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# Updated Assessment of the Drought's Impacts on Crop Prices and Biofuel Production

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## **Abstract**

On August 10th, USDA released updated estimates of the size of this year's corn and soybean crops. Corn yields are now projected at 123.4 bushels per acre, which combined with a drop in projected harvested acres results in an estimated crop size of 10.8 billion bushels—down 17 percent from USDA's July estimates. Soybean production is now estimated at 2.7 billion bushels—down 11.7 percent from July projections. The sharply lowered production estimates suggest the preliminary assessment of the impact of the drought on crop prices and biofuel production that I conducted last month needs to be updated.<sup>1</sup> In the preliminary July assessment, I estimated that a waiver of the conventional ethanol mandate would reduce corn prices by an average of 4.8 percent across the 500 model outcomes considered. The now lower estimates of corn production imply that this estimated impact of a mandate waiver is too low. However, corn and soybean production are not the only economic variables that have changed in the past month. The average gasoline price used in the July assessment was \$2.50 per gallon, which was the average futures price for reformulated gasoline. The average price of the futures contracts from September 2012 to August 2013 is now \$2.78 per gallon—up 11 percent. Higher gasoline prices imply greater market demand for ethanol, which reduces a mandate waiver's impact on corn prices. The net effect of higher gasoline prices and lower crop size on crop prices, and the impact of the mandate waiver, can only be determined by re-running the model used in my July assessment. The results from these updated model runs are presented here.

## **Disciplines**

Agricultural and Resource Economics | Agricultural Economics | Economics | Oil, Gas, and Energy

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**by Bruce Babcock**

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## **Executive Summary**

On August 10th, The USDA released updated estimates of the size of this year's corn and soybean crops. Corn yields are now projected at 123.4 bushels per acre, which combined with a drop in projected harvested acres results in an estimate crop size of 10.8 billion bushels—down 17 percent from USDA's July estimates. Soybean production is now estimated at 2.7 billion bushels—down 11.7 percent from July projections. The sharply lowered production estimates suggest that preliminary assessment of the impact of the drought on crop prices and biofuel production that I conducted last month needs to be updated.<sup>1</sup> In the preliminary July assessment, I estimated that a waiver of the conventional ethanol mandate would reduce corn prices by an average of 4.8 percent across the 500 model outcomes considered. The now lower estimates of corn production imply that this estimated impact of a mandate waiver is too low. Lower corn and soybean production are not the only economic variables that have changed in the past month. The average gasoline price used in the July assessment was \$2.50 per gallon, which was the average futures price for reformulated gasoline. The average price of the futures contracts from September 2012 to August 2013 is now \$2.78 per gallon—up 11 percent. Higher gasoline prices imply greater market demand for ethanol, which reduces a mandate waiver's impact on corn prices. The net effect of higher gasoline prices and lower crop size on crop prices, and the impact of the mandate waiver, can only be determined by re-running the model used in my July assessment. The results from these updated model runs are presented here.

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<sup>1</sup> See "Preliminary Assessment of the Impacts of the Drought's Impacts on Crop Prices and Biofuel Production," CARD Policy Brief 12-PB7 July 2012 available at <http://www.card.iastate.edu/publications/dbs/pdffiles/12pb7.pdf>.

# Updated Assessment of the Drought's Impacts on Crop Prices and Biofuel Production

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On August 10th, The USDA released updated estimates of the size of this year's corn and soybean crops. Corn yields are now projected at 123.4 bushels per acre, which combined with a drop in projected harvested acres results in an estimate crop size of 10.8 billion bushels—down 17 percent from USDA's July estimates. Soybean production is now estimated at 2.7 billion bushels—down 11.7 percent from July projections. The sharply lowered production estimates suggest that preliminary assessment of the impact of the drought on crop prices and biofuel production that I conducted last month needs to be updated.<sup>2</sup> In the preliminary July assessment, I estimated that a waiver of the conventional ethanol mandate would reduce corn prices by an average of 4.8 percent across the 500 model outcomes considered. The now lower estimates of corn production imply that this estimated impact of a mandate waiver is too low. Lower corn and soybean production are not the only economic variables that have changed in the past month. The average gasoline price used in the July assessment was \$2.50 per gallon, which was the average futures price for reformulated gasoline. The average price of the futures contracts from September 2012 to August 2013 is now \$2.78 per gallon—up 11 percent. Higher gasoline prices imply greater market demand for ethanol, which reduces a mandate waiver's impact on corn prices. The net effect of higher gasoline prices and lower crop size on crop prices, and the impact of the mandate waiver, can only be determined by re-running the model used in my July assessment. The results from these updated model runs are presented here.

