The Effect of Oil Price Variability on Biofuel Production

Overview

Background
As concerns about the availability of crude oil have been brought to the forefront of energy discussions, renewable energy sources have also come to the attention of policymakers, energy firms, renewable energy activists, and consumers. Technological improvements are increasing demand for energy in all countries, especially in emerging economies, such as India and China. The necessity to find alternative energy sources becomes even more critical not only in the United States but globally. One particularly recognizable source of renewable and sustainable energy is biofuel.

Biofuel as an Economic Product
- Biofuels have been economically linked to oil since the 1970s, when the U.S. launched Project Independence to minimize vulnerability to foreign oil producers by investing in sustainable energy sources
- The role of ethanol as a gasoline additive further reinforces the connection between oil and biofuels
- Economic studies of biofuel in its early stages determine that ethanol can only compete with the dominating oil market if the blenders’ fuel tax credit remains in place
- Furthermore, growth in the ethanol industry will eventually put upward pressure on food prices
- Pre-existing market structures and cost disadvantages provide obstacles for biofuel in developing its own market

U.S. Biorefineries Over Time

2002

2013

Research Question and Objectives

To what extent does the volatility of oil prices affect the production or output of biofuels?

Objectives:
1. Analyze the trend in oil prices from 1985 to 2014
2. Evaluate the trend in biofuel production opportunities from 1985 to 2014
3. Determine the effect of the volatility of oil prices on bioethanol production

Research Question and Objectives

Objectives 1 and 2
We graph the data on scatter plots to analyze overall trends from 1985 to 2014 (recession months are shaded gray). We also dichotomize the data sets into two distinct periods: Period A: 1985-1999, and Period B: 2000-2014.

Objective 3
To address Objective 3, we create a model that describes bioethanol production as a function of oil price variability (σ), which was calculated by taking the natural log of average monthly oil prices.

Interpretation
The average monthly growth rate for oil prices was -0.1% in Period A, and 0.97% in Period B. Overall, the average monthly growth rate was 0.58%.

The average monthly growth rate for bioethanol production was 0.46% in Period A, and 1.48% in Period B. Overall, the average monthly growth rate was 0.98%.

Conclusions
We can express the results of Objective 3 as a function that describes the expected production of bioethanol per month based on a set of input variables:

\[
Q_t = \frac{1024.31 + 186.05 c_t + 62.13 s_t - 3113.30 T_t - 58.10 m_t - 35.79 c_t}{1} 
\]

where the following are the coefficient estimates of the regression model:

- \(Q_t\) is the output of bioethanol in each period \(t\)
- \(c_t\) is the volatility (natural log) of crude oil prices in period \(t\)
- \(s_t\) is the price of soybeans, lagged by 4 periods
- \(T_t\) is the value of the biofuel tax credit during period \(t\)
- \(m_t\) is a dummy variable describing whether the American economy is in recession during period \(t\)
- \(c_t\) is the price of corn, lagged by 4 periods.

Future Research
- Including biodiesel in the measurement of biofuel production
- Using a different measure of government biofuel policy

This model is useful because it not only significantly explains past changes in biofuel development, but can also be used for estimating the future of biofuels in the United States.