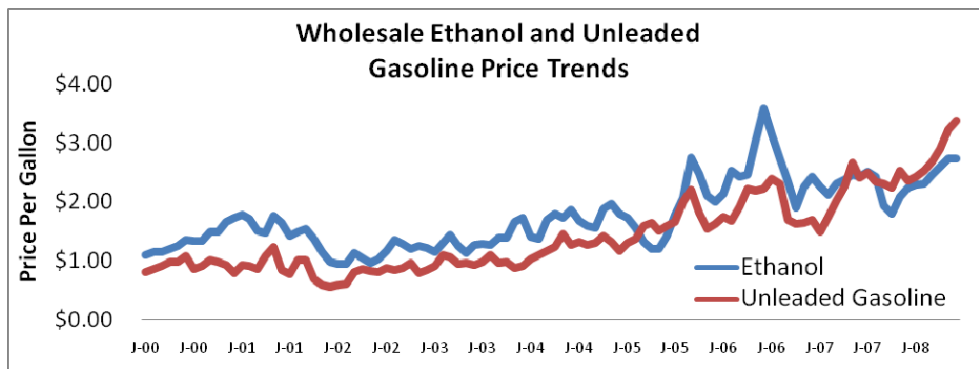


## How Well Does the Price of Unleaded Gasoline Predict the Price of Ethanol?

Dave Swenson  
Iowa State University  
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There are a lot of shortcuts in decision making processes. The often most frequent short cut is called the conventional wisdom or view, which John Kenneth Galbraith in *The Affluent Society* said were "... the ideas which are esteemed at any time for their acceptability." He also said that the "... conventional view serves to protect us from the painful job of thinking." Armed with those notions, let us take a look at the conventional view that the price of ethanol tracks the price of oil (or more appropriately gasoline, the fuel for which it substitutes).

The first graph depicts the relationship between the two commodities on a monthly basis at the wholesale level.\* It is evident that the price of ethanol has, in general, trended in the same overall upward and, occasionally downward, directions as unleaded gasoline over time. We also see, however, that the price of gasoline in recent months has risen above the ethanol price and continues to rise at a faster rate than ethanol. While ethanol continues to track with the price of gasoline, there is evidence of some disconnection. First, the price of gasoline is above the price of ethanol per gallon, a situation that has happened only sporadically over the time series, and never for as long as is currently indicated. Second, while there is obvious price volatility in gasoline, there appears to be, in later months, greater up and down volatilities in the bid prices for ethanol.



We can measure this relationship by doing some basic statistics. As the conventional view is that ethanol tracks, or is therefore *caused by*, unleaded gasoline prices, we can regress the value of ethanol per gallon against the price of unleaded gasoline to see just how well gasoline prices help us understand ethanol prices. The findings are in the next table. Two simple time series were assessed: a month to

\* Monthly wholesale unleaded gasoline prices and ethanol "rack" prices, FOB, Omaha, Nebraska. Analysis period is from January 2000 through June 2008.

month relationship and a one month lag where the previous month's unleaded fuel price determined the current month's ethanol price. The month to month measure indicated that 71 percent (.707) of the variance in the price of ethanol per gallon was explained by the current price of unleaded gasoline.\* The one month lag values indicated that during this decade, 72 percent (.721) of the variance in the price of ethanol per gallon was explained by last month's unleaded gasoline price – a slightly better model but not one to write home about. Either way, while the price of unleaded gasoline certainly explains a large portion of the price of ethanol, 28 or 29 percent of the price is explained by other things.

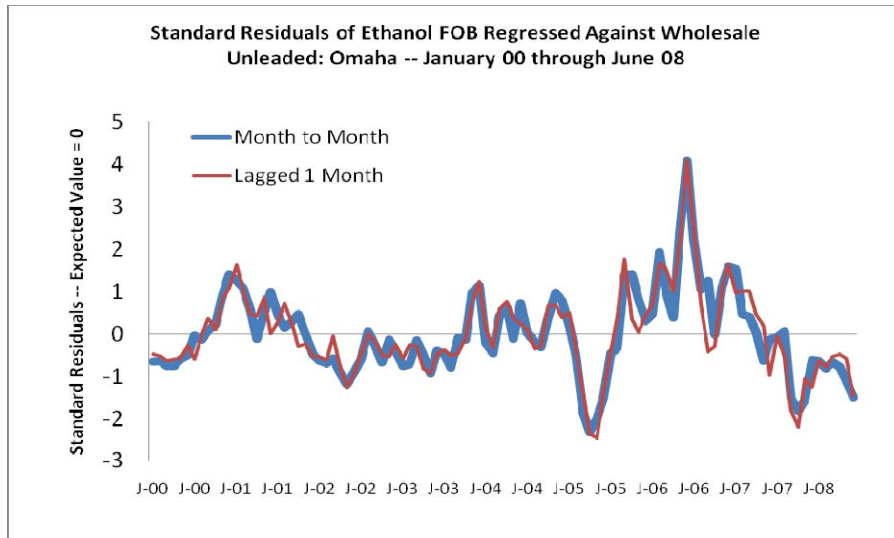
<b>Regression Output</b>		
	Month to Month	One Month Lag
Multiple R	0.841	0.849
R Square	0.707	0.721
Adjusted R Square	0.704	0.718
Standard Error	0.307	0.299
Observations	102	102

The conventional view, then, is relatively safe when looking at the overall time period measured. But when we do this kind of analysis it is important to look for patterns over the series. In statistics we would want the errors in prediction to be distributed randomly over the measurement time frame to increase our confidence in our hypothesis. If the errors are not randomly distributed, then we can assume that there are influential cycles, policies, or important other variables at work.

