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Ethanol – Does the RFS Matter?

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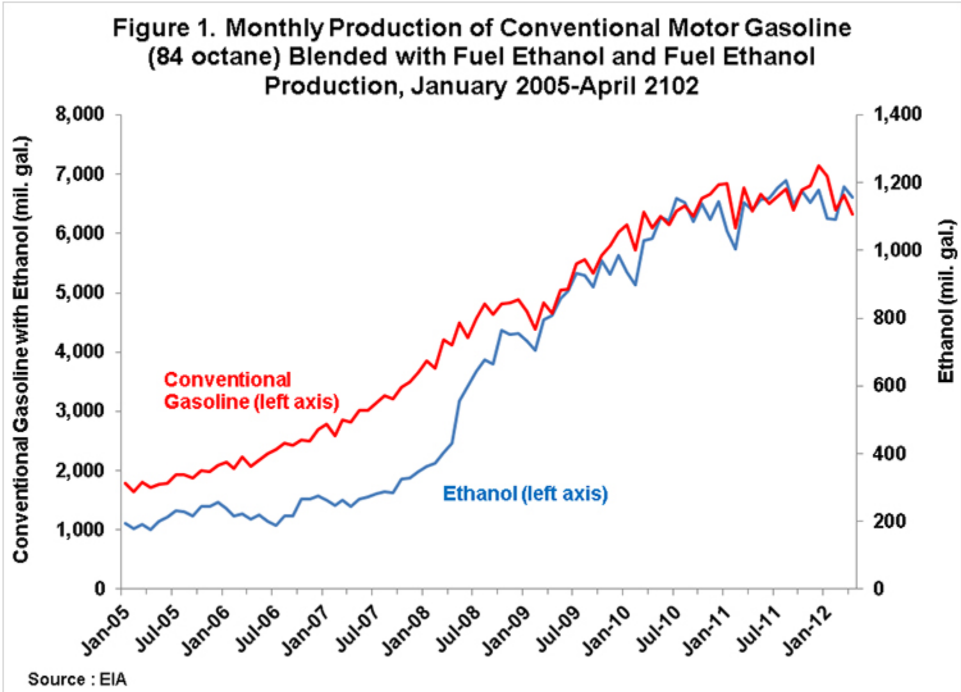
As we noted in a post last week, drought conditions this summer have become as bad as 1988 and perhaps worse, potentially only rivaled in the last century by 1936. As corn yield expectations have declined issues related to rationing usage in 2012-13 have taken center stage. The full extent of any needed rationing will not be known for a while, but the USDA's August 10 Crop Production report will provide some guidance. Assuming that substantial rationing will be required, the issue becomes one of which consumption sector will make the majority of the adjustment. The primary consumption sectors are exports, feed, and ethanol and by-products. It is generally believed that export demand is relatively price inelastic so that high prices might result in only small declines in exports. The Renewable Fuels Standards (RFS) require minimum levels of blending of renewable biofuels so that ethanol use of corn would presumably remain large even with a small crop and high prices. The bulk of the adjustment to a smaller corn supply, then, might be left to the livestock industry as has typically been the case in previous small crop years.

