown in the table below:

Correlations of Monthly Average Prices, Omaha, Nebraska
#2 Yellow Corn, Petroleum Blender Gasoline and Ethanol

Period	**Corn/Ethanol**	**Corn/Gasoline**
1/1990-9/2006	-0.132	-0.255
10/2006-10/2010	0.661	0.666
10/2007-10/2010	0.873	0.752
10/2008-10/2010	0.567	-0.014
10/2009-10/2010	0.753	0.153

Data sources: USDA/AMS and Nebraska Energy Board

Including data for the crops of 2006-2009, we re-estimated the stock/use ratio and corn price equation, including the threshold ethanol production and ethanol price variables. Results are shown in the table below.

Regression for Season Average Corn Price, Feedgrain Crops of 1990-2009

Variable	*Coefficient*	*Standard Error*	*t Stat*
Intercept	4.218	0.543	7.763
Stocks/Use Ratio	-20.623	7.208	-2.861
Stocks/Use Ratio^2	48.087	22.972	2.093
Ethanol Production, Over 4 Billion Gallons	0.199	0.0274	7.271
Ethanol Price, Omaha Blender, over $2/Gallon	1.778	0.589	3.018

Data sources: USDA, World Outlook Board, U.S. Department of Energy, and Nebraska Energy Board

The R^2 of this equation is 0.89. All coefficients have the correct theoretical sign, and all are statistically significant. The two coefficients for stocks/use ratio are essentially identical to the “pre-ethanol” estimates for 1990-2005. Every billion gallons of ethanol production above 4 billion is associated with an increase in corn prices of about 20 cents per bushel. Every 1 cent increase in ethanol prices over $2 per gallon is associated with an increase in corn prices of about 1.8 cents per bushel. In both cases, the effects are independent of, and additive to,

any effects that increased ethanol production may have had on the feedgrains stocks/use ratio.

That is, not only has increased ethanol use of corn caused feedgrains stock/use ratios to be smaller, but in addition has further increased corn prices beyond what those ratios would have indicated based on historical relationships.

We can use this last equation to forecast an average price for the 2010 corn crop. If we assume that the USDA's December, 2010 USDA feedgrains stocks/use ratio estimate of 6.9% for the 2010 feedgrain crop is correct, that ethanol production will be 13 billion gallons, and that the average Omaha ethanol price will be $2.25 per gallon, the estimated season average corn price is $5.26 per bushel. The mid-point of the current (December, 2010) USDA corn price forecast is $5.20. At least for these conditions, the regression model closely mimics the method USDA used for its 2010-crop corn price forecast.

Absent the ethanol production and price effects, the 2010 crop average corn price would be forecast at $3.02 per bushel, $2.24 less than the current forecast. Of that difference, $1.80 is attributed to increased ethanol production above 4 billion gallons, while $0.44 is attributed to ethanol prices above $2.00 per gallon.

Conclusions: From this statistical evidence, we conclude that the increase in corn prices since 2005 has been largely due to a combination of lower stocks/use ratios, increased ethanol production, and a higher energy value of corn. The ethanol production increase was partially caused by 2005/2007 RFS mandates. The underlying, pre-2006, relationship between corn price and the total feedgrains stocks/use ratio was not changed significantly by the influence of ethanol prices and policy. Using realistic projections for ethanol production and price, the regression equation including ethanol's effects closely predicts the mid-point of the current (December, 2010) USDA corn price forecast range of $4.80-$5.60.

With further increases in mandated ethanol production, the model indicates that further upward pressure on corn prices should be anticipated. If energy prices increase from current levels, even more upward pressure on corn prices is indicated. The underlying issue is the fact that the land available for grain and oilseed production is limited. Increases in the RFS and energy prices could cause corn prices to increase further in order to attract more land into corn, and out of competing crops. Land diverted to corn will, in turn, put upward price pressure on other major crops competing for that acreage.

The statistical relationship shows that it is a fundamental market force of higher demand (albeit largely a result of federal policy) causing higher corn prices, not speculators. To the extent that speculators have accumulated

long positions in corn futures, they have likely done so because they have observed the fundamental change in grain demand shown in this paper.

While current statistical evidence is limited to a short period of time, rapid increases in ethanol production appear to be fundamentally related to higher corn prices. In effect, by driving ethanol production with demand guarantees, biofuels policy has caused significant cost increases for all users of feedgrains. Those cost increases are causing reduced production and record-high wholesale prices for meats and poultry. These record-high wholesale prices will eventually be passed along to consumers in the form of higher retail prices that will, most likely, themselves be record high.