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## Food or Fuel? Choices and Conflicts

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The quiet world of farming and food production is undergoing a “sea change” of unprecedented proportions. Since 2005 we have seen a rise in energy prices coupled with policy decisions that have expanded biofuels markets for crops that were traditionally used almost exclusively to feed people and farm animals. In addition, a weak U.S. dollar and increasing global food demand have added to the upward price pressure and increased volatility in major crop markets.

Governments of the United States and the Economic Union (EU) have reinforced changing market conditions with policy choices that tilt the balance towards channeling crop production into biofuel production. The mandates and subsidies in these policies are not transparently linked to market forces. Debate over the wisdom of market-insensitive biofuels policy that adds to crop demand and price uncertainty in a time of record-high prices has become heated.

The basics of what is happening to market supply and demand forces are not difficult to understand. The wrinkles added by biofuels policy are, on the other hand, both significant and add complexity.

### Energy Markets Alone Are Causing Major Changes in Agricultural Markets

For economists, the increase in oil prices and the resulting link to the energy value of crops has turned out to be a test of just how well our theories can predict the outcome. I am happy to report that the theories have passed the exam with flying colors. This is cold comfort for those paying historically high prices for gasoline, corn, soybean oil and soybean meal, but at least we know “how” and “why”.

Market-based demand for crops used in food production is somewhat different from market-based demand for biofuel in one important sense. In the food market, as

production increases price is expected to decline along a short-run demand curve. Price-inelastic demand for food generally leads to large changes in price for relatively small changes in production. Food demand for crops is also not strongly linked to other commodity sectors. This is not true for demand for food crops used as biofuels.

The global market for petroleum-based energy alone, in terms of energy production, is substantially larger than all the potential fuel energy that can be produced from the world’s food crops. Unless we are willing to sharply reduce food consumption we can use only a fraction, and a small one at that, of the current world’s food supply to produce fuel. In the world of energy, potential food-based biofuel production simply cannot come close to replacing a meaningful amount of petroleum, much less total fossil fuel consumption. (Including natural gas and coal) The 15 billion gallon U.S. ethanol RFS for 2012 would use about 6.2% of the 2008 global grain crop to replace about 6.8% of the 2008 U.S. gasoline supply and only 0.8% of global oil production. This creates an asymmetric situation where the biofuel supply is too small relative to the global energy market to have much effect on energy prices, but energy prices can have a major effect on food prices.

To put it simply, the limiting factor on expanding food-based biofuel production is the world’s desire for food, not fuel demand. Even more simply, we like to eat. Open up the possibility of producing biofuels from other sources that do not compete for farmland (algae, wood waste, manure, solid waste, and others) and the limits on production can be expanded. That technology is still, after many years of work, “not quite” ready. It may be a factor in the long term biofuels market, but not today’s.

If biofuels are priced competitively, they are a near-perfect substitute for petroleum fuels. A gallon of ethanol has about 66% of the BTU content of a gallon of gasoline.

Gallon-for-gallon methyl ester (the chemical name for the purified product extracted from fats and blended with diesel fuel to make bio-diesel) has very close to 100% of the BTU content of diesel.

For current engine technology that means that, at 66% of the price of gasoline, ethanol is a near-perfect substitute for gasoline. If E85 (85% ethanol, 15% gasoline) is priced at 71% of the price of gasoline, motorists will not care whether they buy regular gasoline or E85 as their fuel cost per mile will be about the same. Modified engines can take advantage of ethanol's higher octane rating and reduce the energy penalty through higher efficiency than is possible with today's gasoline-based technology. There are none of these engines on the market today. Diesel buyers can pay the same price for methyl ester as diesel and get the same fuel cost per mile.

Until oil prices passed about \$70 per barrel the market economics of converting crops to fuel were not very favorable. Grains and fats were priced too high compared to their energy value to make it profitable to convert them into motor fuels. We did produce some ethanol and methyl ester, but only with the help of government subsidies. With oil at over \$100 a barrel in 2008 the value of crops converted into fuels has been significantly higher than food-market values of just a few years ago. Subsidies are no longer required for biofuels to be a viable use of crops. That is a huge change in market fundamentals.

So, what happens if crop-based production of biofuels is limited to only a small fraction of the petroleum market and petroleum prices suddenly increase, setting values for crops that are higher than prevailing food-market prices? According to economics textbooks the classic market-based process should unfold something like this:

1. Biofuel prices will increase with energy prices, but crop prices will not immediately follow.
2. Biofuel producer profits will increase from higher biofuel prices.
3. Biofuel producers will expand production, but with a time lag.
4. Biofuel production increases are too small to have a material effect on overall fuel prices.
5. However, as biofuel production grows so does demand for the crops used.
6. Production of the biofuel crops is limited by available land and yields, less of those crops are available for food use.
7. The biofuel crops will take acres from other crops, and their prices will also increase.
8. With time lags, higher crop prices will be reflected in higher food prices and lower food production.
9. Higher demand for limited crop supplies will cause crop prices to increase until biofuel profits disappear and fuel value of crops equals food value.
10. Biofuel expansion will stop, and some marginal producers may exit.
11. If crop production increases enough to cause a crop price declines, loop back to Step 3.

