Global Aspects of USDA's Baseline Projections for Biofuels

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In the coming decade, the global agricultural sector will be shaped by many economic, policy, and technical developments. One of the major factors will be the global expansion in biofuels production.

Increasing energy costs have provided an incentive for many governments to encourage the production of petroleum substitutes from renewable agricultural crops. Currently, many countries are making new investments in biofuel production capacity. The main feedstocks envisioned for these investments in the near term are corn and sugarcane for ethanol, and rapeseed oil and soybean oil for biodiesel. However, other feedstocks are also being used. Other feedstocks for ethanol production include barley, wheat, rye, wine, sweet potatoes, sweet sorghum, molasses, and cassava. Other feedstocks for biodiesel include a variety of vegetable oils, recycled oils, and fats from the food industry.

The increasing demand for feedstocks used in the production of biofuels is expected to have a significant impact on global agricultural markets. A number of new supply-and-demand factors will be important, and there is uncertainty related to each factor. Assumptions about these supply and demand factors were incorporated into the 10-year baseline projections for U.S. and world agriculture that the U.S. Department of Agriculture (USDA) made last fall.

What is the USDA Baseline?

Each year, the USDA prepares a set of 10-year projections for U.S. and world agriculture that we refer to as the "Baseline." The USDA Baseline projections are not a forecast about the future. Instead, the projections are a conditional, long run scenario about what would be expected to happen under a specific set of assumptions and conditions.

USDA analysts use a variety of economic models as a starting point for generating the baseline projections. We have a domestic crop-area allocation model and a number of U.S. commodity market models. We also use a U.S. model, the Food and Agricultural Policy Simulator (FAPSIM), to analyze detailed technical and policy options. To help analyze global agriculture, we have a "Linked Country-Commodity Modeling System" that links 24 commodity markets in 39 countries and regions. Output from these models provide essential guidance to the commodity, country, and policy analysts that contribute their expertise and judgment to the final projections. The projections presented here were prepared in November of 2006.

How we modeled biofuels

Our objective was not to model biofuels markets themselves, but rather to focus on the markets for agricultural feedstocks. To incorporate biofuels into our modeling system for international agriculture, we used two different approaches, depending on the country: (1) those modeled specifically, and (2) those affected indirectly.

Explicit Assumptions for Major Biofuel Producing Countries

In our first approach, for six countries that are major producers and/or consumers of biofuels and their feedstocks, we made explicit assumptions about the growth in feedstock demand during the coming decade. Assumptions about the growth in biofuel production reflected the rapid changes occurring in the biofuels industry and policies related to it. The six countries using this approach are the United States, the EU, Brazil, Canada, Argentina, and China. Our assumptions about these countries were based on available data and on assessments of existing policies and statements about future policies. Although there is considerable interest in ethanol production from cellulosic feedstocks, widespread commercial production during the next decade faces many challenges. USDA's projections assume very little commercial availability of ethanol from cellulosic sources during the next 10 years.

Next, I will briefly describe our assumptions and summarize the projections for these six countries.

United States:

USDA first called attention to the rising importance of ethanol 4 years ago in our February 2003 Baseline report. At that time we projected the amount of U.S. corn used for fuel ethanol production would be about 1 billion bushels by 2012. The projections were raised slightly in 2004, and again in 2005. Then, in 2006, projections rose sharply because of the impact of the Energy Policy Act of 2005. USDA again raised the projections in its 2007 baseline. Then, it was assumed that over 4.3 million bushels of corn would be used to produce more than 12 billion gallons of fuel ethanol by 2016. Biodiesel production is assumed to increase to 700 million gallons in 2011 and then level off.