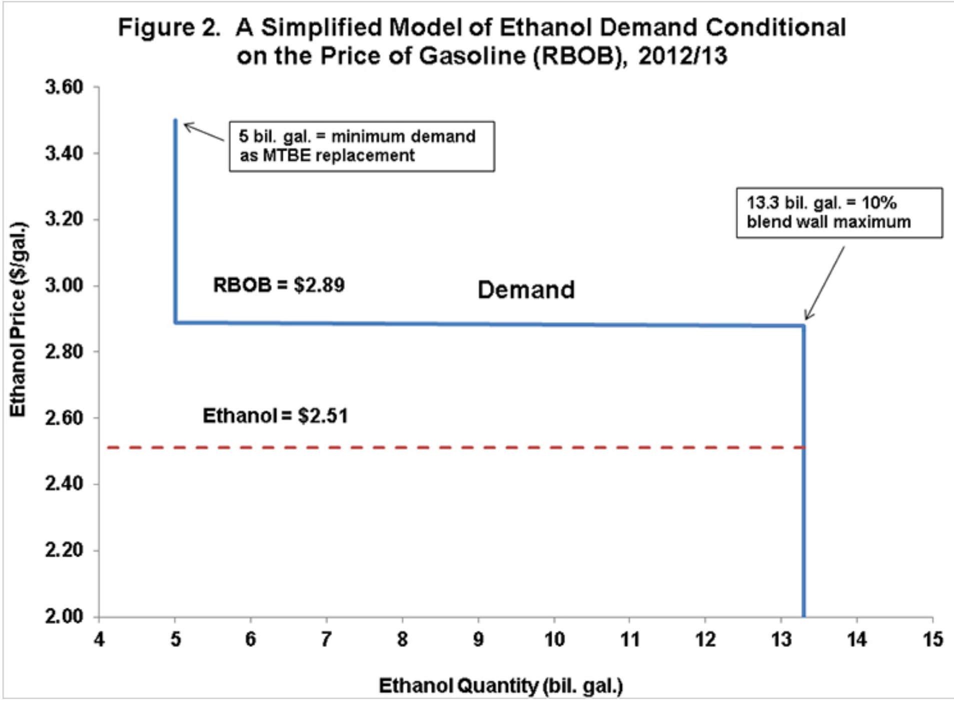
In order to provide some relief to other consumption sectors there has been a growing number of calls for the U.S. Environmental Protection Agency (EPA) to impose a partial or full waiver of the RFS for 2013. (See this recent New York Times op-ed article for just one example.) The suggestion to waive the mandate assumes that ethanol production and blending is motivated only by the RFS and that a lower mandate would result in less ethanol production and blending and less corn consumption in that sector. The purpose of this post is to show that whether a waiver would reduce ethanol production and blending depends to a significant degree on the structure of the demand and supply functions in the ethanol sector. To that end, we develop a conceptual framework to address the issue of the impact of the RFS on corn-based ethanol production and blending.

Before delving into our ethanol demand and supply model, it is important to understand the current role of ethanol in U.S. gasoline blends. Large and increasing mandated biofuels blending levels beginning in 2007 resulted in a fundamental shift in gasoline formulation. A simplified description of the change is that the refining industry has moved to using predominantly 84 octane "conventional" gasoline that is then blended with the higher octane ethanol (around 113) to produce the 87 octane gasoline that is most popular at the retail level in the U.S. Figure 1 shows that production of conventional (84 octane) gasoline with ethanol has moved in tandem with the rising production of ethanol. The adjustment to ethanol as the main source of octane enhancement appears to have been complete by early 2009. Since that time the two production series have moved almost one-for-one. This change in refining practices is not easily reversed. While other octane enhancers are available or could be become available, biofuels mandates and relatively low ethanol prices make it the current product of choice.