Although it seldom happens in real life, the economics textbooks in this case predict what has happened up through Step 9. A marked slowing of new ethanol plant construction indicates that Step 10 is also in the process of occurring. Longer term implications of higher energy prices for agricultural markets include, but are not limited to:

1. Energy markets and food markets become tightly coupled. That is, increases (decreases) in energy prices will cause crop prices and food production costs to increase (decrease).

2. Prices for crops and feedstuffs other than those used for biofuels will also be affected due to competition for land and substitution in use.
3. Land prices and rents will move in tandem with changing energy prices; landowners are potentially the major beneficiaries in the form of higher land prices.
4. High (relative to pre-2007) energy prices will cause increased demand for farm inputs and will cause crop production costs to increase.
5. Food production volume will be affected by the demand and price for energy via the biofuels market.

Bruce Babcock of Iowa State University and Wallace Tyner of Purdue University have come to essentially these same conclusions (Babcock) (Tyner).

### **Energy Policy Reinforcing the Energy Market Linkage to Agriculture and Food**

Energy policy affects food and agriculture through biofuels and their links to both energy production and crop demand and use. The biofuel policy tools commonly used are subsidies for biofuel producers, mandated production and/or use, and tariffs designed to protect the domestic market. Current U.S. policy makes use of all three of the tools. EU policy is focused in mandates.

Mandated use of ethanol in the United States was first proposed in 2003, but not enacted until 2005. The Energy Policy Act of 2005 had an ethanol mandate (the Renewable Fuel Standard, or RFS) that was relatively modest and did not have a significant effect on agricultural markets. However, enacted on December 19, 2007, the Energy Independence and Security Act of 2007 (EISA) set forth a much higher RFS.

To put the higher EISA RFS in perspective, the crop year 2008/2009 EISA RFS is about 10 billion gallons of ethanol. It would require at least 91 million tons of corn be used from the 2008 U.S. crop. USDA is currently (as of August 12, 2008) forecasting 104 million metric tons of corn use, about 4% of total global grain production, for ethanol production from the 2008 corn crop. While the 2008/2009 ethanol mandate may be slightly smaller than forecast production, the presence of a market guarantee of this magnitude could be underpinning current corn prices.

In addition to the RFS mandate, U.S. policy also grants the biofuels industry tax credits, paid to the company that blends ethanol or biodiesel with petroleum fuels. The tax credits do not adjust with market conditions. Fixed cash infusions into biofuel use raise the value of biofuels to the blending company and raise the market price of biofuels without regard to energy or crop prices. With higher biofuels prices the biofuel producer has an advantage over other crop buyers. However, there can be only one market price for any crop, so the biofuels industry eventually bids much of the value they receive from the tax credits into crop prices. The tax credits are adding to the upward pressure on crop prices on top of the market pressures from higher energy prices.

The end result with both the tax credits and mandates is that much of their value will always eventually be bid into biofuel prices, and then crop prices. Crop farmers, not the ethanol industry, become the major beneficiaries of the tax credits. Eventually, higher crop prices will be capitalized into land prices, and the ultimate benefit will accrue to landowners.

Finally, the ethanol tariff of \$0.54 per gallon is a barrier which helps protect U.S. ethanol producers from more efficient producers outside of the United States. However, in a sense

the tariff and tax ethanol credit cancel each other, and the net effect is to deny foreign ethanol producers the value of the U.S. tax credit paid for all ethanol in the prices they receive.

There has also been political fallout over biofuels policy. The voice of agriculture is fracturing along lines of crop producers versus crop users. As the public sees crop farmer income grow while their food prices increase (MSNBC) support for farm programs and biofuels policy may erode.

### **What Happens When Policy Meets Cold Reality?**

History teaches us that in most cases reality eventually wins. We also often see “unintended consequences.” Energy policy can set any mandated level of ethanol production, but even the U.S. Congress or the President cannot change the weather or double crop yields overnight. Actually, to replace just 50% of U.S. gasoline consumption with E85 would take 100 billion gallons of ethanol. Including 9 billion for food, feed and exports, corn production would need to be over 40 billion bushels to make that happen. From 80 million acres of U.S. corn it would take a yield of over 500 bushels per acre. We are currently at about 160 bushels in a good year. We also would still be importing significant amounts of crude oil. When it appeared that the 2008 corn and soybean crops were at risk from flooding, corn prices soared to unprecedented highs. On June 18, 2008, several corn futures contracts closed at over \$8 for the first time ever. Cash corn was selling for close to \$9 per bushel in California. Prices of soybeans and wheat were also on the rise. Within a few weeks it became apparent that the crops were improving, and prices declined, but remained at historically high levels.