EU:

The EU has used rapeseed oil to produce biodiesel in relatively large quantities over the last decade. At the time USDA made its projections last November, the EU had a target (not a mandate) that 5.75 percent of total transportation fuel use should come from biofuels by 2010. EU policies allow planting rapeseed on set-aside land and also provide for an area subsidy for biofuel crops, but the EU relies on individual member states to offer tax credits on biofuels. The USDA projections assume that about two-thirds of the target is met by 2010, and that because of increasing total fuel use, the 5.75 percent target is still not quite reached by 2016.

The EU projections further assume that biodiesel accounts for a large majority of total biofuels use. Rapeseed oil is the feedstock for about 80% of EU biodiesel production. In the EU, the area planted to rapeseed and the crushing capacity both increase sharply. In addition, the EU increases rapeseed oil imports from Russia and Ukraine. It also imports palm oil from Southeast Asia, as well as some biodiesel made from Southeast Asian palm oil. The EU also produces some ethanol, most of it from wheat and some sugarbeets.

Brazil:

Brazil has been the world's largest ethanol producer, but nearly all of it is made from sugarcane rather than grains. For several decades, Brazil has used sugarcane to produce ethanol and then used the ethanol for automotive fuel on a large scale. As a result, Brazil has implemented a major substitution of crop-based fuel for petroleum. In southern Brazil, some

land has been shifted from grain and oilseeds production to sugarcane. The projections assume this trend continues, but at a slower pace.

Brazil's biodiesel production is small relative to ethanol. However, biodiesel production is assumed to nearly double in the next few years. Much of the new capacity will be in the soybean production areas in the Central-West region of the country. The biodiesel produced in this interior region will substitute for regular diesel fuel that has to be trucked long distances from the coast to the interior. Sugarcane for ethanol and soybeans for biodiesel do not compete for cropland because they are generally planted in different areas of the country.

Canada:

Canada has mandated that biofuels make up 5 percent of all motor vehicle fuel by 2010. However, funding for initiatives to encourage biofuel production is limited. Some provinces have production goals and provide some production incentives. Ethanol production capacity is assumed to rise rapidly to about 211 million gallons by 2010 from 2.4 million in 2005. Feedstocks include corn for ethanol plants in Ontario and wheat for plants in the prairie provinces.

Biodiesel plants are being built in western Canada that will use rapeseed oil as a feedstock. In the projections, land is shifted to rapeseed from wheat, barley, and some reduction in summer fallow. In eastern Canada, at least one biodiesel plant is being expanded that uses soybean oil as a feedstock. Canadian biodiesel production is projected to rise from 13 million gallons in 2007 to 58 million gallons in 2010.

Argentina:

In Argentina, the production of biodiesel is assumed to nearly triple over the next several years. Argentina has a system of differential export taxes that has one rate for soybeans, a lower tax rate for soybean oil exports, and an even lower export tax rate for biofuels. The tax advantage for biodiesel provides an incentive for further investments in Argentina's already large crushing industry. Some of this new biodiesel is to be produced specifically for export. Argentina is projected to import some soybeans from other South American countries in order to keep its crushing facilities running at near full capacity.

Argentina is planning for a limited ethanol production capacity.

China:

In China, corn used to produce ethanol was projected to nearly triple during the projections, reaching about 354 million bushels (9 million tons) by 2016. However, because of China's food security policy, it was assumed that a subsidy for producing fuel ethanol from corn will be eliminated, and that China will attempt to focus on ethanol production using nongrain feedstocks such as sweet potatoes and cassava.

Implicit Impacts of Expanded Global Biofuels Production

Now let me turn to the second approach that we used to model the impact of biofuels in other countries. Many other countries do not have mandates or targets for biofuel production. However, their production and use of agricultural products that can be used for feedstocks are affected by the impact of higher world prices that ripple through their borders to affect

producer and consumer prices. The impact in a particular country depends on how open that country's border is, and how responsive their producers and consumers are to price changes.

