National and Global Market Implications of the 2012 U.S. Drought

by Wallace E. Tyner

February 26, 2013 - The 2012 drought in the US has caused tens of billions of dollars of economic losses and repercussions that reach all corners of the globe through market interactions. During the summer of 2012, there were numerous calls to suspend biofuels mandates. What’s missing from the public debate is an examination of two assumptions driving these calls: 1) that biofuels, not the drought, are to blame for price spikes and 2) that reducing or eliminating the biofuels mandate would quickly lead to price reductions.

The rise of biofuels

Biofuels have been on the scene since the early 1980s. Brazil was the initial global leader producing ethanol from sugarcane. The United States began significant corn ethanol production stimulated by the $0.40 per gallon corn ethanol subsidy provided in 1978 legislation. Subsidies for biofuels continued in the US until the end of 2011. The European Union (EU) also became a major biofuel producer, primarily with biodiesel from rapeseed. Over time, Brazil, the US, and the EU switched from biofuel subsidies to mandates. As the quantities of biofuels grew, subsidies became visible government expenditures, whereas the costs of mandates were realized in higher average fuel prices, rather than government budget lines. The US named the mandate the Renewable Fuel Standard (RFS) and called for 35 billion gallons of ethanol equivalent of biofuels by 2022, plus one billion gallons of biodiesel. Of the total, up to 15 billion gallons can come from corn ethanol. Today, US ethanol production capacity has reached this level.

Biofuels' proponents argue that they provide increased energy security, reduced greenhouse gas (GHG) emissions, improved environmental quality, and increased farm incomes. Opponents state that corn ethanol leads to increased food commodity prices, does not significantly reduce greenhouse gases, and may not improve environmental quality.

Drivers of commodity price swings

There were three main drivers of the 2008 commodity price surge: 1) global changes in production and consumption of key commodities; 2) the depreciation of the dollar; and 3) growth in the production of biofuels. The first driver meant that global consumption growth outpaced global supply increases in the years prior to 2008. This meant that stock levels were already low entering the 2008 season. Since commodities on global markets are priced in US dollars, the fall of the dollar led to increases in the dollar denominated prices. The dollar went from $0.90/€ in 2002 to as much as $1.60/€ in 2008. The third driver was corn ethanol, which had been growing more rapidly. The challenging feature of analyzing these causes is that it is impossible to separate the different drivers because they are so closely intertwined.

With the financial crisis of 2009, commodity prices plunged from their 2009 highs. Between spring 2008 and February 2009, each of the above drivers...
from 2008 reversed direction. A world financial crisis put the brakes on global income growth. Global crop production returned to more favorable levels for both the 2007/08 and the 2008/09 crops. After July 2008, the exchange rate of the US dollar appreciated by as much as 22 percent against major currencies. Energy prices collapsed, influenced by changes in income and exchange rates. Lower energy prices made ethanol less profitable, which also reduced demand for corn and other commodities.

In 2011, commodity prices surged again as both the demand for corn for ethanol and Chinese demands for soybean skyrocketed. Twenty-seven percent of the overall 2010-11 corn crop was used to produce ethanol, compared to only 10 percent of the 2005-06 crop. Furthermore, China substantially increased soybean imports to rebuild their low reserve soybean stocks, and stock-building accounted for nearly 40 percent of the increase in Chinese soybean imports since 2008. Figure 1 shows the change in US crop area required for the combined biofuels demand for corn and Chinese demand for soybean imports. The combined area went from 20.2 million acres in 2006 to 45.2 million in 2011, more than doubling in five years.\(^v\)

The US agriculture sector entered 2012 with already low corn and soybean stocks and the drought forced the US Department of Agriculture (USDA) to significantly lower corn expectations to 10.73 billion bushels, down 27 percent from the June estimate of 14.8 billion bushels. The low stocks plus low production led to corn prices at different points exceeding at $8 per bushel. The high prices in turn led to renewed concerns about the food versus fuel debate.

![Figure 1. Evolution of US Acres Used for Ethanol and China Soybeans](image1)

### Weighing policy proposals

With a substantial fraction of US corn going towards ethanol production, several groups proposed waiving the US Renewable Fuel Standard (RFS) for 2013. In addition, there have been calls for introducing longer term “flexibility” into the RFS. Let me first discuss the impacts of a possible RFS waiver and then describe some of the other policy proposals.

