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The Competitive Position of Ethanol as an Octane Enhancer

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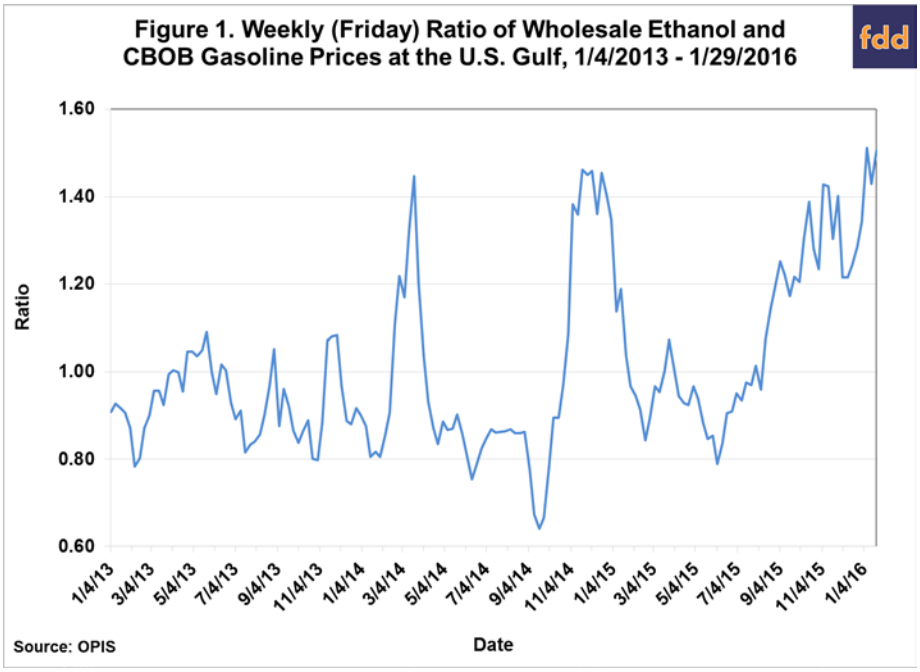
In the *farmdoc daily* article of January 13, 2016 we chronicled the recent sharp decline in crude oil and gasoline prices that has resulted in the "upside-down" relationship of ethanol prices exceeding gasoline prices. Figure 1 shows wholesale ethanol and CBOB gasoline prices at the U.S. Gulf, and it indicates that ethanol prices have remained well above gasoline prices over the last month. We noted in the previous article that crude oil and gasoline prices could remain low for an extended period, perhaps threatening the competitive position of ethanol in gasoline blends. However, the RFS conventional ethanol mandate provides a safety net for domestic ethanol consumption even when ethanol prices are above gasoline prices. In addition, the conventional ethanol mandate implies that the price of ethanol would have to remain above the ethanol plant "shut down" price in order to ensure that mandated quantities of ethanol are produced. We did acknowledge that a continuation of high ethanol prices relative to gasoline prices opens the possibility that ethanol will become a relatively expensive source of octane in gasoline blends. Here, we examine the price relationship between ethanol and the alternative sources of octane known as aromatics as an indication of the competitive position of ethanol as an octane enhancer.

Analysis

Gasoline sold at the pump is actually a blend of ethanol and a number of petroleum products, such as methane, butane, and naptha (see Leffler, 2008, Ch. 14). Refinery blending economics for gasoline are complicated due to the differing array of characteristics of alternative blending components and regulatory requirements to produce "spec" gasoline. For example, ethanol has chemical characteristics that may be beneficial, e.g., as an octane enhancer, or detrimental, e.g., high vapor pressure. Energy companies have developed sophisticated mathematical refinery models to determine optimal blends of the various gasoline components given prices and technical specifications.

