

The Relationship of Ethanol, Gasoline and Oil Prices

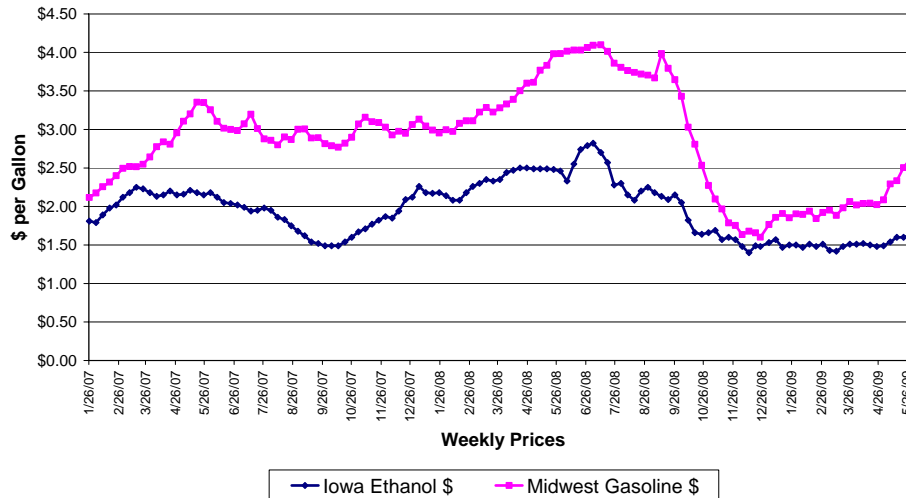
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Since early 2007 ethanol prices in Iowa have traded in a wide price range. The high for the period of \$2.82 per gallon occurred in early July 2008, while the low of \$1.40 per gallon occurred in mid-December 2008. Iowa ethanol prices declined approximately 51% during this 6 month period (see Figure 1). Since the market low in late 2008, Iowa ethanol prices have trended sideways to slightly higher through early June 2009, closing at \$1.69 per gallon on June 5, 2009. Given the relative strength of corn prices during this period, (i.e., the primary input into the starch or grain-based ethanol refining process), low ethanol prices have severely limited if not in many cases eliminated the profitability of operating ethanol plants in Iowa, Kansas and other locations in the Midwestern United States. See "[Tracking Ethanol Profitability](#)" in the renewable energy section of the AgMRC website for more information on estimated ethanol plant profitability. (http://www.agmrc.org/renewable_energy/ethanol/tracking_ethanol_profitability.cfm)

Relationship of Ethanol and Gasoline Prices

Gasoline prices in the United States have a primary and critical impact on domestic ethanol prices, although other regulatory and environmentally-oriented mandates by the U.S. Federal government also have a major impact on ethanol market supply-demand and prices. Beginning in early 2007, U.S. gasoline prices trended higher into the spring months of that year, then leveled off in the summer months of 2008, with high price of \$4.10 per gallon during the week of July 11, 2008. From mid-September to Christmas in December 2008, U.S. gasoline prices declined 60%, from \$3.98 to \$1.60 per gallon (Figure 1).

Figure #1.
Iowa Ethanol and Midwest Gasoline Prices
January 26, 2007 through June 5, 2009



Source: USDA Ag Marketing Service, *National Weekly Ethanol Summary* (<http://www.ams.usda.gov/mnreports/lswethanol.pdf>), Energy Information Administration - U.S. Dept. of Energy (http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_p2W.htm)

What type of statistical relationship exists between Iowa ethanol prices and U.S. Midwest gasoline prices? The positive correlation between these two energy price series over the time period examined here is 83%. To understand how to interpret correlation relationships, a negative correlation of -100%

would indicate that price movements between Iowa ethanol and Midwest gasoline prices are perfectly negatively correlated – moving in exactly opposite directions over time. A correlation of 0% would indicate that over time there is no correlation or relationship between the movement in these two price series. A positive correlation of +100% indicates that changes in these two price series move perfectly together in the same direction over time.

