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Breaking the Link between Food and Biofuels

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Briefing Paper 08-BP 53
July 2008

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Executive Summary

Production of biofuels from feedstocks that are diverted from food production or that are grown on land that could grow crops has two important drawbacks: higher food prices and decreased reduction in greenhouse gas emissions. If U.S. policy were to change and place greater emphasis on food prices and greenhouse gas reductions, then we would transition away from current feedstocks toward those that do not reduce our ability to produce food. Examples of such feedstocks include crop residues, algae, municipal waste, jatropha grown on degraded land, and by-products of edible oil production. Policy options that would encourage use of these alternative feedstocks include placing a hard cap on ethanol and biodiesel production that comes from corn and refined vegetable oil, thereby forcing growth in biofuel production to come from alternative feedstocks; differentiation of tax credits and subsidies so that the alternative feedstocks receive a higher incentive than do corn and refined vegetable oil; and greatly increased funding for research to hasten the feasibility of producing and refining alternative feedstocks.

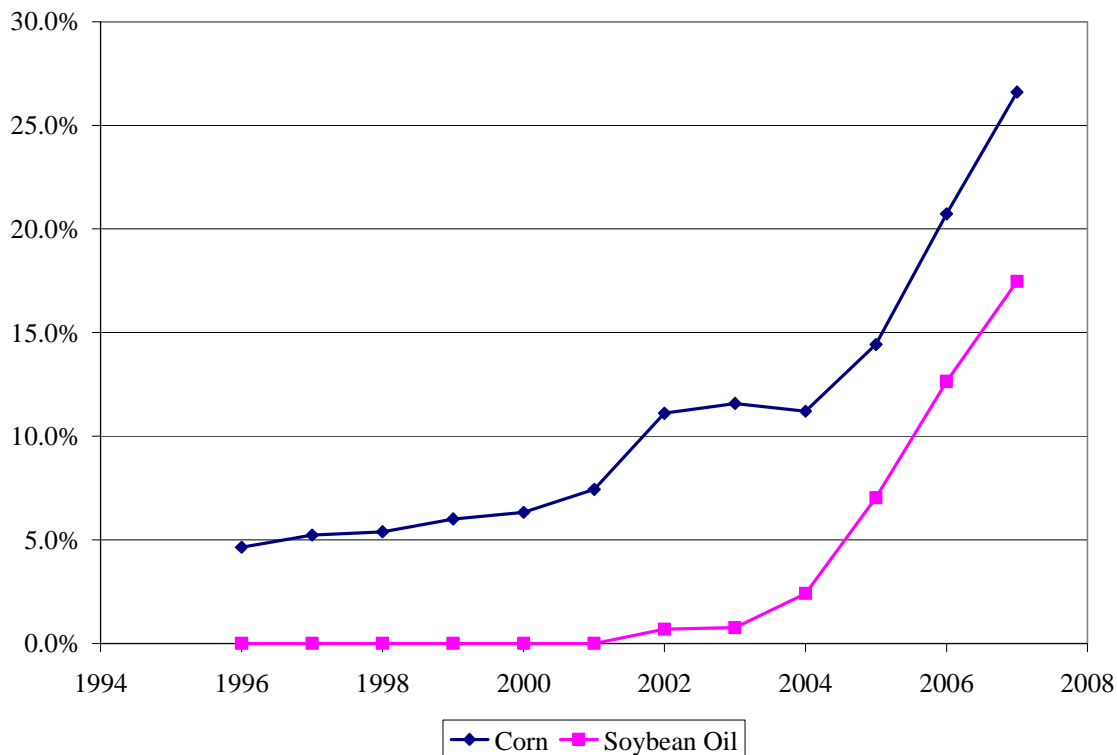
Keywords: biofuels, feedstocks, food prices, policy.

BREAKING THE LINK BETWEEN FOOD AND BIOFUELS

Expansion of biofuel production in the United States, Europe, and South America has coincided with recent sharp increases in prices for food grains, feed grains, oilseeds, and vegetable oils. It is only natural then to associate high food prices with expanded biofuel production. The credibility of this association is heightened by the fact that the U.S. ethanol industry uses corn as its main feedstock; the U.S. and South American biodiesel industries use soybean oil as their main feedstock; biodiesel in Europe mainly comes from rapeseed oil; Brazilian ethanol is produced from sugarcane on land that could be used for food production; and biodiesel in Southeast Asia is made primarily from palm oil. That is, practically all biofuels in the world are produced from feedstocks that could be used to produce food or that are produced on land that could produce food.