The impacts are estimated for the 2012–13 crop year that begins on September 1. Although the USDA's August 10th projections of the size of US corn and soybeans crops are available, there still exists some uncertainty about what the actual size of the two crops will be because of forecast errors. The USDA provides historical data that quantifies these forecast errors for both crops. Distributions of crop sizes centered at the USDA forecast values are created using these forecast errors. Draws from these production distributions are combined with draws from gasoline prices into a stochastic partial equilibrium model. This type of model solves for market-clearing prices for a large number of random “draws” of yields and gasoline prices. The model is calibrated to information that is available at the current time, including USDA's supply and demand projections, and the level of futures prices for gasoline, corn, and ethanol. A brief overview of the model is that it finds equilibrium prices of US corn ethanol, Brazilian sugarcane ethanol, US biodiesel, corn, soybeans, soybean meal, and soybean oil. The prices depend on the level of wholesale gasoline prices, US corn and soybean yields,

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<sup>2</sup> See “Preliminary Assessment of the Impacts of the Drought's Impacts on Crop Prices and Biofuel Production,” CARD Policy Brief 12-PB7 July 2012 available at <http://www.card.iastate.edu/publications/dbs/pdffiles/12pb7.pdf>.

soybean yields in Brazil and Argentina, and the level of Brazilian ethanol production. The next section presents the set of assumptions that are used in the analysis.<sup>3</sup>

### **Assumptions**

*US Corn Production:* The USDA forecasts that the size of the US corn crop will be 10.779 billion bushels; but because of forecast errors, there is still uncertainty about what the actual crop size will be. The mean of the absolute value of the percent forecast error in USDA forecasts since 1980 is 4.67 percent. Figure 1 shows the error percentages. In 1983 the USDA made a 25 percent forecast error, which is far larger than any other error. If this outlier is removed then the mean forecast error is 4 percent. If it is assumed that forecasts errors measured in bushels are centered around zero, and are normally distributed, then actual corn production is normally distributed with a mean of 10.779 billion bushels, and a standard deviation of 0.55 billion bushels. Figure 2 shows this assumption.

*US Soybean Production:* The USDA forecasts that the size of the US soybean crop will be 2.692 billion bushels. The mean of the absolute value of the percent forecast error in USDA forecasts since 1980 is 5.08 percent. Figure 3 shows the error percentages. If it is assumed that forecasts errors measured in bushels are centered around zero, and are normally distributed, then actual soybean production is normally distributed with a mean of 2.692 billion bushels, and a standard deviation of 0.17 billion bushels. Figure 4 shows this assumption.