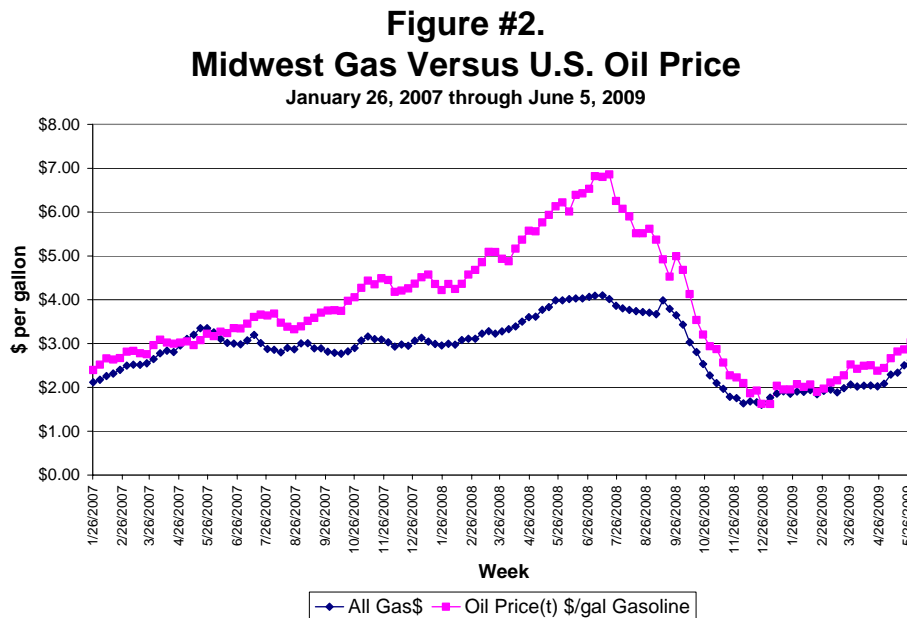
When Iowa ethanol prices are regressed upon Midwest gasoline prices for this period, the following price relationship exists:

$$\text{(Model \#1)} \quad \text{Ethanol\$}^{\text{Iowa}} = \$0.676 \text{ per gallon} + [\$0.445 \text{ multiplied by Midwest gasoline\$ /gallon}]$$

At the average prices for ethanol and gasoline for the late January 2006 through early June 2009 period, a 10% increase in Midwest gasoline prices brought about a 6.59% increase in Iowa ethanol prices.

Relationship of Midwest Gas and U.S. Oil Prices

With oil or petroleum being the raw product from which gasoline is produced, it is expected that there would be a positive relationship between oil and gasoline prices. A positive correlation of 93% exists between U.S. Midwest gasoline prices and the U.S. price of oil (Figure 2) over the 2007-mid-2009 period.



Source: Energy Information Administration - U.S. Dept. of Energy, Weekly Midwest All Formulations Gasoline Prices (http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_p2W.htm), Weekly United States Oil Price (<http://tonto.eia.doe.gov/dnav/pet/hist/wtotosaw.htm>)

In this analysis, weekly U.S. domestic spot oil prices (FOB weighted by estimated oil import volume) are presented on an equivalent gallon of gasoline produced basis. Since one barrel of oil typically produces 19.6 gallons of gasoline gas, the price per barrel of oil is divided by 19.6 gallons to derive a price or cost of oil per gallon of gasoline produced.

When Midwest gasoline prices are regressed upon U.S. oil prices for this period, the following price relationship exists:

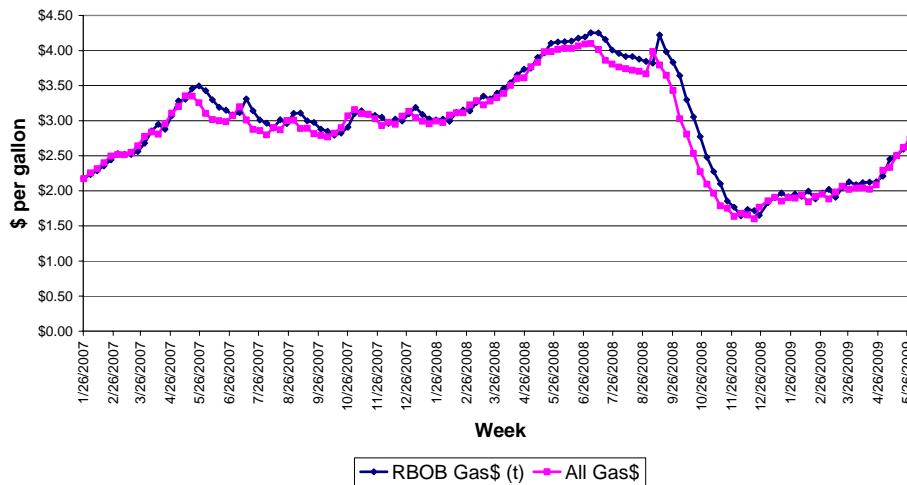
$$\text{(Model \#2)} \quad \text{Gasoline\$}^{\text{Midwest}} = \$1.108 \text{ per gallon} + [\$0.466 \text{ multiplied by U.S. Oil\$ /gallon}]$$

At the average prices for ethanol and gasoline for the late January 2006 through early June 2009 period, a 10% increase in U.S. domestic oil prices brought about a 6.14% increase in U.S. Midwest gasoline prices.