#### Renewable Fuel Standard Waiver

The RFS is a mandate that requires blending of a certain amount of corn ethanol each year.\(^1\) For 2012, it was 13.2 billion gallons, and the level increased to 13.8 billion gallons in 2013. If the US Environmental Protection Agency (EPA) determined that there is “economic harm” due to the RFS, the EPA has the authority to waive all or part of the RFS. The EPA cannot require that less ethanol be produced – it can only remove or reduce the requirement that a certain amount be blended each year. There is some built-in flexibility in the RFS as blenders can carry forward credits (called RINs) that they did not need to meet

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\(^1\) Technically, corn ethanol is not required, but in practice, the RFS effectively becomes a mandate for corn ethanol. There are also required levels for advanced biofuels and biodiesel.
blending requirements in earlier years. Estimates are that about 2.6 billion gallons of these credits exist, so the blending amounts in 2013 could be reduced by as much as 2.6 billion gallons even without an EPA waiver.

There were many calls for the EPA to waive the RFS in light of the corn shortage. Governors of six states, livestock groups and even the Director-General of the UN Food and Agriculture Organization (FAO) argued for a waiver. However, on November 16, 2012, the EPA denied the petitions to waive the RFS due to the drought induced high corn prices.

The impact of an EPA waiver depends critically upon how oil refiners and fuel blenders would react. To what extent would they change their behavior if the EPA issued a waiver?

To answer this question, we need to better understand the incentives faced by fuel blenders. First, there are the direct economic incentives. In November 2012, ethanol, even with high corn prices, was about 30 cents per gallon cheaper than reformulated gasoline blending stock. At these prices, fuel blenders would have no incentive to reduce blending even if EPA issued a waiver. For this to change, it would take some combination of lower crude oil and gasoline prices and/or higher corn prices. That scenario seems unlikely, but is not impossible. Also, there are many different kinds of gasoline blending stock in the US, and some of them can be cheaper than reformulated blending stock. Gasoline prices also vary by season, so there are circumstances for which blenders could have an economic incentive to use less ethanol.

Then there are technical issues inhibiting changes to the current blending practices. Since 2008, refiners have been producing at the refinery 84 octane gasoline instead of 87. The lower octane fuel is less expensive to produce, and it can be blended with 10 percent ethanol (with an octane of 115) to yield the standard 87 octane at the pump. Given this supply chain, it is not clear how quickly the oil industry could or would change back to producing 87 octane gasoline with other additives. Even if it appeared to make sense to make the switch, it would take time, and they might have to switch back the next year unless the RFS were waived again. The bottom line - there are strong economic and technical incentives to keep current ethanol blending practices in place even if EPA were to issue a waiver. Thus, it is quite possible there would be minimal impact even if a waiver was issued.

However, given the uncertainty, it’s possible to estimate the potential impacts on corn price in the event that a waiver was issued and refiners and blenders chose to change current practices. The combined impact of a large waiver, plus use of existing prior blending credits could result, under an assumption of blending flexibility, in a reduction of corn price of as much as $2 per bushel. A smaller waiver would have proportionately smaller impacts. It must be stressed that this is not the most likely case, but is a possibility.

A very important point is to understand that the economic harm done by the drought is large – in the tens of billions of dollars. EPA could not reduce the economic harm. If refiners and blenders do not have or do not use blending flexibility, a waiver has no impact. To the extent that there is blending flexibility that is used, an EPA waiver would redistribute the economic harm, but not reduce it. Livestock producers would be better off and corn growers worse off.

The bottom line then is that a reduction in the RFS blending mandate would likely have little impact on corn prices. With RFS capacity in place, and even with corn prices around $8, it is still more profitable to continue blending corn ethanol into gasoline.

Grain diversion proposals

Livestock groups have proposed making the RFS level a function of the corn stocks to use ratio. The RFS level could be adjusted as much as twice a year as a function of the ratio. In other words, when stocks are low, the RFS would be reduced, and with normal stocks, the RFS would be unchanged. This proposal
has some of the same issues as a waiver (likely little short-term blending flexibility), and it also would introduce uncertainty into the market.

Brian Wright and others have suggested creating more flexibility in the mandate\textsuperscript{viii} by using a competitive process to achieve shut-down of part of the ethanol production capacity. Essentially, ethanol plants would bid to close up shop for a year or some other pre-determined period, in return for a government payment.