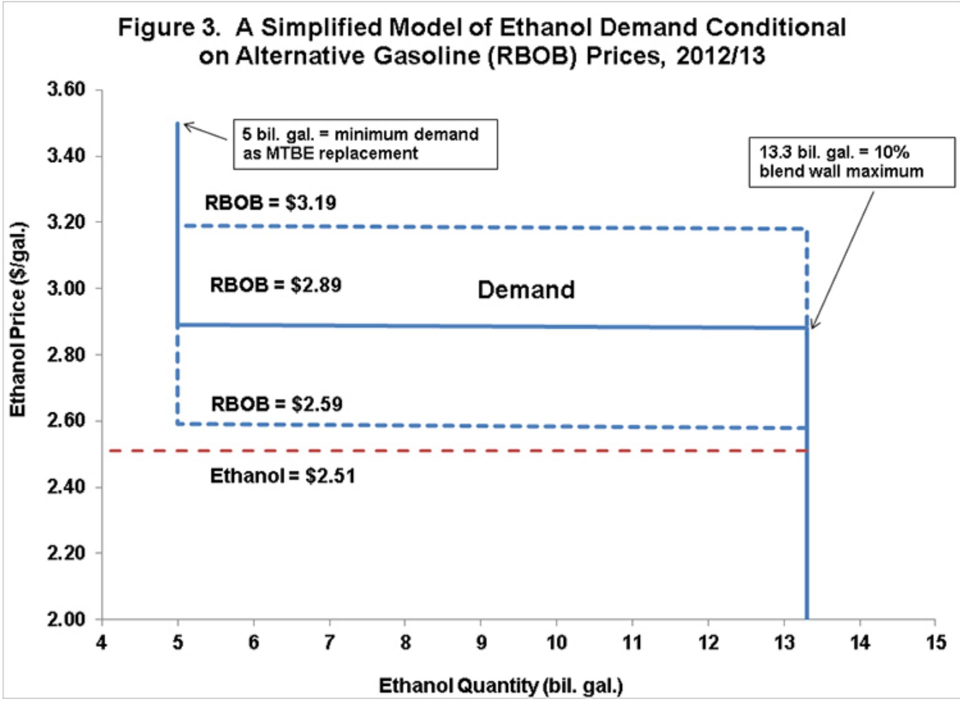
Ethanol Demand and Supply

Our basic conceptual model of the market demand for ethanol in 2012-13 is presented in Figure 2. We assume that the demand for ethanol is conditional on the price of reformulated (RBOB) gasoline that is blended to an 87 octane level, but not vice versa. There is a good bit of controversy regarding the impact of ethanol production on gasoline prices. We are persuaded that the impact, if any, is likely to be small, a position consistent with the results of two recent studies (here and here). Returning to Figure 2, the price of ethanol is plotted on the vertical axis and the quantity demanded is plotted on the horizontal axis. The demand function can be assumed to represent domestic demand for blending if net trade in 2012-13 is close to zero. While both imports and exports of ethanol have been large at times, trade has declined so that net exports totaled only about 40 million gallons in May 2012. This illustration assumes zero net trade.



The demand function in Figure 2 is not the typical continuous function depicting a negative relationship between price and quantity demanded. Instead, the function reflects structural considerations in the ethanol market. Note that ethanol blending is expected to be at the 10 percent "blend wall" for all ethanol prices below the price of RBOB gasoline, depicted as the vertical portion of the demand function at 13.3 billion gallons. The profitability of using ethanol as an octane enhancer increases with lower ethanol prices (given a fixed RBOB gasoline price) and refiners would have an economic incentive to use more ethanol, but the use of ethanol is capped by the blend wall. For the 2012-13 corn marketing year, the blend wall is assumed to be 13.3 billion gallons, which is 10 percent of the motor fuel gasoline consumption currently projected by the U.S. Energy Information Agency (EIA) for this period plus small amounts for E15 and E85 blending. We argued in an earlier post that it is going to be quite difficult to expand the current 10 percent blend wall for domestic ethanol consumption in the near future due to the lack of clarification of liability issues associated with dispensing E15, the need to install blender pumps at retail stations, and the need to clarify engine warranties for E15. It is also possible for the 13.3 billion gallon blend wall forecast for 2012-13 to be too high if gasoline consumption falls short of current forecasts.

The next thing to note about the demand function in Figure 2 is that there is some minimum amount of ethanol required to meet the oxygenate requirement (MTBE replacement) necessary to meet emissions standards for carbon monoxide regardless of the price of ethanol. It is not known with certainty what this amount is, but it is estimated at 5 billion gallons here and depicted by the vertical portion of the demand curve at that amount. Finally, for quantities of ethanol between 5 billion and 13.3 billion gallons, the demand function in Figure 2 assumes blenders would not be expected to pay more for ethanol than for gasoline. This is depicted by the horizontal portion of the function. This portion of the function assumes that sufficient quantities of lower priced octane enhancers would be available to replace ethanol in the fuel blend. Figure 3 illustrates the shift up or down in the demand function as the result of higher or lower gasoline prices. The demand functions in Figure 2 and 3 are similar to those presented recently by Bruce Babcock of Iowa State University. One difference is that he plots the ratio of gasoline and ethanol prices on the vertical axis. In addition, he assumes that larger quantities of E15 and E85 would be blended when ethanol prices are low relative to gasoline. This may be an appropriate assumption in the longer run, but as we note above, such blending opportunities would be very limited in the shorter run. In addition, Babcock imposes no minimum amount of ethanol blending at high ethanol prices relative to gasoline prices.