Relationship of Midwest RBOB Gas and U.S. Gasoline Prices

RBOB gasoline prices represent reformulated gasoline blendstock for oxygen blending (i.e., RBOB). Ethanol is blended with RBOB gasoline to make products such as E-10 (i.e., 10% ethanol blend gasoline). It makes sense that the demand for ethanol would be closely associated with the demand for RBOB gasoline, since they are complementary products (i.e., ethanol can not be effectively used in the U.S. without blending it with RBOB blendstock. A positive correlation of 98% exists between U.S. Midwest gasoline prices and the price of RBOB gasoline (Figure 2).

Figure #3.
Midwest RBOB Versus Gasoline Price
 January 26, 2007 through June 5, 2009



Source: Energy Information Administration - U.S. Dept. of Energy, *Weekly Midwest Reformulated Gasoline Prices* (http://tonto.eia.doe.gov/dnav/pet/hist/mg_tr_p2W.htm), *Weekly Midwest All Formulations Gasoline Prices* (http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_p2W.htm),

When Midwest RBOB prices are regressed upon Midwest gasoline prices for this period, the following price relationship exists:

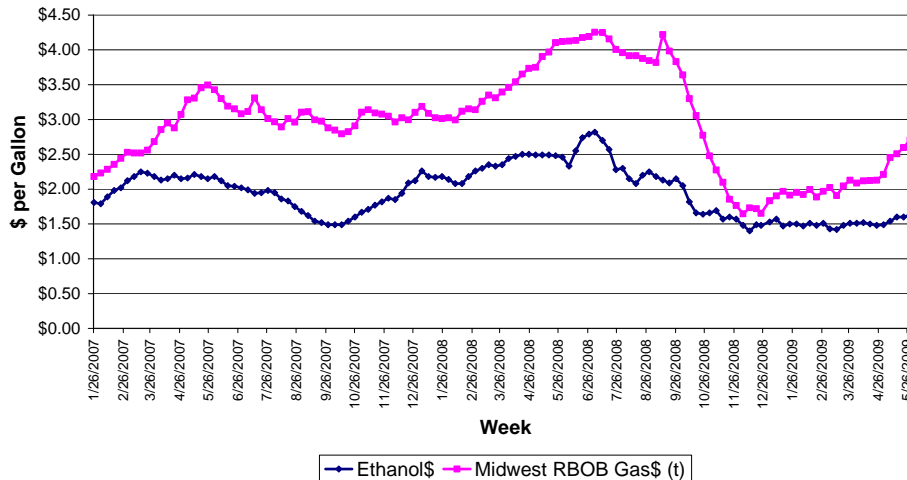
$$\text{(Model \#3)} \quad \text{RBOB\$}_{\text{Midwest}} = \$0.087 \text{ per gallon} + [\$1.003 \text{ multiplied by Midwest gasoline\$ /gallon}]$$

At the average prices for RBOB and gasoline for the late January 2006 through early June 2009 period, a 10% increase in Midwest gasoline prices brought about a 9.73% increase in Midwest RBOB gasoline prices.

Relationship of Iowa Ethanol and Midwest RBOB Prices

As stated above, ethanol and RBOB gasoline prices are complementary in nature, i.e., neither is sold to consumers without the other. In this analysis, a positive correlation of 82% existed between Iowa ethanol prices and the price of Midwest RBOB gasoline (Figure 4).