The next graph looks at the pattern of standard errors in prediction over the measurement period. In the period before late 2004, we see that there are patterns to the errors, either in the model over- or under-predicting the price of ethanol, but that the errors are relatively minor. That is they are tracking relatively close to the expected value of zero. After that time, however, the magnitude of the errors in prediction increases sharply. First they are very low in early 2005, a period when the industry was losing money, and then they shoot strongly into the positive area where the model is seriously under-estimating ethanol prices into the early part of 2007. Global and political events help to explain these early errors. Hurricanes in the Gulf, Mideast tensions, and U.S. government policies all contributed to price spikes in ethanol through the 2006 period. Thereafter, the pattern has been for the model to over-estimate ethanol price. Or, to state it differently, ethanol prices are much lower than the predictive model would suggest.

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\* When we do these types of analyses, we pay attention to the **Adjusted R Square** value.



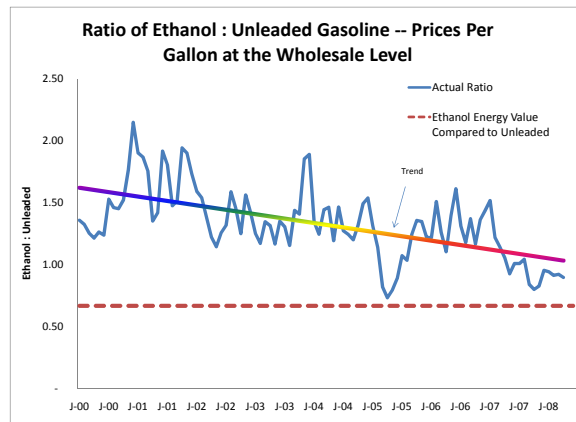
While the conventional view (this model) is partially correct, and would have been even more accurate a tool in the pre-2005 period, that seemingly safe assumption breaks down in the latter portion of the measurement period. The errors in prediction are much greater in the last 18 months, which suggests that the conventional view is, while still conventional, increasingly prone to estimation error leading, therefore, to predictive instability.

Where does this take us? Again, as we are looking at the relationship between ethanol and unleaded gasoline, we need to consider what would or should be the determinants of price. First of all, ethanol in the current market is mandated by the federal government. The target for 2008 is 9 billion gallons; it grows to 15 billion gallons by 2015. Second, through various mechanisms, the production of ethanol is subsidized through tax credits, most notably the \$.51 per gallon U.S. tax credit that is paid at the blender level plus various other credits and subsidies at the national, state, and local levels. Third, the price of ethanol is supported by protective import tariffs of \$.54 per gallon. Fourth, ethanol is a fuel additive in the reformulated fuels that are required by law in several areas; it therefore has desirable environmental benefits that extend beyond its use as just a motor fuel. And last, ethanol as a motor fuel contains two-thirds the energy content as regular unleaded gasoline. Stated differently, it takes a gallon and a half of ethanol to provide the same energy as a gallon of regular unleaded gasoline.

Factors one through four work to boost the price of ethanol, and the last factor is a constraint on the price of ethanol: stated differently, as its primary use is as a motor fuel, its "conventional" value is two-thirds the price of unleaded gasoline, plus the value of the subsidies and other supports that are in place.

The last graph depicts a simple ratio of the price of ethanol relative to unleaded gasoline during this decade. The reader will notice that the relationship between the two commodities is volatile, as was already demonstrated above. We can see that at one point in early 2005 the value approached the

energy value of .67, a time of widespread operating losses in the industry. We can also see that the value has dropped sharply since January of '07. The overall linear trend is persistently downward. In December, 2000, the ratio was 2.15; in June of '09 it was .90. Market forces will continue to put downward pressure on the price of ethanol per gallon so that it approximates much more closely its energy content of .67. That downward pressure will, ultimately, impinge on the profitability of this sector and its overall desirability as an investment opportunity.



What can we take away from this? The basic points are relatively straightforward:

- Ethanol prices are explained in large part by the price of unleaded gasoline over time.
- Increasingly in latter months, however, the price of ethanol is explained by other factors – the predictive power of the model deteriorated after 2005.
- While there are many factors that help to support overall ethanol price, the overall trend in ethanol prices is downward relative to the price of gasoline with an expected long run outcome of prices at or just above the energy content value.
- There are very predictable market forces at work in the ethanol production market, all production supporting subsidies, mandates, and penalties notwithstanding, that may make moot calls to roll back the ethanol mandates both in the current period and on into the future.
  - Ethanol demand growth has slowed.
  - The rate of increase in supply has slowed, too, as new plant expansions abate.
  - Excess profits have been trimmed.
  - Investment dollars for energy are flowing into other alternatives.
- Finally, many of the conventional views about ethanol prices, profits, patterns of growth, economic benefits, and long term outcomes, appear to have become somewhat less “... esteemed ... for their acceptability” given the performance of the industry in recent months.

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