Of course, the truth is more complicated than critics of biofuels want to believe. The world has consumed more wheat than has been produced in six of the last seven years. Rice consumption has been higher than rice production in five of the last seven years. The resulting drawdown in wheat and rice stocks is largely responsible for the large increase in rice and wheat prices because neither rice nor wheat is used in biofuels. It is difficult to find a link between the prices for these staple food crops and expanded biofuel production.

However, for corn and oilseeds, a link certainly exists. Figure 1 shows that the share of the U.S. corn crop that is consumed by the ethanol industry has grown from around 5% to more than 25% in 10 years. The share of U.S. soybean oil consumed by the U.S. biodiesel industry has grown even more rapidly. Add in the increased use of vegetable oil in biodiesel production in Europe, Asia, and South America and there is no doubt that corn and vegetable oil prices are much higher than they would have been without expansion of the biofuels sector.



Note: 2007 levels are projected by FAPRI.

FIGURE 1. Share of U.S. corn crop and soybean oil production converted into biofuels

Although there is disagreement about exactly how much corn and soybean prices have increased because of biofuels, economists generally agree that the resulting impact on food prices is relatively modest. For example, Elobeid et al. estimated that a 30% increase in corn prices and the resulting increases in other commodities that compete with corn for land would increase U.S. at-home food expenditures by approximately 1.3%. Agricultural economists also agree that a change in federal biofuel policy would have a modest impact on both commodity prices and food prices if crude oil prices remain high. McPhail and Babcock estimated that removal of all federal biofuel policies would decrease corn prices by just 13% in the 2008/09 marketing year. The Food and Agricultural Policy Research Institute (FAPRI) recently estimated that the three federal policies—the Renewable Fuels Standard, the blenders tax credit, and the tariff on imported ethanol—increase corn prices by an average of 16% in the long run. The reason for these results is that existing biofuel plants have created a direct link between commodity prices and crude oil prices. Thus, if

higher crude oil prices are with us to stay, then in the long run, biofuel feedstock prices will largely be determined by oil prices, regardless of whether current biofuel production and consumption subsidies and mandates stay in place (Elobeid et al.).

High crude oil prices signal the world that substitute transportation fuels are needed, and for the time being, the primary source of substitute fuel is biofuels. If we continue to rely on biofuel feedstocks that are used directly to produce food or that are produced on land that would be producing food, then we will strengthen the direct link between crude oil prices and food prices. That is, food prices will reflect crude oil prices not only in terms of the energy used to grow the crops, manufacture the food, and transport and store the food but also in terms of the cost of raw ingredients such as grain, meat, milk, and vegetable oils. There may be some disagreement about the magnitude of the impact on food prices from biofuels, but there is no disagreement that there is an impact. The ultimate size of the impact will be determined by the level of crude oil prices and the degree to which biofuel production is increased because of public policy incentives.

If we were all wealthy and food expenditures made up a small fraction of our disposable incomes, then there would be nothing wrong with linking food and crude oil prices. It would simply be a choice that we make to spend a bit more on food and a bit less on fuel. But food expenditures make up a large portion of disposable income for billions of people. Higher food prices directly reduce the amount that is available for spending in all other areas. This negative impact of biofuels on non-food disposable income in much of the world opens U.S. and European biofuel production to valid criticism. One way of countering this disadvantage would be to de-link food and biofuel production. This can be accomplished either through policy initiatives or through development of new technologies that use feedstocks that are not part of the food supply.

Competition between Food and Biofuel Feedstocks

Biofuel feedstocks can have both direct and indirect effects on food supplies. If biofuels are produced from feedstocks that would have been used for food, then biofuels directly reduce potential food supplies. This reduction occurs even if feedstock price increases result in an expansion of supply because the expanded feedstock supply will typically reduce the supply of other food crops. For example, U.S. corn used to produce

ethanol reduces the amount of feed available for livestock. The large expansion in supply of corn in response to ethanol's growth reduces the amount of acres planted to soybeans in the United States. In aggregate, there are fewer acres devoted to food production than there would be in the absence of biofuels.

The resulting price increase from the reduction in supply will induce farmers to expand planted acres. If the new acres would not otherwise have been cultivated, then there are greenhouse gas consequences from the newly tilled acres that can be attributed to expanded biofuels. The greenhouse gas emissions from tilling new land can dramatically reduce the net reductions that can be achieved with biofuels (Searchinger et al; Fargione et al.; Feng et al.).