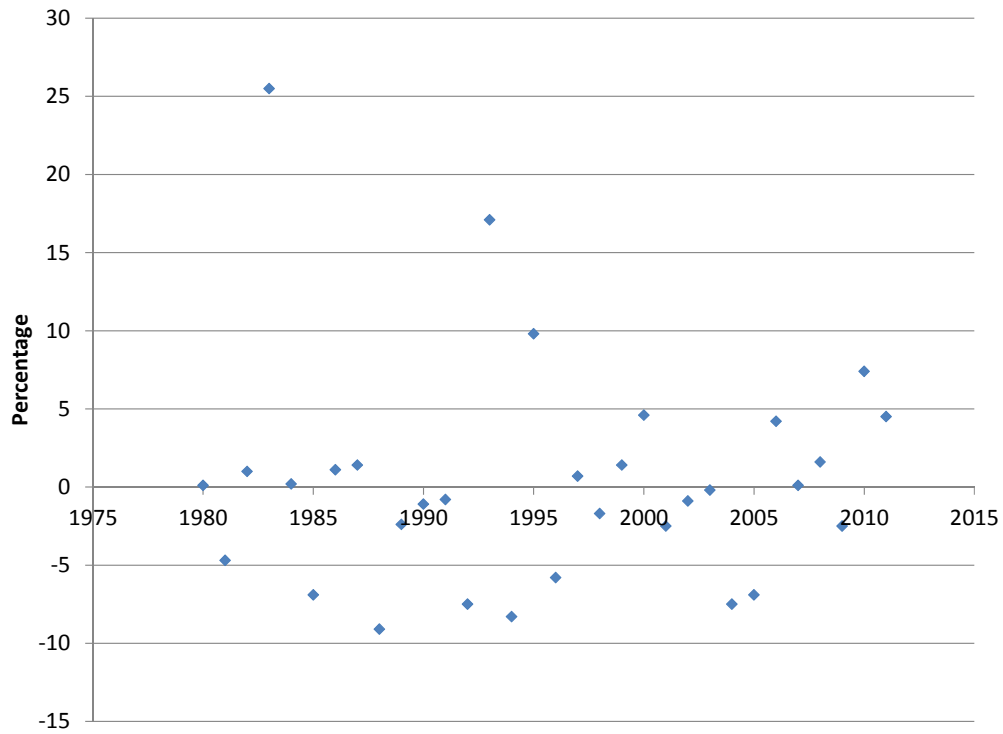
*US Biofuel Mandates:* The conventional biofuel mandate is 13.2 billion gallons in 2012, rising to 13.8 billion gallons in 2013. Because this analysis is based on a marketing year, a weighted average of the two mandates, 13.6 billion gallons, is used. While it is not certain how many excess blending credits, or RINs, are available from 2011 to meet this mandate Professor Nick Paulson at the University of Illinois, and Seth Meyer, an economist for the UN's Food and Agricultural Organization, estimate that 2.6 billion excess RINs were available at the end of June, 2012.<sup>4</sup> Assuming that 2.4 billion of these excess RINs are used to meet the 2012–13 mandate implies that 11.2 billion gallons of ethanol must be consumed during this period. Equilibrium prices are simulated for both 11.2 billion gallons and 13.6 billion gallons to show the impacts of the flexibility built into the Renewable Fuels Standards rule. No account is given for the additional flexibility that allows borrowing from next year's obligations to meet this year's mandate, because this would push obligations in 2014 well beyond the ability of the US vehicle fleet to use the ethanol. In addition, prices are simulated assuming a mandate waiver during this period in response to the request for a waiver submitted to the EPA by US livestock groups.

The biodiesel mandate is set at 1.28 billion gallons. It is assumed that 600 million of these gallons are produced from soybean oil or other close substitute for soybean oil. Though

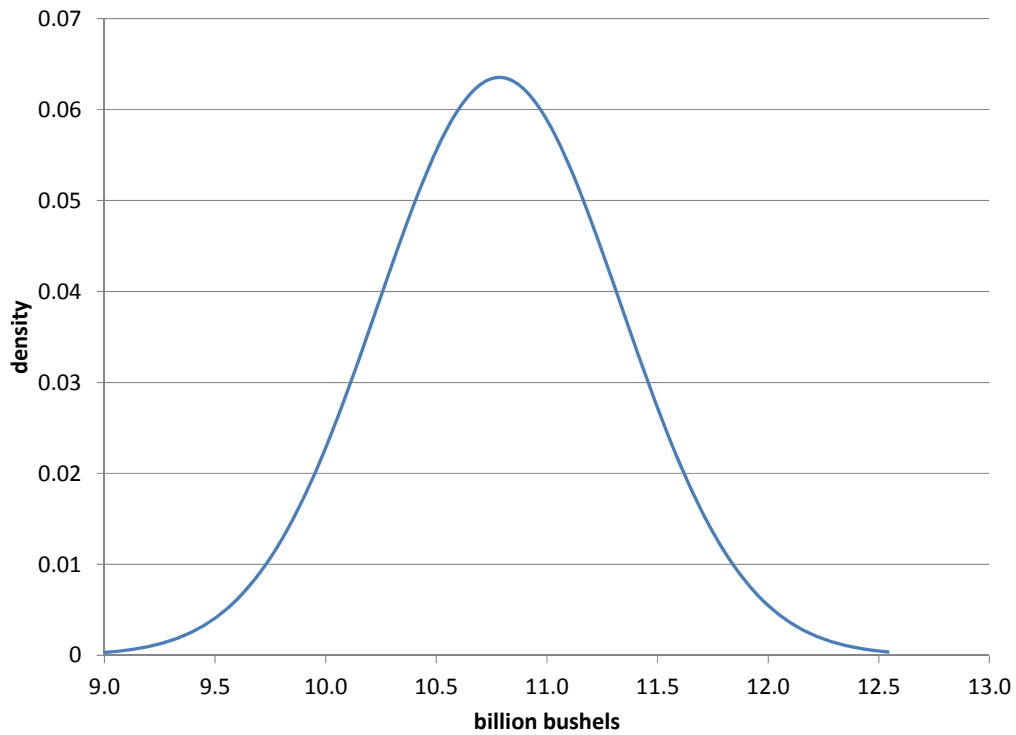
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<sup>3</sup> For an overview of the model see Babcock, B.A., K.J. Barr, and M. Carriquiry, "Costs and Benefits to Taxpayers, Consumers, and Producers from U.S. Ethanol Policies," Staff Report 10-SR 106, Center for Agricultural and Rural Development, Iowa State University, July 2010.