Our assumption in Figures 2 and 3 that sufficient quantities of octane substitutes are immediately available once the price of ethanol exceeds the price of gasoline may not be realistic. Figure 4 presents a more likely depiction of the portion of the ethanol demand function assumed to be horizontal in Figures 2 and 3. At ethanol prices modestly above gasoline prices, other octane enhancers may not be substituted for ethanol because they are more expensive or it simply takes time to bring these alternatives on line, so that the vertical portion of the demand function extends above the price of gasoline at the blend wall. At increasingly higher ethanol prices, however, alternative octane enhancers may be substituted at an increasingly higher rate, depicted by the changing slope of the demand function.

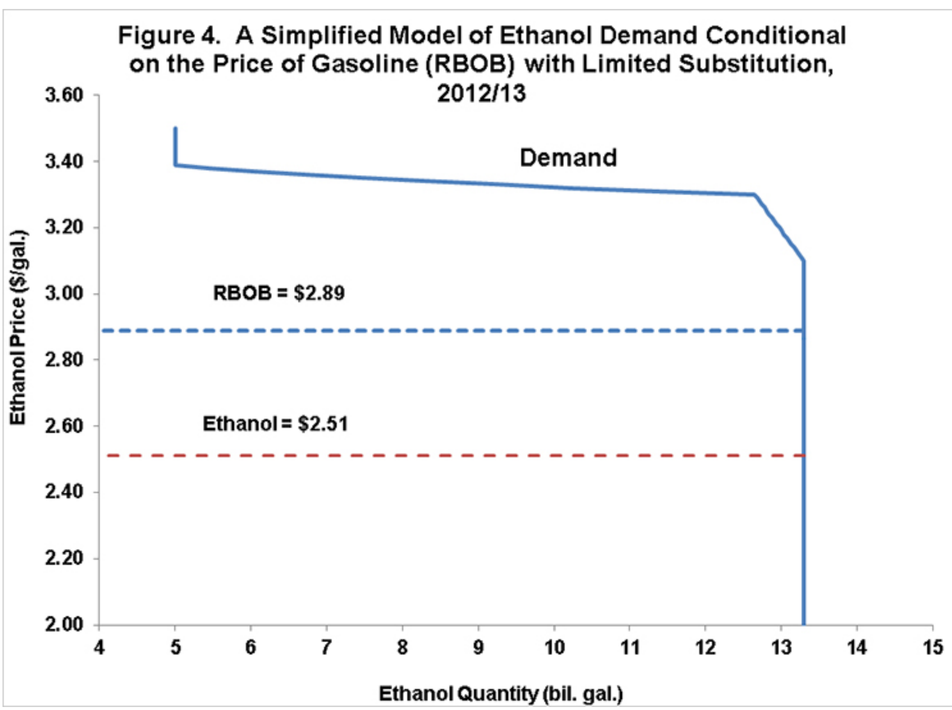
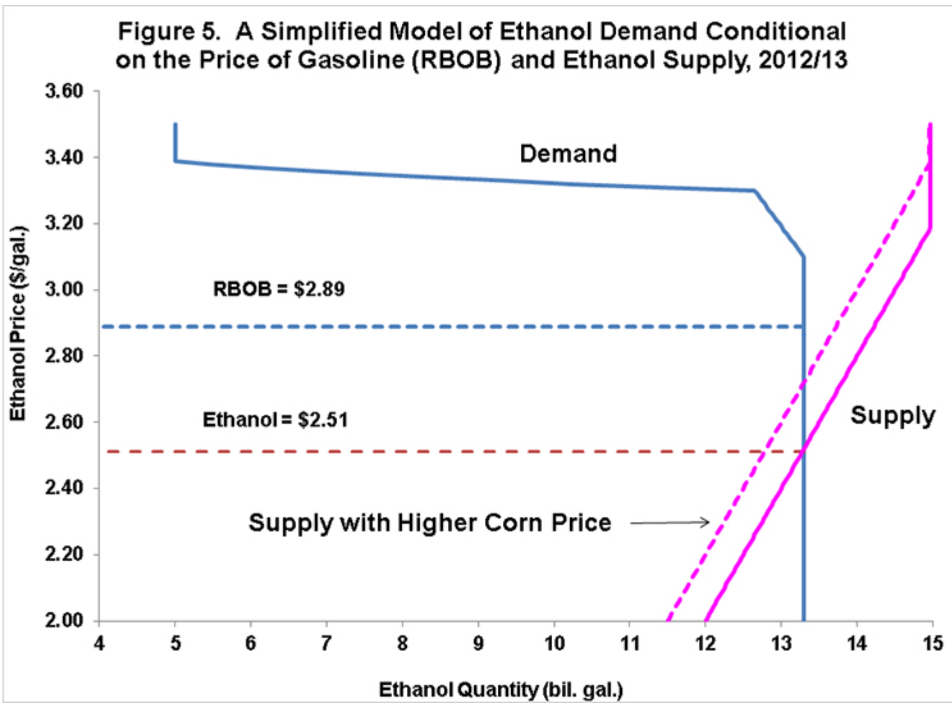
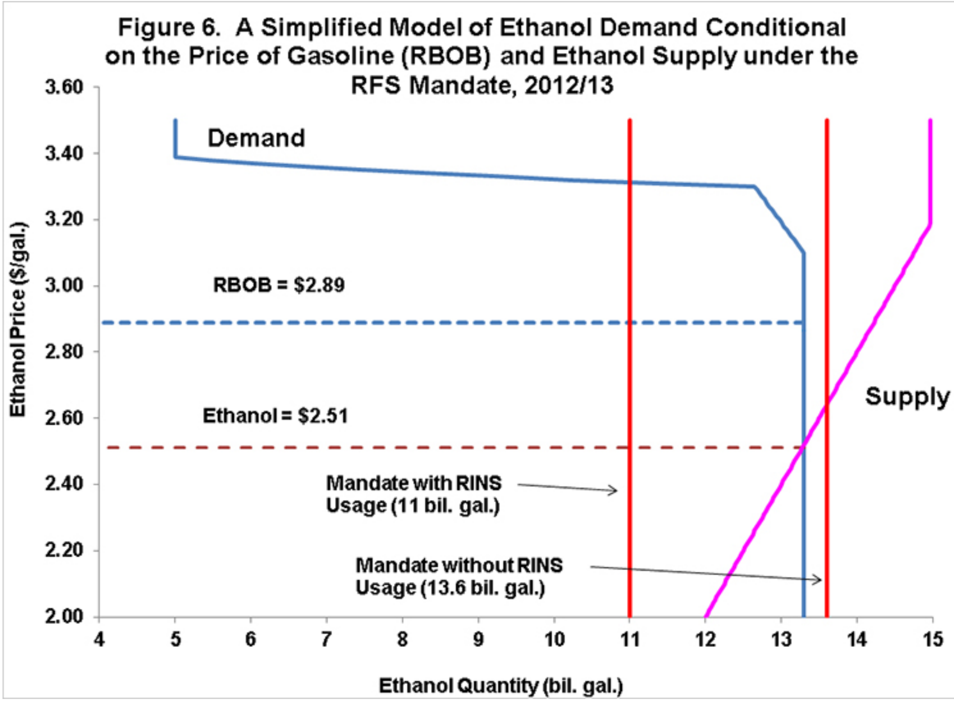