Even if a feedstock is not directly used to produce biofuels, it can still affect food supplies if the feedstock is grown on land that would otherwise be planted to a food crop. For example, oil from jatropha is not suitable for human consumption. However, if jatropha plantations are sited on prime agricultural land, then biodiesel produced from jatropha will decrease food supplies. If the plantations are located on land that is not suitable for food crop production, then the effects are minimal, perhaps limited to a reduction in some grazing land. Similarly, if dedicated biomass crops such as switchgrass or miscanthus are planted on agricultural ground, then food supplies will be affected.

It would seem that because biofuels require biomass, and because biomass typically requires land, there will always be a connection between biofuel production and food supplies. But a lot of biomass is produced that has little, if any, impact on the amount of land available to produce food. Tapping these sources of biomass for future increases in biofuel production will help break the link between food and energy prices and will significantly increase the net reduction in greenhouse gas emissions that we can obtain from biofuels.

Feedstocks that Do Not Reduce Cropland

Producing biofuels out of feedstocks that cannot be used directly for food production or do not reduce the amount of land that can be used to produce food can be accomplished in two ways. The most straightforward way is to capture biomass that is currently treated as either waste or that is a co-product of existing production processes with very

low or negative current economic value. Examples of waste streams that could potentially be converted into biofuels include a portion of municipal trash and garbage, crop residues, wood pulp residues, and forest residues. Currently these streams often generate negative value in that consumers and firms must pay for disposal. New technology that allows for economic conversion of these potential sources of feedstock for biofuels offers the double benefit of a reduction in global waste and the generation of valuable transportation fuels. In addition, tapping waste streams places no burden on the world's ability to produce food.

Crop residue, in particular corn stover, has been identified as a waste stream that could be tapped for conversion into cellulosic biofuels. Other residues are wheat and rice straw. Not all residue can be viewed strictly as a waste product. For example, on highly erodible land, corn stover is an efficient means of reducing soil erosion. In addition, some fraction of stover likely contributes to maintenance of soil organic content, which helps to maintain soil fertility. But many Corn Belt farms treat a large proportion of corn stover as a waste product needing to be managed. Excess stover in fields can prevent timely planting of the following year's crop, particularly if corn is planted after corn. Removal of some fraction of the stover for conversion into biofuels would actually benefit many corn farmers.

There are relatively few examples of potential biofuel feedstocks that are truly waste in that their current uses generate negative or zero economic value. There are more examples of by-products that could be taken from their current use and given higher value as a biofuel feedstock. Inedible tallow, poultry fat, restaurant grease, yellow grease, and oil by-products from vegetable and whole-plants can all be converted to biodiesel, a fact that has more than doubled their value in the last two years. Using these biodiesel feedstocks does not displace food, although previous users must find alternative feedstocks for their products.

Nearly all biodiesel is currently produced from refined vegetable oils. The portion of the vegetable oil that is used for biodiesel is the triglyceride portion, which is the same portion used in food and food preparation. But biodiesel can also be produced from by-products of edible oil production. Haas et al. report that biodiesel made from soybean soapstock—a by-product of soybean oil processing that is high in free fatty acid con-

tent—is a high-quality fuel. Palm fatty acid distillate is a similar material that is in abundant supply given the large growth in palm oil production. The extent to which existing biodiesel plants can use these by-products is limited to about 10% of feedstocks. However, there are second-generation biodiesel plants that are in development that can operate completely on these feedstocks. As with grease, not all of these high fatty acid materials have zero current value. But diversion of these materials from their current use (or from landfills) will likely add value to them and create highly valuable biofuels without increasing food prices. In addition, because using these feedstocks will not decrease cropland, their contributions to greenhouse gas reductions will likely be far greater than those of feedstocks that displace cropland.

The second way that biomass can be created without competing for food land is to use land that is not suitable for producing food or to grow the biomass without using land. *Jatropha* is an oil-bearing crop that its backers claim is suitable for growing in arid regions that would not otherwise be used for intensive agriculture. If this claim is borne out, and *jatropha* is planted on this type of land only, then biodiesel made from *jatropha* will not compete with food.