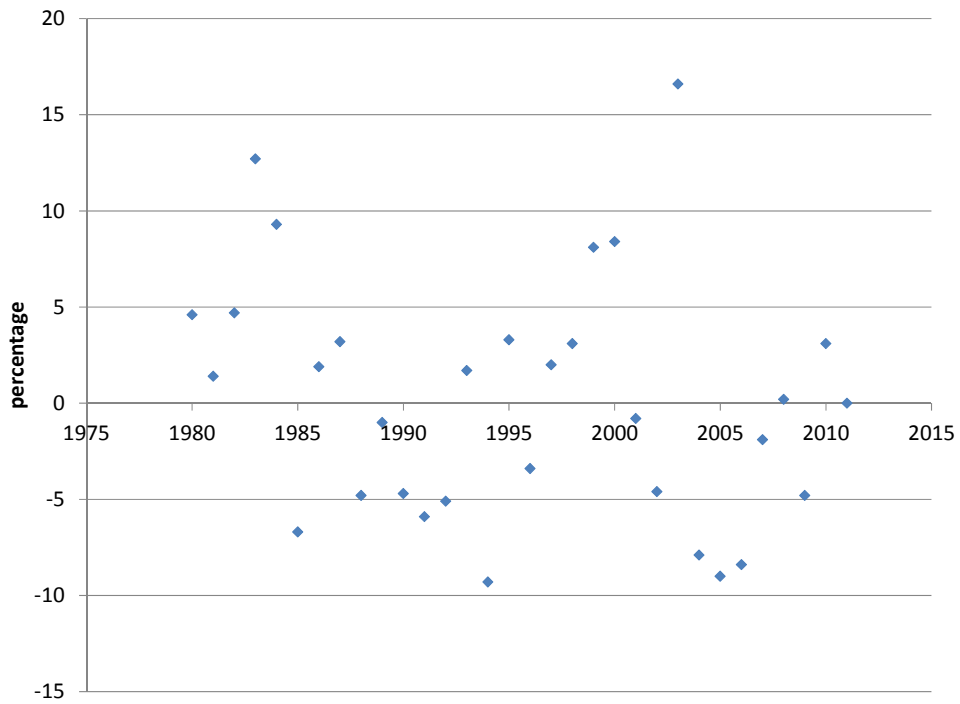
<sup>4</sup> The analysis is available at [http://www.farmdocdaily.illinois.edu/2012/08/an\\_update\\_on\\_rin\\_stocks\\_and\\_im.html](http://www.farmdocdaily.illinois.edu/2012/08/an_update_on_rin_stocks_and_im.html).



