Discussant comments on "Biofuels: The changing nature of agricultural demand"

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The range of issues covered in this seminar was considerable, and I commend Roz Naylor for covering the topics of food, environment, and energy in such a nuanced fashion. I also want to thank the organizers of this Stanford symposium for allowing me the opportunity to provide commentary and reflection on the very interesting and complex topic of biofuels and their impacts on agricultural markets, livelihoods, and the environment.

Price impacts and market interactions

My first point has to do with the linkages between biofuels and prices – both agricultural and non-agricultural – that came out strongly in Roz's talk. The debate over the influence of biofuels growth on prices in agricultural commodity and food markets has been active, and Roz's overview pointed to many of the arguments connecting biofuels to rising food prices. Earlier papers have tried to tease through the complex interactions between market price spikes and the numerous underlying drivers of change (von Braun 2008, Trostle 2008, OECD 2008); a more recent study by Headey and Fan (2010) tries to discuss the comparative strength of these market determinants on food prices in order to differentiate the trade policy-driven effects on rice prices from those on US-dominated maize markets. It is important, however, to distinguish between the causality of biofuels growth on prices versus the underlying policies that govern biofuels themselves. Whereas many authors would lay the blame of maize price spikes on specific policies such as the US ethanol tax credit and blending mandates, others (Babcock 2010) make a more nuanced analysis to isolate the effect of those tax credits versus other macro-economic drivers and influences that led to the rapid growth of maize-based ethanol in the US. Babcock's analysis shows that the rapid growth in US ethanol production in the 2005-2007 period had less to do with the tax credit and more to do with favorable oil and maize prices. These favorable prices allowed early entrants into the ethanol sector to realize sizable returns to investment and encouraged further investment and expansion of capacity. Although expansion of production capacity and actual ethanol production remains the dominant driver that pushed up the prices of maize in domestic and international markets, the underlying causality of biofuel policy is much weaker in Babcock's assessment.

In terms of the actual impact of biofuel-driven price increases on poverty levels and other measures of welfare, there are now improved assessments of the distributional impacts of the 2007-08 price spikes. For example, de Hoyos and Medvedev (2009) use household-level data from a wide selection of countries to infer the welfare impacts of price shocks (see also Ivanic and Martin (2008)). While a number of countries in South East Asia and Latin America show benefits accruing to households who were net sellers of the commodities undergoing price increases, they do simulate an increase in poverty in South Asia and sub-Saharan Africa. Their results also show overall lower levels of price

volatility within domestic markets compared to international prices. de Hoyos and Medvedev's conclusions emphasize the importance of price transmission between international and local markets in determining the degree of household impacts due to price changes. This point is worth bearing in mind when making arguments about welfare impacts in developing countries that come from demand side shocks in international markets. Within each region and country, there is also a great degree of heterogeneity across household types that will determine the ultimate distribution of these impacts. Although not yet published, results coming from the country-level analysis of China for the 'Biofuels and the Poor' project (Huang et al. 2011) show that many rural households benefit from the higher prices induced by biofuels growth due to the facts that most are net producers and everyone has access to land. The effects on livestock producers, by contrast, are negative due to the increase in feed prices; a similar effect experienced by US livestock producers.

I want to draw attention to two other aspects of Roz's price discussion. First, all price increases are not equal. In general, it is better to have steady and relatively slow-moving increases in prices rather than sudden and transient price spikes in the market. In the case of the former, farmers are better able to mobilize resources and capital, make adjustments to production practices, and even adjust crop area if price changes are sustained and gradual. In the case of sudden shocks, there is much less room for supply-side adjustment. Net consumers are especially vulnerable, since they are less able to adjust expenditure on quasi-fixed categories like housing and durables. Net consumers tend instead to make cuts to food intake or to pull children out of school, responses which have dynamic and long-lasting consequences, especially when the curtailment of schooling happens for girls (Holmes et al. 2008).

The second point is that, on a smaller scale, there are some food markets that can influence how energy markets adjust (e.g. Brazilian ethanol). Although I do agree with Roz's general point that the asymmetric impact of energy markets on agriculture can never be matched in the reverse, the dynamic and flexible nature of ethanol and sugar markets in Brazil allows producers to reduce production in one market in order to increase volume in another. The steady increase of sugar prices and export demand from Brazil has caused its domestic ethanol production to decrease. That, in turn, has necessitated US maize ethanol imports to satisfy ethanol demand of Brazil's expanding flex-fuel vehicle fleet. Higher ethanol prices in Brazil (due to decreased production) and relatively lower prices of US maize-based ethanol (due to increased production) make imports attractive; a situation likely to persist in the near-term (Babcock 2010). The impact of food (sugar) prices on energy (ethanol) market dynamics is strengthened by the capacity constraints that currently exist in the Brazilian sugar sector, preventing the rapid expansion of production to meet the demands of both markets. Flexibility in producing products for multiple markets from the same feedstock is not shared by all biofuel-producing countries, and is a unique feature of the long history of investment that has gone into developing the ethanol sector in Brazil.