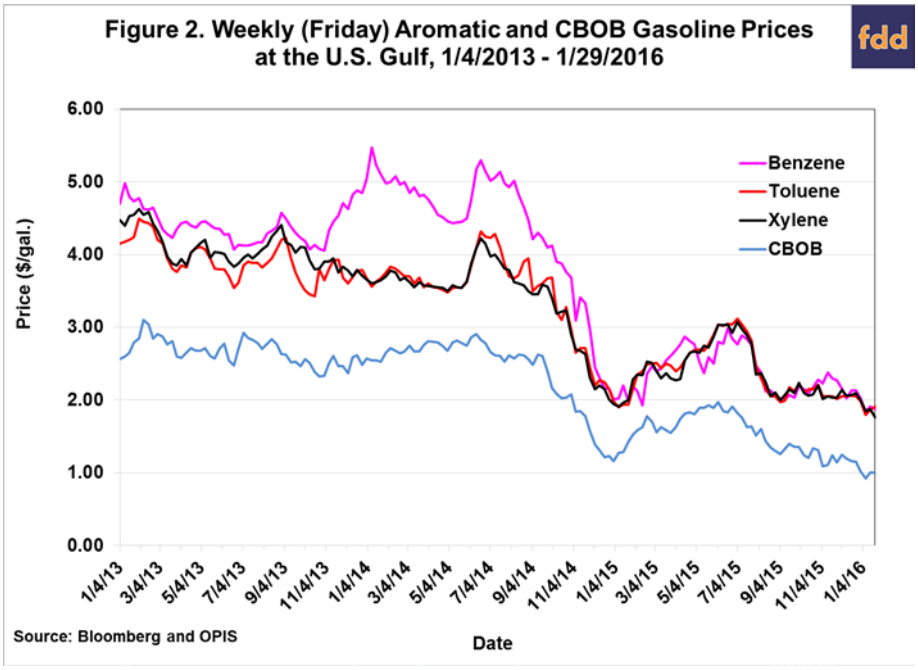


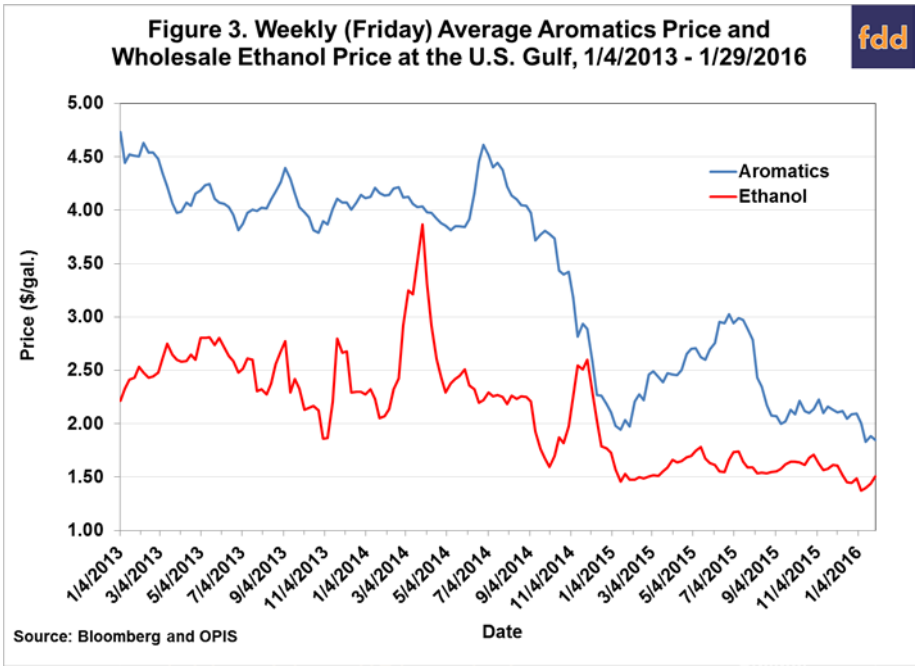
We focus on the value of ethanol in the gasoline blend as an octane enhancer because there is ample evidence the market value of ethanol is related to its relatively high octane rating. While certainly not equivalent to a complete mathematical treatment of gasoline blending, a direct comparison of the price of ethanol and alternative sources of octane does shed some light on the question of the marginal value of ethanol as an octane enhancer. We first addressed the issue of the relationship of ethanol prices to the price of other octane enhancers in the *farmdoc daily* article of January 30, 2015. In particular, we considered the price of the aromatic compounds benzene, toluene, and xylene relative to the price of ethanol. These compounds have octane ratings generally similar to that of ethanol and have a long history as octane enhancers in gasoline blends. Aromatics are typically produced via high-pressure catalytic reformers in the same refineries that produce other petroleum feedstock for gasoline blending. In our previous article, we examined the weekly prices of these aromatics and the price of ethanol at the Gulf for the period January 4, 2013 through January 16, 2015. Except for a brief period in the spring of 2014, ethanol was lower priced than each of the aromatics. Ethanol prices were below the average price of the three aromatics for the entire time period, suggesting that ethanol was generally the low cost octane enhancer for the entire period. The question is whether that position has changed over the past year in light of substantial further decline in the price of crude oil and gasoline.