Why did this happen when even a damaged 2008 corn crop could still have been the 4<sup>th</sup> largest on record? A major factor was likely that

for the first time in history we had \$140+ crude oil prices coupled with an expanded biofuels industry with a RFS mandate large enough to use sufficient grain relative to production to make a substantial difference in crop prices.

While improved weather at least temporarily alleviated the 2008 supply crunch, it is not clear at this point just how such a scenario of tight crop supplies and EISA policy will interact. Corn prices at the levels of June, 2008 were not profitable for ethanol producers, food or animal feed users. We were, for a few weeks, in an unprecedented bidding process to determine who was to have access to a corn crop that was predicted to be much smaller than that of 2007. At some point we would have reached prices that would have rationed use, or the RFS would have been reduced. Had the RFS been reduced, prices may have dropped sharply overnight.

Finally, along with higher crop prices we have also seen a marked increase in price volatility. The coefficient of variation of monthly 2007–crop cash corn prices has been about three times the level of the 2000–2006 crops. The increased demand for biofuels, partly market driven and partly as a result of policies promoting their production, has reduced crop stocks levels, driving price volatility higher. Less stable crop prices raises another set of issues regarding how crop users will manage higher risks.

### **Why We May Need to Re-examine Current Energy Policy**

Arguably, the biofuels features of the Energy Independence and Security Act of 2007 (EISA) will achieve few of the goals implied by the law’s name. A recent Iowa State study of EISA policies concludes that they are in fact not designed to promote cleaner energy production, energy independence or energy security, but rather are intended to increase farm incomes and land prices (Rubin, Carriquiry, and

Hayes). The study examined a wide range of policy options, and concluded that the policy set contained in EISA had the largest benefit for agriculture of the options examined. In their conclusions the authors state "There is strong evidence to suggest that the primary purpose of these (EISA biofuel) policies was to remove land from food and feed production and in so doing to increase farmers' and landowners' incomes."

By establishing price-insensitive subsidies and mandates EISA also partially isolates a large portion of key crops from market forces, pushing adjustments in production and prices onto the food production sector. The result is higher, more volatile, food prices and reduced security of our world's food supply. Increased biofuel production, subject to the whims of weather, also arguably reduces even our overall fuel security.

The payoff for EISA biofuels policy is small relative to the energy market. Even if the 36 billion gallon EISA mandate for 2022 could be met it would not make a material change in the country's dependence on foreign oil. The petroleum equivalent of the mandate is about 570 million barrels of oil per year, or only about 15% of 2008 U.S. oil imports. That still leaves the U.S. highly vulnerable to world oil market interruptions.

On equity grounds biofuels policy has helped promote a transfer of income and wealth from food consumers and crop users to crop producers

and land owners (Taheripour and Tyner). In effect, biofuels policy can be seen as a regressive food tax, the proceeds of which largely go to farm owners.

Current U.S. biofuels policy deserves to be revisited by Congress and the Administration. Together with oil price instability, EISA's inflexible biofuel mandates, subsidies and tariffs have increased both costs of food production and price volatility. Both higher costs and higher risks have been imposed on the food production sector.

At a minimum, a more flexible biofuels policy that is responsive to agricultural and energy market realities should be preferable to the fixed tax credits, RFS and tariffs contained in EISA. An energy policy that more strongly emphasizes energy conservation and fuel production from non-food sources, including incentives to increase U.S. oil and natural gas production, could also be part of that debate.

To solve the potential dilemma of "food vs. fuel" demands that we effectively address long-term energy consumption, production and prices. Failure to do so could lead to a future of significant increases in global food and energy costs, a marked decline in global living standards, and an increase in global poverty rates. If this happens the world will be neither a more independent nor secure place to live.

## For More Information

Babcock, B. A. (2008). When Will the Bubble Burst? *Iowa Ag Review*. Winter 2008 Vol. 14 No. 1.

MSNBC (2008). *As food prices spiral, farmers, others profit*. Available online: <http://www.msnbc.msn.com/id/24840735/>.

Rubin, O., Carriquiry, M. & Hayes, D. (2008). *Implied Objectives of U.S. Biofuel Subsidies*, Working Paper 08-WP 459. Ames Iowa. Iowa State University. Center for Agricultural and Rural Development.

Taheripour, F. and Tyner, W. (2007) *Ethanol Subsidies: Who Gets the Benefits?* Farm Foundation. April, 2007

Tyner, W. (2008) The US Ethanol and Biofuels Boom: Its Origins, Current Status, and Future Prospects. *BioScience*. Vol. 58, No. 7 (July/August 2008), pp.646-53

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