Multiple uses of biofuel feedstocks and products

One of the major issues that I see as critical in the economic success of the biofuels sector is that of multiple uses for the biofuel feedstock, its final product, and its various by-products that are generated in production. It is this type of flexibility that has helped the growth and competitiveness of the Brazilian ethanol sector up to the present. When considering a feedstock like jatropha, this is where its problematic aspects come out. It does not have readily usable by-products and it produces a non-edible oil. If jatropha's cost-competiveness as a biofuel deteriorates under adverse changes in market conditions, producers cannot find alternative uses for the crop.

Taking Tanzania as an example of a country with considerable investor interest and biofuel feedstock production potential (FAO, 2010), the company 'EcoEnergy' (formerly operating under the name SEKAB) has taken a different approach to its ethanol production. It is wholly dedicated to the production of sugar for the food market, knowing that sugar demand is likely to continue growing within the region. By focusing on boosting productivity in sugar production, they are able to lower their costs and reliably supply a growing food market, yet they are still able to convert the molasses produced into ethanol for additional revenue. This approach – which can be characterized as 'food first' – seems to make sense for a country like Tanzania, and might be a good approach for others to follow, even using other crops. Oil crops like rapeseed or sunflower are possible examples where the growing domestic and global demand for food oils can be met with high-volume production, while still leaving the producers flexible to sell the oilseed itself for export and processing elsewhere. Alternatively, these oilseeds can be crushed for oil, thereby producing a useable by-product (oil cake) that can be marketed as livestock feed. For those African countries that are not well-suited to producing higher-yielding oil palm, these kind of oilseeds can be a viable alternative. The use of those oilseeds for biodiesel production would be secondary to their primary value in food production; however if market conditions were to change in a way that is favorable to blending, the producer would have several options.

The kind of production flexibility that is alluded to in these examples presupposes that there is a relatively high degree of vertical integration in the biofuels enterprise, a desirable characteristic of a viable biofuels sector (Hazell and Martin 2011). This ability to integrate vertically, along with the achievement of high levels of feedstock productivity, and the procurement of a stable source of market demand are key criteria for sectoral viability proposed by Hazell and Martin. Yet these criteria are the characteristics lacking in a number of countries that are currently pursuing biofuels programs (Mitchell 2010).

The problematic nature of jatropha

Roz discussed the use of jatropha as a biodiesel feedstock, and some of its attributes that have been attractive to its proponents and problematic to its critics. I would like to spend some time discussing jatropha, given the degree to which it has been promoted as a biodiesel feedstock in Africa as well as in Asia. As Roz rightly pointed out, jatropha can

survive under adverse conditions and on marginal lands, but these conditions also lead to marginal yields. Such yields are not suitable for a biofuel enterprise that is trying to achieve commercial scale. The current yields of jatropha under rainfed conditions are simply too low (no more than 3 mt/ha) to sustain the levels of jatropha-based biodiesel production that are predicted by its more enthusiastic proponents. There has been virtually no systematic effort at genetic improvements of jatropha, and most field trials have centered around trying to improve yields with different agronomic practices on the predominant *jatropha curcas* variety that has been promoted in Asia and Africa (Hazell and Evans 2011). Given the much greater genetic variety of jatropha that exists in Latin America, some experts foresee much greater improvement in crop traits if jatropha were to undergo an intensive investment program of crop improvement over the coming ten years (Hazell and Evans 2011).

In the absence of such an R&D effort, an unacceptable amount of risk is being transferred to smallholders when jatropha is promoted as a feedstock for large-scale commercial operations and smallholder outgrowing schemes. In addition to the lack of readily-usable by-products for feed (like other oil crops), the low-yielding nature of the crop (in the absence of additional inputs like water and fertilizer) and the absence of a well-defined and operating value chain make the prospects for success rather dim, at least on a commercial scale. Those who may choose to crush the pods for oil that can be used to replace kerosene or other substitutes for home heating or lighting might still do so. But this kind of small-scale application is quite different from the kind of large-scale operations that are being proposed in parts of Africa and Asia, regions already exposed to market volatility and adverse environments for agricultural productivity and growth.