Other Europe and the former Soviet Union:

For the former Soviet Union and Eastern Europe, we made no explicit assumptions about increases in biofuels production. However, the projections reflect an increase in rapeseed production in Ukraine, Russia, Romania, & Bulgaria that is generated by higher rapeseed prices. Much of the production gains in this part of the world are destined for EU markets, either has rapeseed, as rapeseed oil, or as biodiesel.

Southeast Asia (Malaysia & Indonesia):

Looking at Southeast Asia, again we made no assumptions about increased production of palm oil or its use for biodiesel. However, higher world prices for palm oil stimulate expansion of the area planted to palm oil. Malaysia expects to not only export more palm oil, but also to produce biodiesel for the export market. More of Southeast Asia's palm oil exports will be destined for biofuels use and less for food use.

Africa:

Some countries in Africa are reported to be making plans to produce biofuels. However, this will need considerable investment in manufacturing capacity and in the associated infrastructure. Certainly there is the agronomic potential to grow sugarcane, corn, and cassava for biofuels feedstocks. But, will social and political forces lead to policies to encourage biofuels production in a low-income, food-deficit region where food prices are a major concern? The USDA projections assume no significant use of agricultural commodities for biofuels production, beyond those embodied in rising trends in industrial use.

The Impact of Biofuels on Agricultural Markets

During the next 3-4 years, biofuels production is projected to expand rapidly in a number of countries. What will be the impacts of these increases in biofuel production?

First, the associated increase in the demand for feedstocks will raise the absolute level of agricultural prices, and will also change the relative price relationships among various agricultural commodities.

- Most fundamentally, prices rise for most crops. The price of corn rises the most because the demand for ethanol competes with the demand for corn used for feed, and the demand by foreign importers. Although the demand for corn used for ethanol production was the largest contributor to the increase in prices during the past year, some other factors also played a role.

  Prices for other crops also rise. Soybean prices rise because world prices for vegetable oils rise, and in the United States, some soybean acreage shifts to corn production. The prices of other grains, such as wheat, are buoyed by their feed value as a replacement for corn.

- Increased demand for ethanol feedstocks such as corn increases the price of corn relative to prices for other crops. In the USDA projections, the soybean-corn price ratio declines because the price of corn rises more than the price of soybeans.

- Prices for vegetable oils also rise in comparison to prices for oilseeds and protein meals because a greater share of the value of oilseeds is derived from the oil content relative to the protein content. In some of the world's growing areas, rapeseed—containing more than 40 percent oil—becomes more profitable than soybeans—which has only 18 percent oil.

- Another change in traditional price relationships is that the price of feedstuffs used as a source of energy (such as corn) rise relative to the price of protein feeds (such as soybean meal and distillers grains).

There are some other impacts of the expanding world biofuels production.

- The United States dominates world trade in corn. However, increasing use of corn for U.S. ethanol production and rising world prices limit U.S. export growth. During the next half decade, some countries respond to higher world prices by increasing corn production and exports—most notably Argentina, Brazil, Ukraine, Republic of South Africa, and some countries in Eastern Europe. And high prices also trigger adjustments in demand. Still, U.S. corn exports are projected to grow after the ramp up in domestic ethanol production slows in 2009. The U.S. share of world corn trade declines from the historical 60-70 % range to the 55-60 % range.

- In Brazil, soybean exports are projected to double, even though Brazil's domestic demand increases for soybean meal for feed, and for soybean oil for human consumption and biodiesel production. Brazil's growth rate for the area planted to soybeans is projected to average more than 4 percent a year in response to higher world prices. China is projected to be the major market for Brazil's increase in soybean exports.

- Supplying the projected growth in biofuel feedstocks will require a global increase in the area planted to crops. During the last 30 years, the growth rate for the world's total area planted to 10 major field crops has averaged less than 0.2 percent per year. (The crops include: wheat, rice, corn, barley, sorghum, other feed grains, soybean, rapeseed, sunflowers, and cotton). However, in the USDA projections, the projected total area harvested of these crops grows nearly 0.4% per year -- more than double the average rate of the last 30 years. Some of the increased area comes from Brazil where new lands are brought into crop production, and from Argentina where some pasture is converted to cropland. The former Soviet Union has land currently idled that was farmed in an earlier era that can be brought back into production. And, of course, existing land can be cropped more intensively. But the land-use implications of the projection scenario do raise the question: is the biofuel expansion a sustainable growth path?