Figure 5 simply adds an ethanol supply function to the demand function presented in Figure 4. The supply function assumes the typical continuous positive relationship between ethanol price and quantity produced (absent trade), all other factors constant. It is assumed, however, that ethanol supply in the short run cannot exceed production capacity, depicted by the vertical portion of the supply function at 15 billion gallons, the current nameplate capacity of existing and expanding ethanol refineries reported by the Renewable Fuels Association. The intersection of the supply and demand function determines the equilibrium price and quantity of ethanol blended, about $2.50 per gallon recently. The primary shifter of the supply function is the price of corn. At higher corn prices (all other factors unchanged), less ethanol would be supplied at each price of ethanol. This is depicted by the dotted supply function to the left of the original function. Similarly, lower corn prices would shift the supply function to the right. It is important to note that the equilibrium quantity of ethanol produced and blended would be at the blend wall over a wide range of both corn and gasoline prices. The equilibrium has to shift out of the vertical portion of the demand function to reduce the quantity blended. That would require a combination of higher corn prices and/or lower gasoline prices.



Role of the RFS and RINs

Figure 6 adds the 2012-13 RFS mandate for renewable biofuels to Figure 5. The mandate for the 2012 calendar year is 13.2 billion gallons and the mandate for the 2013 calendar year calendar year is 13.8 billion gallons. The mandate for the 2012-13 corn marketing year is calculated as 13.6 billion gallons and depicted by the vertical line at that amount. Since the mandate exceeds our estimate of the blend wall by 300 million gallons, credits from previous discretionary blending, in the form of excess Renewable Identification Numbers (RINs) would have to be used to meet 300 million gallons of the mandate. It is estimated that about 2.6 billion gallons of excess RINs are currently available (see yesterday's post by Nick Paulson and Seth Meyer) so that as little as 11 billion gallons of ethanol would have to be produced and blended to meet the 13.6 billion gallon mandate. However, with ethanol prices below gasoline prices and the supply/demand equilibrium at the blend wall, there would be little incentive to use RINs beyond 300 million gallons to meet the mandate. Similarly, if the mandate was reduced below 13.6 billion gallons in our conceptual framework, there would be no incentive to actually reduce ethanol production and blending below the blend wall unless there was also a shift in the supply and/or demand functions for ethanol. A full or partial waiver of the RFS, then, may be ineffective in reducing corn consumption for ethanol production given favorable price relationships for blending ethanol with conventional gasoline.



The important question, then, becomes what combination of gasoline prices and corn prices might be required to reduce ethanol production and corn consumption for ethanol below the blend wall? As indicated earlier, such a reduction would require a combination of gasoline and corn prices so that the price and quantity equilibrium in Figure 6 shifts far enough to the left that it is outside the vertical portion of the demand function. At one extreme, if such a shift was the result of only lower gasoline prices (shift in demand) the price of gasoline would have to be below the price of ethanol by a margin large enough to start the transition to octane substitutes. That margin is not known, but $0.20 per gallon is illustrated in Figure 6. All else equal, then, the price of RBOB would need to decline below $2.31 per gallon in our illustration just to start substituting other octane enhancers for ethanol. At recent price ratios of NYMEX WTI crude oil futures to RBOB futures of about 30 to 1, crude oil (WTI) would need to be priced below $69 per barrel for RBOB to be priced at $2.31 per gallon.

At the other extreme, if the necessary shift in the price and quantity equilibrium was the result of only higher corn prices (shift in supply) then ethanol would have to be priced above RBOB by at least $0.20 to initiate the transition to alternative octane enhancers. All else equal, then, ethanol prices above $3.09 per gallon in this illustration would be required to initiate the transition. In that case, corn prices above $10 per bushel would be required to reduce ethanol production below the blend wall. This corn price target is based on the calculation of shutdown prices presented in our earlier post here. It is important to emphasize that we are not forecasting the price of corn to necessarily move to $10. This is simply a rough estimate of the needed price of corn, all else constant, in order to begin the process of reducing the quantity demanded of ethanol below the blend wall in 2012-13. The market price of corn does not ever have to go this high and force this outcome. Instead, the market price could remain below $10 with the adjustment in the use of corn falling almost entirely on other consumers of corn. Combinations of lower gasoline prices and higher corn prices between these two extremes would have the same result. While this analysis is only illustrative, it does underscore the large change in economic incentives that may be required to reduce ethanol production and blending below the blend wall, regardless of the RFS mandate.