The ethanol plant bid prices would certainly include their shut-down and start-up costs as well as foregone revenue from operations. It could be an expensive option for the government in a time of tight budgets. It would also require the refining and blending sectors to find other more expensive oxygenates and octane enhancers to replace the ethanol. Also, the notion that this kind of operation would be undertaken only in drought years would create a system very difficult to manage for the entire supply chain.

**Global impacts of high commodity prices**

While there are many challenges in increasing global food production, there are opportunities, as well.\textsuperscript{2} To the extent that prices are higher in the longer run, farmers will be induced globally to increase acreage and production. At present there are many places in the world where grain yields are less than half those in the United States, but with adequate soils and available rainfall. One study of yield gaps for major crops\textsuperscript{x} estimates that 50 percent more maize, 40 percent more rice, 20 percent more soybeans, and 60 percent more wheat could be produced globally if the top 95 percent of croplands produced at their current climatic potential. Clearly, in practice all this potential could not be realized. It does, however, illustrate the broad scope for yield increases globally if economic incentives are strong.

Table 1 provides data on test plot corn yields compared with farmer yields in different world regions to indicate the size of yield gaps. The United States yield gap evidenced in Table 1 is around 20 percent, but other countries have gaps as high as 75 percent, indicating a tremendous potential for achieving higher productivity using existing agricultural technologies in these areas.

Higher corn prices could induce farmers in these areas to make technical changes, such as improved seed varieties or higher fertilizer use, which would help close the yield gap. In fact, this outcome could be quite positive as much of this area is in developing countries with poor farmers. Higher revenue from sales of grains at higher market prices could help alleviate poverty in these areas. The potential poverty reductions would not apply to all rural residents, but mainly to land-owning farmers.

A precondition for achieving this supply response, production increase and possible poverty reduction is that governments in developing countries permit higher world prices to be transmitted to their farmers. In the 2008 price spike, many governments stymied the impact of higher prices to the detriment of their rural populations.

Between 2006 and 2012, the world saw unprecedented expansion of global harvested area of key agricultural commodities. Globally, the flexibility to expand area for high demand crops was composed of about 70 percent new area, and 30 percent displacing alternative crops.

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In the United States, where cropland area has been fairly stable, the new corn and soybean demands caused land to be reallocated away from other crops. The global expansion in harvested area is shown in Figure 3. Crops with the largest increase were corn, soybeans, and rapeseed. The 100 million acre expansion in global crop area since 2006 was in response to higher commodity prices. This expansion occurred largely in developing countries and especially in Sub-Saharan Africa, South America, former Soviet Union, and Asia as demonstrated in Figure 4.

The magnitude of supply response over time would also depend on the difficulty of removing very important constraints in credit markets, rural infrastructure, marketing infrastructure, crop insurance and institutions. The difficulty of making these changes will vary region-to-region, but higher price will induce movement in the direction of higher productivity. The World Bank estimates that 70 percent of the world’s poor live in rural areas in developing countries and derive their primary livelihood from agriculture. While it is not entirely clear how the different segments of the rural economy would fare from higher prices, and it would vary from one region to another, it is likely that to the extent that governments permit higher world prices to be transmitted to rural areas, farmers would respond with higher production, resulting in higher rural incomes. Most of the concern with high commodity prices is aimed at protecting urban poor from the adverse impacts of these higher prices. As shown in Figures 3 and 4, the harvested area in recent years increased significantly due to higher commodity prices and most of the increase occurred in developing countries. So while there is no doubt that higher agricultural commodity prices adversely affect net food buyers, particularly in urban areas, there is also potential for substantial gains for rural farmers and poverty reduction in developing countries. That side of the picture is often ignored, but Figure 3 clearly demonstrates that markets work, and farmers respond to incentives all over the globe.

Conclusions

Clearly, there are a multitude of drivers of the commodity price swings over the past several years. These include growth in global demand with increased incomes, population, and dietary transition; weather shocks in different parts of the world for different commodities; restrictive trade policies practiced by some countries in the face of higher prices; evolution of the US dollar exchange rate; changing trade patterns; and the emergence of a large biofuels market, especially corn ethanol in the US. Some would like to blame ethanol for the lion’s share of price increases, but evidence indicates that’s not the case.
The fact that ethanol has played some role in the commodity price increases has been a key driver of the food versus fuel debate. Government incentives were critical to establishing and growing the US ethanol industry. The question now, however, is what policy choices should be considered today. Ethanol is now an integrated part of the US fuel supply system. An associated reality is that unless crude oil prices plummet or corn prices increase, it will be economically attractive to continue using ethanol for fuel. Short-run policy fixes are not likely to have much impact so long as this economic reality persists. The government could choose to buy down ethanol production, but that approach is also fraught with difficulties.