Figure #4.
Iowa Ethanol Versus Midwest RBOB Prices
 January 26, 2007 through June 5, 2009



Source: USDA Ag Marketing Service, *National Weekly Ethanol Summary* (<http://www.ams.usda.gov/mnreports/lswethanol.pdf>), Energy Information Administration - U.S. Dept. of Energy, *Weekly Midwest Reformulated Gasoline Prices* (http://tonto.eia.doe.gov/dnav/pet/hist/mg_tr_p2W.htm)

When Iowa ethanol prices are regressed upon Midwest RBOB gasoline prices for this period, the following price relationship exists:

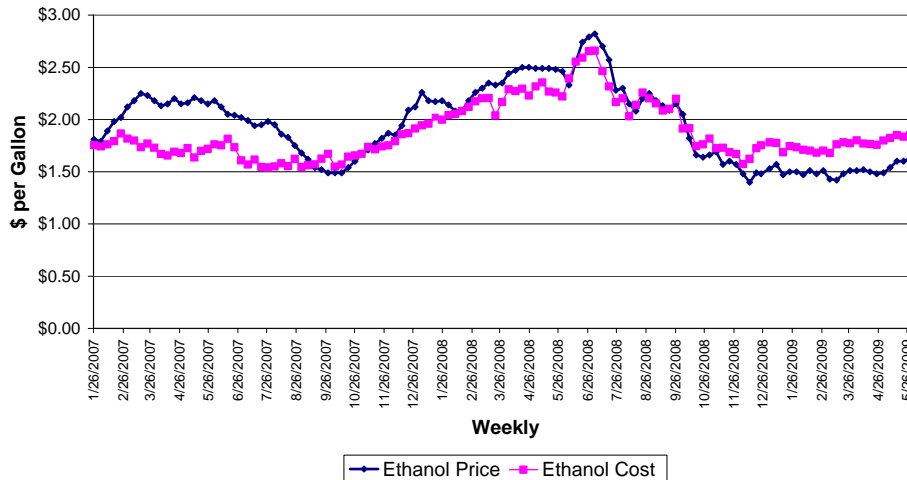
(Model #4)
$$\text{Ethanol\$}^{\text{Iowa}} = \$0.690 \text{ per gal.} + [\$0.435 \text{ multiplied by Midwest RBOB gasoline\$ /gallon}]$$

At the average prices for RBOB and gasoline for the late January 2006 through early June 2009 period, a 10% increase in Midwest RBOB gasoline prices was associated with about a 6.46% increase in Iowa ethanol prices.

Relationship of Iowa Ethanol Price and Estimated Ethanol Cost of Production

The final ethanol-related relationship examined is that between the Iowa price of ethanol sold and the estimated cost of production. The estimated cost of production is an approximation that relies on criteria developed in Kansas. If in the short run, changes in ethanol cost of production may be reflected in ethanol prices, then it would be possible that ethanol plants may have an indirect influence on prices. This issue will be examined below. In this analysis, a positive correlation of 77% existed between ethanol prices and the estimated cost of production of ethanol in Iowa (Figure 5).

Figure #5
Iowa Ethanol Price Versus Cost
 January 26, 2007 through June 5, 2009



Source: USDA Ag Marketing Service, National Weekly Ethanol Summary (<http://www.ams.usda.gov/mnreports/lswethanol.pdf>), Kansas State University

When Iowa ethanol prices are regressed upon estimated ethanol cost of production for this period, the following price relationship exists:

$$\text{(Model \#5)} \quad \text{Ethanol\$}^{\text{Iowa}} = -\$0.024 \text{ per gal.} + [\$1.051 \text{ multiplied by Midwest RBOB gasoline\$ /gallon}]$$

At the average prices and costs for ethanol and gasoline for the late January 2006 through early June 2009 period, a 10% increase in estimated ethanol costs was associated with approximately a 12.1% increase in Iowa ethanol prices. At issue is a question of short run “causality”, i.e., in the short term do changes in ethanol cost of production actually lead to changes in ethanol prices?

Conclusions

This paper provides an examination of some of the economic factors that have affected Midwestern ethanol prices and plant profitability during the period of January 2007 through early June 2009. Broader energy market and economic factors have affected the U.S. ethanol industry during the 2007-2009, and are likely to continue to do so for the foreseeable future. These factors include prices for oil, gasoline and feedgrains, as well as that of RBOB gasoline, and broader economic trends in the United States and abroad. Of particular interest will be the price of oil / gasoline and feedgrains, since these factors play such major roles in determining the profitability of ethanol production in the United States. Look for these factors to be discussed in more detail in future issues of the Renewable Energy newsletter. The price series discussed in this article will continue to be tracked in the [Fuel and Grain Price Historic Comparison](http://www.agmrc.org/renewable_energy/ethanol/fuel_and_grain_price_historic_comparisons.cfm) (http://www.agmrc.org/renewable_energy/ethanol/fuel_and_grain_price_historic_comparisons.cfm).