The analysis is helpful in understanding how large of a waiver would be needed to impact the equilibrium price and quantity of ethanol in 2012-13. Specifically, a partial waiver of the mandate down to 11 billion gallons (about 20 percent) may not impact the market price or quantity of ethanol even if blending economics were such that the transition to other octane enhancers was initiated. For waivers between 11 and 13.6 billion gallons, our framework predicts that the only impact would be that blenders do not have to use up the available stock of RINs to make up the gap between the lower production of ethanol and the mandated level under the RFS. This is just another way of saying that the existence of a large stock of RINs provides a built-in waiver mechanism for the ethanol mandate. This mechanism has the potential to reduce ethanol use of corn about 1 billion bushels (2.6 bil. gal./2.8 bu./gal.). Of course, this type of waiver mechanism is dependent on reducing the market incentives to blend ethanol through lower gasoline and/or higher corn prices.

The analysis also points toward a scenario where the pressure would ratchet up quickly on the EPA to wave a much larger proportion of the mandate. If gasoline prices are low enough and/or corn prices are high enough such that the market equilibrium quantity of ethanol production is less than 11 billion gallons in 2012-13, then the sum of ethanol production plus the entire stock of RINS would not be large enough to meet the RFS mandate of 13.6 billion gallons. Blenders do have the option to defer up to an additional 20 percent of the RFS mandate in a given year but this “borrowing” has to be made up in the following year. We do not believe it is reasonable to project substantial usage of the borrowing provision in this scenario because the additional quantities would push ethanol blending well above the 10 percent blend wall in the following year (2013-14). The use of advanced biofuels RINS is a possibility but the stock of these credits is not likely to be very large. The bottom line is that at least a partial waiver of the mandate in this scenario is likely to be a practical necessity.

There are a couple of caveats to this analysis that should be noted. First, there is the possibility that current favorable blending economics for ethanol are somewhat transitory due to the limited availability of alternative sources of octane enhancers at the present time. This limitation may ease somewhat with the switch from refining for so-called “summer gasoline blends” to “winter gasoline blends.” Second, the demand function presented in Figure 6 is parameterized based on market data from the time period when the RFS mandates have been in place. The move by the gasoline refining industry towards blending ethanol with conventional gasoline for octane enhancement during this time period may have been driven more by cost minimization considerations given the mandates than unconstrained profit maximization. If this is the case then removing the mandates may result in faster substitution of alternative sources of octane than we assumed. The net effect of both of these factors would be to move the vertical section of the demand function below the price of RBOB in Figure 6 to the left. This would increase the immediate impact of waiving the mandate on the price and availability of corn.

Conclusions

The EPA does not necessarily have the ability to substantially ease the plight of livestock producers in 2012-13 at the stroke of a pen. Waiving the RFS mandate for ethanol may have a smaller impact on the price of corn or the quantity of corn available for feed than many expect. This conclusion is consistent with a recent Iowa State University study that estimated the price of corn would drop an average of only 28 cents across a range of corn yield outcomes due to a full waiver of the mandate. Without large changes in the economic incentives to blend ethanol with conventional gasoline, at least in theory, the price of corn and availability of corn for feed may be unaffected. If so, other policy options to aid the domestic U.S. livestock sector in 2012-13 might be considered, including direct payments, corn export restrictions, or quotas on ethanol or other corn processing uses. None of these options seems particularly attractive from either a practical or political standpoint.

It is important to emphasize that it is not our intention to give the impression that the RFS mandates have not had any impact on the corn and ethanol markets. Our view is that the mandates were a significant factor in building out the U.S. ethanol industry to its present capacity. However, once the capacity was put in place reversing the mandates will not necessarily reduce ethanol production and blending due to the adjustments made by the gasoline refining industry.