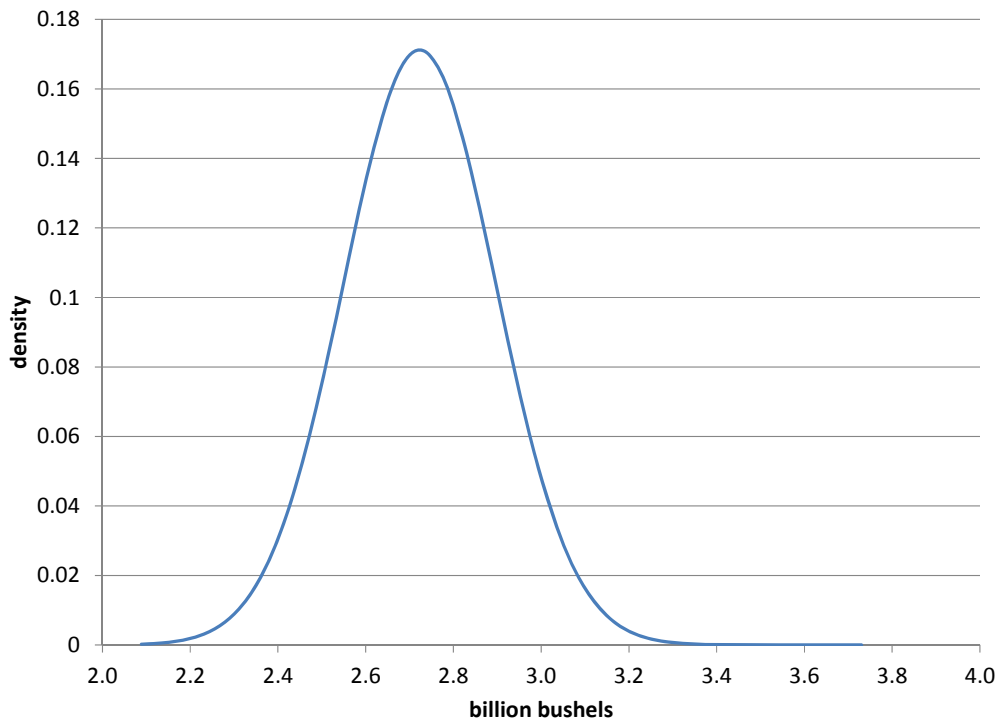
**Figure 1. Crop production percent errors in USDA's August forecasts for corn**



**Figure 2. Distribution of US corn production in 2012**



**Figure 3. Crop production percent errors in USDA's August forecasts for soybeans**



**Figure 4. Distribution of US soybean production in 2012**



livestock groups requested a biodiesel mandate waiver, prices are simulated assuming that it is also waived in the scenario in which the corn ethanol mandate is waived.

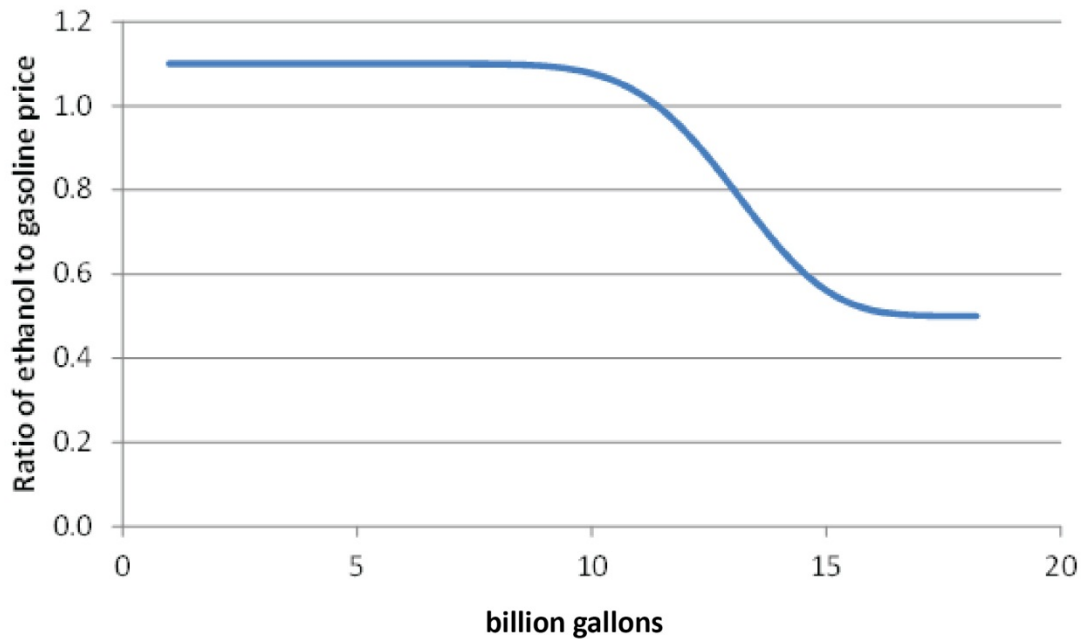
The other advanced biofuel mandate is set at 483 million gallons. This mandate can be met by either imported sugarcane ethanol from Brazil or by biodiesel made from feedstocks that qualify the fuel to meet the biomass-based diesel mandate. This mandate is also assumed to be waived under the waiver scenario analyzed here.