Another example of biomass being produced on non-agricultural land is the planting of dedicated biomass crops on land that otherwise would not produce food. There are large areas in the upper Midwest and the Southeast that once produced food crops but are now in pasture or trees. Conversion of these lands to the production of woody biomass to be used for cellulosic biofuels would not affect food prices.

A last example is to produce biomass without extensive use of land by producing algae in ponds. PetroSun has evidently begun operation of an algae-producing facility in Rio Hondo, Texas. An estimated 4.4 million gallons of algal oil will be produced on 1,100 acres of ponds. To put this into perspective, 1,100 acres of soybeans produce approximately 70,000 gallons of soybean oil. If the ponds are located on land that is not suitable for crops, then algae as a feedstock will not affect food prices.

Given the high price of crude oil and the great incentive for finding substitutes for crude oil-based transportation fuels, we might see continued growth in the competition between food and fuel. However, there are alternative types of feedstocks that can be turned into transportation fuels without affecting food costs. Of course, for many of these

feedstocks we would expect that their diversion from current uses to biofuels would result in higher prices for some non-food products. Whether we see more growth in feedstocks from food crops or from non-food crops depends in large part on the types of policies that are in place.

Policy Choices

There are many potential objectives one could aim to achieve with biofuel policies, including energy security, diversification, and greenhouse gas reduction. By any measure the incentives given to corn ethanol and biodiesel have been successful at increasing the proportion of the U.S. fuel supply that comes from U.S. biofuels. But one near-term cost of achieving this goal is higher corn and vegetable oil prices, which have increased and will continue to increase food prices. For most U.S. consumers, such a trade-off may make sense. But for the world's poor, there is no trade-off, only loss, because they use little fuel and they must pay higher prices for some food items. Another problem with diverting food crops to biofuels is that promised greenhouse gas reductions likely will not materialize because new cropland will be brought into production in response to higher commodity prices.

Current policy incentives partly recognize the problems with diversion of food crops. The new Renewable Fuels Standard (RFS) applies to, at most, 15 billion gallons of ethanol made from corn and to one billion gallons of biodiesel. Cellulosic and other advanced biofuels account for the remaining 20 billion gallons of mandates. It seems that the thinking behind this construction of the RFS is that moving to cellulosic and advanced biofuels will cap the impact on food prices and greenhouse gas emissions from crop-based biofuels. In addition, the new farm bill reduces the blenders' tax credit for corn ethanol from 51¢ to 45¢ per gallon and creates a \$1.01-per-gallon cellulosic biofuel production tax credit.

However, current policies are not so clear-cut in trying to minimize food and greenhouse gas impacts. For example, there is no indication that Congress is prepared to eliminate the blenders tax credit completely once U.S. corn ethanol production reaches 15 billion gallons. And the new tax credit for cellulosic biofuels is awarded regardless of whether the cellulosic feedstock displaces food crops or not. Furthermore, current policy

awards U.S. biodiesel made from virgin vegetable oils twice the subsidy given to previously used feedstocks.

Current policy does not clearly differentiate between biofuels that use feedstocks that affect food prices and those that do not. This lack of focus on food prices is understandable because the rapid increase in commodity prices did not occur until just after the new RFS was passed. If Congress desired to place greater importance on minimizing the impact of biofuels development on food prices, then there are a number of steps that could be taken.

First, Congress could place a hard cap on ethanol made from corn and on biodiesel made from refined vegetable oil. The current RFS is a floor rather than a cap, and existing tax incentives combined with high crude oil prices could mean future production of corn ethanol and biodiesel made from refined vegetable oil could increase to unintended levels.

Second, Congress could better target tax credits and fuel standards by basing them on the impact each biofuel feedstock has on food prices. Given the link between land use for food crops and greenhouse gas emissions, such targeting could be set based on full greenhouse gas targeting. This type of greenhouse gas targeting would automatically give a greater incentive to producers who use waste and by-product feedstocks in biofuel production. Thus, for example, biodiesel producers who use the high fatty acid by-products from vegetable oil refining or algal oil would be given as high a tax credit as a biofuel producer who uses corn stover as a feedstock. These producers would all receive a much higher incentive than an ethanol producer who uses corn or a biodiesel producer who uses soybean oil.

And finally, Congress could mandate that the Energy Department and Agriculture Department ramp up research programs for biofuel feedstocks, with priority being given to developing feedstocks that do not affect food prices and have large greenhouse gas reductions. Justification for expanded research is that food, energy, and climate change will likely be the three biggest issues facing the United States and the world over the next 10 to 20 years.

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