- Another impact of the higher prices of food crops is that food aid shipments from donors to low-income, food-deficit countries may decline. If donor countries do not increase their budgets for food aid, then, when food prices rise, the fixed budget buys less food to donate.

- Another consequence of the growth in biofuels output is that consumers all over the world will spend more on food. For most consumers in high income countries, the impact will be small. But lower income consumers in low-income food deficit countries will have to budget significantly more for food – unless they are a farm family that produce more food than they consume.

Summary

I have presented a scenario about the future of biofuels in world agriculture. This scenario was based on what we knew and, more importantly, on assumptions about things we did not know last November. The basic story from this scenario can be summarized as follows:

Demand: Biofuels are a new source of demand for some agricultural products. Demand for feedstocks to produce biofuels will be strong.

Supply: The supply chain will need more resources (land, fertilizer, new seed varieties).

Trade: Some countries will increase production and exports of feedstocks, and of biofuels. (E.g., Ukraine, Russia, Romania, Bulgaria, Indonesia, Malaysia, Brazil, and Argentina.) Other countries will become importers of feedstocks, and/or of biofuels. (E.g., the EU, Japan, and South Korea.) It is unclear how much trade will occur in feedstocks versus trade in biofuels themselves.

Prices: Not only will the general level of crop prices rise, but the price relationships among crops change from traditional patterns. Although I have not talked about the impact on meats, the baseline scenario also projects higher prices for poultry and beef, and particularly for pork.

Uncertainties

There are also many uncertainties associated with the future of the biofuels industry and its impact world agriculture. I have appended a list of some of those uncertainties for us to think about.

- Energy prices (oil & natural gas): The most important is the future price of petroleum and natural gas.
- Responsiveness of the biofuels industry and agriculture sector to price changes: First, is the responsiveness of biofuels prices and production to the prices of petroleum. Second, is the responsiveness of feedstock prices and production to the price of ethanol and biodiesel. Third, what will be the impact of expanding biofuels production on farmers' costs of production, particularly with respect to increased fertilizer costs, costs and availability of water for irrigation, and costs of farm land. And how will available cropland by allocated to various crops given considerations of costs of production, cropping rotations, and maintenance of soil quality. Finally, what will be the response of consumers to biofuels prices and the vehicles that use them; and to the new meat-price relationships?

- Additional crop land: How much additional land can be brought into crop production -- on a sustainable basis? And, how much more intensively can existing cropland be used?

- Water availability: What will be the result of competition for water between the biofuels industry and agricultural sector, and the residential, commercial and industrial users of water?

- New technological developments in the biofuels industry: Innovations in the manufacture of biofuels and their coproducts are expected. New crop varieties will likely be developed that have higher genetic yield potential, and are also more suited to biofuels end uses. There may also be new coproducts developed which will affect the profitability of producing the biofuels themselves.

- Biofuels policies and funding: Biofuels have evolved from being a small, innovative industry taking advantage of legitimate economic and environmental opportunities, to a rapidly growing and technologically changing industry. A number of countries have mandated that biofuels account for a specific percentage of total fuel use. In some cases, the mandates appear to be unrealistic, or appear to lack the funding or commitment of governments or businesses necessary to achieve them. This creates a high degree of uncertainty, country-by-country, and globally.

For more information about the USDA projections, go to the following web site: http://www.ers.usda.gov/Briefing/Baseline/

The Economic Research Service also has a Bio-energy briefing room with additional information about biofuels. It is located at: http://www.ers.usda.gov/Briefing/Bioenergy/