The weekly (Friday) price of each of the three aromatics and the price of CBOB gasoline at the U.S. Gulf are shown in Figure 2 for the period January 4, 2013 through January 29, 2015. The source for the aromatics price data is Bloomberg, while the CBOB data is from OPIS. During 2013 and 2014 benzene was the highest priced aromatic, sometimes by a wide margin, but this premium essentially disappeared in early 2015. The prices of toluene and xylene were very similar for the entire period. All three aromatics prices in 2015 and so far in 2016 have tended to move together. CBOB prices were always substantially lower than the price of the aromatics, which is not surprising given the higher production costs of the aromatics compared to other petroleum blendstocks. In general, the aromatics have been priced about 140 to 170 percent above CBOB. It is interesting to note that the aromatic price premium has actually increased in recent months.

The average price of the aromatics and the price of ethanol at the U.S. Gulf are presented in Figure 3. The source for the ethanol price data is OPIS. The average price of aromatics increased sharply during the first half of 2015, causing the spread between aromatics and ethanol to exceed $1 per gallon. The price of aromatics has since declined below $2 per gallon, but still sits today at $0.35 above the price of ethanol, which has been relatively constant over the past year. To date, ethanol appears to have retained its position as the low cost octane enhancer even as ethanol prices have increased relative to gasoline prices. That position might be threatened, however, if the price of aromatics remained near current levels and the price of ethanol moved sharply higher. Since the feedstock for conventional ethanol production, almost entirely corn, represents the majority of the cost of producing ethanol, the price of that feedstock is the

primary determinant of the price of ethanol, particularly when the RFS conventional mandate exceeds the E10 blend wall (*farmdoc daily*, January 13, 2016). So, conditions that resulted in sharply higher corn prices, e.g., a shortfall in U.S. production, would result in a sharply higher ethanol price. With aromatics prices at $1.85 and ethanol prices at $1.50, it would not take a large shortfall in U.S. corn production to move ethanol prices above aromatics prices. For example, during the summer of 2012, drought conditions caused the price of ethanol to spike from around $2 to $2.60 in just a few weeks.





Implications

Ethanol has been a relatively cheap source of octane in gasoline blends for U.S. refiners for several years. However, the recent rise of ethanol prices above gasoline prices has raised the specter of ethanol losing its place as the cheapest source of octane. While this would not necessarily limit ethanol consumption due to the existence of the RFS conventional ethanol mandate, it would have implications for the cost of complying with the RFS mandates. To assess any changes in the competitive position of ethanol in gasoline blends, the price of the aromatic compounds benzene, toluene, and xylene were analyzed relative to the price of

ethanol. These compounds have octane ratings generally similar to that of ethanol and have a long history as octane enhancers in gasoline blends. Despite the recent increase in ethanol prices relative to gasoline, ethanol prices still remain below that of the aromatics. As a result, ethanol continues to retain its position as the low cost octane enhancer in gasoline blends. The biggest threat to maintaining this position is a shortfall in U.S. corn production that caused both corn and ethanol prices to spike.

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