The US corn ethanol industry is mature, and not likely to grow in the future. The RFS reaches its maximum of 15 billion gallons in 2015; the capacity already exists in the US. As corn yield increases over time, the share of corn going to ethanol will fall, and price volatility related to inelastic ethanol corn demand will also diminish.

In the meantime, we likely will rely on markets to allocate the scarce corn resources and increase global commodity supplies. While markets do this job well, there is no escaping the pain caused by supply disruptions like the 2012 drought.

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### Table 1: Test Plot and Country Average Maize Yields: Selected Countries 2008 to 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Test mean yield (bu/ac)</th>
<th>Test mean yield st dev (bu/ac)</th>
<th>Tests (n)</th>
<th>Country yield average (bu/ac)</th>
<th>Yield gap (bu/ac)</th>
<th>% of test mean</th>
<th>Testing mechanization level</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>199</td>
<td>36</td>
<td>723</td>
<td>156.9</td>
<td>41.9</td>
<td>79%</td>
<td>High</td>
</tr>
<tr>
<td>Vietnam</td>
<td>103</td>
<td>23</td>
<td>86</td>
<td>69.2</td>
<td>34.0</td>
<td>67%</td>
<td>Low</td>
</tr>
<tr>
<td>France</td>
<td>221</td>
<td>31</td>
<td>133</td>
<td>143.9</td>
<td>77.6</td>
<td>65%</td>
<td>High</td>
</tr>
<tr>
<td>Italy</td>
<td>231</td>
<td>29</td>
<td>76</td>
<td>146.5</td>
<td>84.9</td>
<td>63%</td>
<td>High</td>
</tr>
<tr>
<td>Argentina</td>
<td>188</td>
<td>52</td>
<td>88</td>
<td>114.1</td>
<td>73.6</td>
<td>61%</td>
<td>High</td>
</tr>
<tr>
<td>China</td>
<td>153</td>
<td>30</td>
<td>140</td>
<td>84.6</td>
<td>68.1</td>
<td>55%</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Thailand</td>
<td>121</td>
<td>22</td>
<td>184</td>
<td>65.7</td>
<td>55.5</td>
<td>54%</td>
<td>Low</td>
</tr>
<tr>
<td>Philippines</td>
<td>105</td>
<td>29</td>
<td>277</td>
<td>40.8</td>
<td>64.7</td>
<td>39%</td>
<td>Low</td>
</tr>
<tr>
<td>Indonesia</td>
<td>107</td>
<td>32</td>
<td>51</td>
<td>38.2</td>
<td>69.1</td>
<td>36%</td>
<td>Low</td>
</tr>
<tr>
<td>Pakistan</td>
<td>148</td>
<td>21</td>
<td>50</td>
<td>45.5</td>
<td>102.7</td>
<td>31%</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Mexico</td>
<td>181</td>
<td>54</td>
<td>113</td>
<td>52.4</td>
<td>128.2</td>
<td>29%</td>
<td>High</td>
</tr>
<tr>
<td>India</td>
<td>142</td>
<td>35</td>
<td>114</td>
<td>36.2</td>
<td>105.8</td>
<td>25%</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>

Source: Mike Edgerton, Monsanto Corp.
About the Author
Professor Tyner is an energy economist and James and Lois Ackerman Professor of Agricultural Economics, Purdue University. He received his B.S. degree in chemistry (1966) from Texas Christian University, and his M.A. (1972) and Ph.D. (1977) degrees in economics from the University of Maryland. He has over 250 professional papers in these areas including three books and 90+ journal papers, published abstracts, and book chapters. His past work in energy economics has encompassed oil, natural gas, coal, oil shale, biomass, ethanol from agricultural sources, and solar energy. In June 2007, Senator Richard G. Lugar of Indiana named Tyner an “Energy Patriot” for his work on energy policy analysis. In 2009 he received the Purdue College of Agriculture Outstanding Graduate Educator award and was part of a group that received the College Team award for multidisciplinary research on biofuels. In 2011, he served as Co-chair of the National Academy of Sciences Committee on Economic and Environmental Impacts of Biofuels.

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2 U.S. Environmental Protection Agency, Subpart M - Renewable Fuel Standard, E.P. Agency, Editor 2010. p. 120.

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