*US Demand for Ethanol:* The voluntary willingness to pay for ethanol by blenders defines the US market demand curve for ethanol. The willingness to pay is assumed to depend on the quantity of ethanol in the market and the price of gasoline—when gasoline prices are high, so too is the value of ethanol as a substitute for gasoline. The value of ethanol falls as ethanol consumption increases because of the difficulty in moving beyond a 10 percent blend in the US vehicle fleet. Figure 5 shows the market demand curve used in this analysis. As shown, if the wholesale price ratio of ethanol to gasoline is 0.9, then the quantity of ethanol demanded is about 12.4 billion gallons. If the price ratio rises to 1.0, the quantity demanded drops to 11 billion gallons. It is assumed that if the price ratio drops to 0.5, it will entice the nation's owners of flex fuel vehicles to use E85, or it will entice enough retail outlets to invest in E15 pumps. The average wholesale gasoline price used in this study is \$2.78 per gallon. The volatility of gasoline prices is set at 20 percent.

## **Results**

Three mandate scenarios were run through the stochastic simulation model. The first scenario acts as if there is no flexibility in the mandates so that they must be met in full. The second scenario assumes that the effective conventional biofuels mandate that is met by corn ethanol is reduced by 2.4 billion carryover RINs. The biodiesel mandate and the other advanced biofuel mandate are not reduced because there is no evidence of carryover RINs for these two fuels. The third scenario does away with all mandates. The focus of this analysis is on the ethanol market and mandate, because ethanol will have a larger impact on fuel and feed prices.

Table 1 presents the average results across all 500 simulated market outcomes. The first column of results would be if no flexibility existed in meeting the corn ethanol mandate. An average price of about \$9.73 per bushel would be needed to meet the mandate and to allocate corn supplies across alternative uses. This average price is higher than the average price projected by the USDA on August 10th, because under this full mandate scenario 4.8 billion bushels of corn are used on average to produce ethanol, whereas the USDA projects that 4.5 billion bushels are used. Ethanol production is allocated to exports and domestic consumption, which does not drop below 13.6 billion gallons because of the mandate. The average ethanol price of \$2.85 is the price needed to allow ethanol plants to cover their production costs. The United States exports 670 million gallons of ethanol and imports 483 million gallons. Because this model only allows trade between Brazil and the United States, this means that the model shows that the advanced biofuel mandate is met by imported Brazilian sugarcane ethanol. These exports are facilitated by imports from the United States, in that the imports lower the



**Figure 5. Assumed demand curve for US ethanol**

**Table 1. Average Results Across all 500 Yield and Gasoline Price Draws**

	<b>Full Mandate</b>	<b>Flexible Mandate</b>	<b>No Mandate</b>
Corn Price (\$/bu)	9.73	7.82	7.24
Ethanol Plant Price (\$/gal)	3.37	2.85	2.70
Soybean Price (\$/bu)	17.57	17.54	16.93
Soybean Oil Price (cents/lb)	56.6	56.1	45.9
Soybean Meal Price (\$/ton)	530	531	552
US Ethanol Production (billion gallons)	13.3	12.0	11.5
Ethanol RIN Price (\$/gal)	1.35	0.26	0
US Ethanol Exports (billion gallons)	0.0	0.39	0.38
US Ethanol Imports (billion gallons)	0.71	0.485	0
Biodiesel RIN Price (\$/gal)	2.03	1.99	0
Advanced Biofuel RIN Price (\$/gal)	1.63	0.82	0

domestic ethanol price in Brazil so they lower the cost of meeting the advanced biofuel mandate. Average RIN prices are high: \$1.01 for conventional ethanol, \$2.35 for biodiesel, and \$1.69 for sugarcane ethanol. Because all RIN prices are expressed in dollars per gallon of ethanol equivalent, the biodiesel RIN price is equivalent to a gap of \$3.53 per gallon between the cost of producing another gallon of biodiesel and the market value of the fuel.