The policy objectives of biofuel programs

Roz's talk alluded to the various motivations that have underlain the push to expand the biofuels sector within OECD as well as within less-developed countries. I believe the policy objectives are often contradictory and misconstrued by those proponents who have not fully thought through the implications that are embedded in each of the suggestions. In general, one can classify the objectives of different national biofuels programs as follows:

1. Aiming to produce as much biofuels as possible, using the most favorable and cost-effective feedstock possible. This (at the risk of slight over-simplification) is the essential objective of the US biofuels program. Maize is the most suitable feedstock for ethanol in the US, as it is grown in large quantities at high levels of productivity and far outcompetes alternatives like US-grown sugar (Shapouri et al. 2006). While the Renewable Fuels Standard (RFS) seeks to reduce greenhouse gas (GHG) emissions from maize ethanol with gradual increases in stringency, the design of the program is such that maize will remain the favored feedstock and will likely be used to produce ethanol far in excess of mandated levels, as long as favorably-high oil prices persist, which seems likely.

2. For countries like those within the EU, the principled objective of their biofuels program is to reduce the carbon intensity within the transportation sector by avoiding fossil fuel emissions and by replacing them with low-carbon biofuels. The Renewable Energy Directive (RED) of the EU has been the driving policy, and has been strengthened by a Fuel Quality Directive (FQD) that places strict standards on environmental sustainability and sets concrete goals for the reduction of carbon emissions in transport fuels. Within the US, the Low Carbon Fuel Standard (LCFS) does something similar, but is only operating within the state of California, and is currently under litigation because of the way its standards penalize 'high-carbon' biofuels coming from outside the state. Some scholars have promoted the idea of such a standard being used to replace or supplement the existing RFS within the US (Sperling and Yeh 2009). An ongoing project led by the Institute for Transportation Studies at UC Davis is looking into the policy implications and environmental consequences of scaling up the LCFS to the national level.

3. Many countries that are burdened with costly imports of fossil fuels are seeking to reduce these imports through producing biofuels nationally. This is not a primary motivation among richer, OECD countries.

4. The goal of increasing energy security (and 'independence'), on the other hand, is a stated policy goal of the US, as well as of other countries who would seek to import less fuel from countries they dislike even if it does not reduce the overall consumption of fuel or its carbon intensity.

Each of these goals – as stated – are quite different from each other, and cannot all be achieved simultaneously. The ultimate design of a national biofuels program should be based on a solid understanding of what the policy objectives are. If carbon reduction is paramount then importing 'sweeter' crude oil from less friendly countries should over-ride issues of energy independence and security. This focus might result in the importation of lower-carbon biofuels from other countries which is often at odds with the high tariffs that are put in place to protect infant or more mature biofuel sectors in some countries. The US does not seem clearly committed to carbon-reduction goals, at least on the national-level. The adoption of an LCFS-like policy is likely, therefore, to remain a state-level initiative; perhaps scaled up on a sub-regional level, as has been proposed in some of the Mid-Western (MGA 2010) or Northeastern States (NESCAUM 2011).

Closing thoughts

In closing, I would like to summarize some key dimensions of biofuels policy that I think are worth bearing in mind when considering the feasibility and desirability of scaling up biofuel consumption and production in regions like sub-Saharan Africa. My comments seem to complement well the conclusions that Roz also drew in the closing slides of her presentation.

Biofuels operations seem to work best when (1) they are supported by highly-productive feedstock supply, which helps lower costs and improve competitiveness; (2) they are able to offer multiple uses of their products and by-products; and (3) where they can create more advantageous economies through vertical integration within the sector. Where these conditions cannot be met, then serious thought should be given to the re-design of the sector and of national policy.

The map of Energy Poverty shown by Roz illustrated that the energy problems of Africa go well beyond transportation fuels. There is a heavy reliance on biomass for household energy that is strongly correlated with poverty (Ewing and Msangi 2009), and which has important gender implications. The latter is especially important in terms of what it represents for the time spent by women and girls in gathering firewood (Rossi and Lambrou 2008). In meeting these needs, it might make more sense for some countries to focus on options outside of biofuels for transportation, and perhaps on the basis of regional cooperation, especially when there are resources, such as rivers, that can be exploited for hydropower-based electricity.

The main benefits for biofuels investments to the developing economies of sub-Saharan Africa may be in terms of the region's need for investments into the agricultural and agri-business sectors. If so, the focus should remain on how to enable these investment flows without incurring the potential downside risks of badly conceived biofuel programs. If there are well-conceived agribusiness projects that provide investments in flagging sectors of Africa's food economy, and which can mobilize labor, capital and investments in needed marketing and distribution infrastructure, then it would seem worthy that they be explored. For example, there is likely to be sustained and increasing demand for beverage alcohols throughout Africa, which provides opportunities for those farmers growing grains like sorghum, millet, barley, or starch-rich crops like cassava or sugarcane. Whether or not the ethanol that is produced from the fermentation process goes towards blending with transport fuels, the connecting of farmers to well-functioning supply chains and stable markets for goods means that there are opportunities for increased on-farm income and employment.

It may be the case that the last thing Africa needs, from a nutrition-perspective, is more alcohol/ethanol. But many Africans are certainly dying for (or dying from the lack of) agribusiness opportunities.

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