Accounting for the flexibility in meeting the mandate that exists decreases corn and ethanol prices, because average ethanol production decreases by 1.4 billion gallons. The average corn price decreases by \$0.91 per bushel and ethanol prices drop by \$0.25 per gallon. The RIN price for conventional ethanol drops substantially to an average of only \$0.16 per gallon. The reason for this drop is that the cost of producing ethanol is lower due to lower corn prices, and the willingness to pay for ethanol by blenders is higher because of lower ethanol volumes. Because biodiesel does not have carryover RINs, the flexibility in the mandate has no impact on the biodiesel market. The price of advanced RINs decreases by \$0.79 per gallon. The reason for this drop is the higher willingness to pay for ethanol by US blenders and higher US exports to Brazil, which lowers the price that Brazil needs to send sugarcane ethanol to the United States.

Moving from the flexible mandate to the no mandate scenario has a modest impact on the corn and ethanol markets and a large impact on the biodiesel market. Removal of the mandate decreases corn prices by \$0.58 per bushel relative to the flexible mandate average corn price—a decline of 7.4 percent. Ethanol prices only drop by \$.15 per gallon, and ethanol production only declines by 500 million gallons. The reason why these effects are not larger is the ethanol demand curve shown in Figure 5. This demand curve measures the value that blenders place on ethanol at different volumes. At an average domestic consumption of 11.4 billion gallons, the value of ethanol in this demand curve is at par with wholesale gasoline. This high valuation of ethanol is consistent with the current price of ethanol relative to gasoline, and perhaps reflects a large value of ethanol in allowing refineries to produce a below-octane gasoline that when blended with 10 percent ethanol results in an 87-octane blend. If this demand curve overstates the value of ethanol to blenders, then the effects of removing the mandate would be larger.

The impacts of removing the biodiesel mandate is that practically all biodiesel production from vegetable oil would be stopped. The price of soybean oil would drop by an average of 10.2 cents per pound (18 percent), and the price of soybean meal would rise by \$21 per ton because of decreased supplies of meal.

### **Conclusions**

A short corn crop promises to heighten concern about food prices, fuel prices, and the ability of livestock farmers and biofuel producers to stay in business. Results from a market simulation model provide insight into the economic effects of the short crop in 2012. Two findings stand out. The first is that the flexibility built into the Renewable Fuels Standard allowing obligated parties to carry over blending credits (RINs) from previous years significantly lowers the economic impacts of a short crop, because it introduces flexibility into the mandate. The 2.4 billion gallon amount of flexibility

assumed in this study lowers the corn price impact of the ethanol mandate in this drought year from \$2.49 per bushel to \$0.58 per bushel. This means that waiving would lower corn prices by about 7.4 percent.

The second finding is that if the current price of ethanol relative to gasoline accurately reflects the value of ethanol to blenders, then the price of ethanol will be supported at quite an attractive level as long as ethanol quantities are not pushing up against the blend wall. This implies that ethanol plants will be a strong competitor for corn even without a mandate. In the no mandate scenario simulated here, ethanol production drops by only 500 million gallons when the mandate is waived. This 500 million gallon drop in supply is enough to raise the value of ethanol in the marketplace to support 11.5 billion gallons of production and continue high corn prices. The desire by livestock groups to see additional flexibility on ethanol mandates may not result in as large a drop in feed costs as they hope.

The results of this analysis cannot be interpreted as concluding that ethanol production has no impact on corn prices. If US ethanol consumption were somehow banned, then US corn prices would drop to an average of \$2.67 per bushel. But there is no mechanism for implementing a ban on corn ethanol production. The only tool that the US government has at its disposal to lower corn prices is to waive the mandate.