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GLOBAL DEVELOPMENT AND ENVIRONMENT INSTITUTE

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The Cost to Mexico of U.S. Corn Ethanol Expansion

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Abstract:

More than 40% of U.S. corn is now consumed in the production of ethanol. With the United States by far the world's largest producer and exporter of corn, this represents an estimated 15% of global corn production. A recent survey by the National Academy of Sciences estimated that globally biofuels expansion accounted for 20-40% of the price increases seen in 2007-8, when prices of many food crops doubled. This had a dramatic impact on poor consumers and on net-food-importing developing countries. Expanding U.S. production and consumption of corn-based ethanol, which has been encouraged by a range of U.S. government subsidies and incentives, is considered one of the most important biofuel programs in putting upward pressure on food prices. Mexico now imports about one-third of its corn from the United States. Using conservative estimates from a study on U.S. ethanol expansion and corn prices, we estimate the direct impacts of U.S. ethanol expansion on Mexican corn import costs. We find that from 2006-2011, U.S. ethanol expansion cost Mexico about $1.5 billion due to ethanol-related corn price increases. Other methodologies suggest the costs could be more than twice as high, surpassing $3 billion over the period.

The Cost to Mexico of U.S. Corn Ethanol Expansion

Timothy A. Wise[1]

Introduction

More than 40% of U.S. corn is now consumed in the production of ethanol. With the United States by far the world's largest producer and exporter, this represents an estimated 15% of global corn production. The growth in U.S. ethanol production has been dramatic and quite recent, stimulated by high oil prices, government subsidies and tariff protection, and a mandate for increasing biofuel use that has nearly 10% of U.S. gasoline sales accounted for by ethanol.

Biofuels expansion in general, and U.S. corn ethanol expansion in particular, are widely seen as among the major contributors to the recent surge in food prices. By 2010, biofuels were consuming 6% of global grain consumption, up from negligible amounts just a decade earlier. While debate continues over the extent of the biofuel impact on food prices, there is broad consensus that the expansion, with its direct consumption of food and feedstocks such as corn and its competition with food and feed crops for land, has been one of the important contributors to global food price increases. These, in turn, have had a direct impact on the food-import bills of developing countries, many of which have become heavily dependent on outside sources of basic food commodities in the last 25 years. At the individual level, of course, higher international prices for agricultural commodities have contributed dramatically to hunger and caused food riots in many countries.

What is the cost of U.S. ethanol expansion to import-dependent developing countries? In this paper, we take Mexico as an illustrative example. Mexico's import dependence in corn has grown from around 7% in the years before the North American Free Trade Agreement (NAFTA) liberalized corn trade to about 34% now. The combination of rising import volumes and higher prices has caused Mexico's annual corn import bill to climb from less than $200 million before NAFTA to 2.6 billion in 2011.

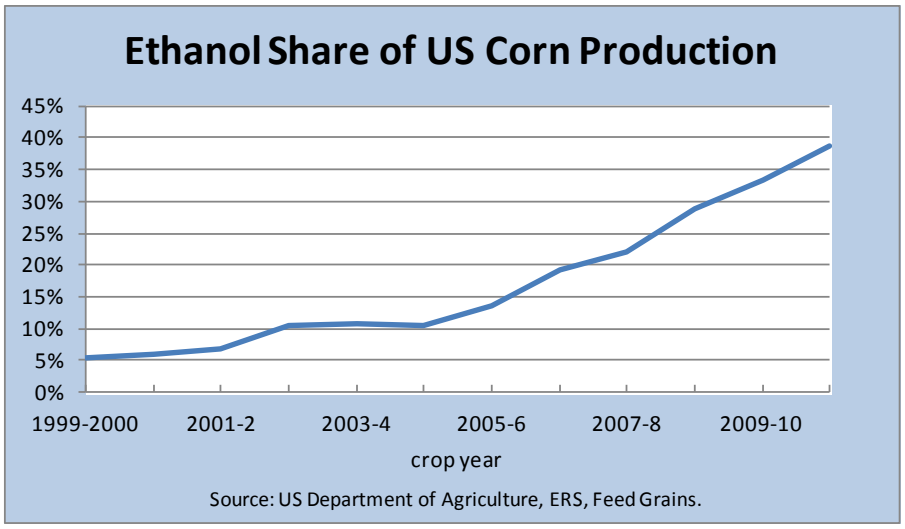
A recent survey by the National Academy of Sciences estimated that globally biofuels expansion accounted for 20-40% of the price increases seen in 2007, when prices began to rise sharply. Using conservative estimates from a study on ethanol and corn prices, we estimate the direct impacts of U.S. ethanol expansion on Mexican corn import costs. We find that from 2006-2011, U.S. ethanol expansion cost Mexico about $1.5 billion in higher corn prices. Other methodologies suggest the costs could be more than twice as high, surpassing $3 billion.

[1] The author would like to thank research assistants Kate McMahon and Elise Garvey for their invaluable assistance in preparing this paper.

Background

Since 2000, the United States has seen increasingly rapid growth in the amount and shares of corn used to produce ethanol. At 13.7 billion gallons, U.S. ethanol production today is nearly nine times what it was in 2000, while the share of U.S. corn going to ethanol has risen from 5% to 40% in the last twelve years (see Figure 1).

Figure 1.



Ethanol expansion has been encouraged by several government policies: a tax credit, a protective tariff, and a consumption mandate. The tariff protected the domestic ethanol industry from foreign competition by imposing a $0.54 tax on imported ethanol from non-NAFTA countries, such as sugarcane ethanol from Brazil. Additionally, ethanol benefited from a sizable tax credit, which existed in some form for more than 30 years, and afforded blenders of ethanol a $0.45 tax credit. In 2011, this credit was estimated at $6 billion. On top of this, the industry is supported with the Renewable Fuel Standard (RFS), which developed originally in 2005 and was expanded six-fold in 2007. The 2007 RFS mandates the consumption of an increasing amount of biofuel each year, culminating in 2022 with a 36 billion gallon mandate, at least 15 billion gallons of which can be produced from cornstarch. The remaining gallons are supposed to be filled with so-called “advanced” biofuels, including 16 billion gallons of cellulosic biofuels, but as that industry continues to be slow to develop it seems unlikely the United States will be able to fill that mandate by 2022. Another important policy related to ethanol in the US is “the blend wall,” or how much ethanol can legally be blended into a gallon of gasoline. While at present, the limit is 10% (known as E-10), EPA has approved a petition to increase this limit to 15% (E-15) and has begun to register producers, making it possible that E15 could be on the market in some places by the summer of 2012. Because E-15 is not compatible with certain engines, it remains unclear how much this will boost ethanol demand. Other more minor forms of support – through loan guarantees, grants and other more minor tax credits – also continue to subsidize the industry.

While the U.S. Congress declined to extend the tax credit and tariff at the end of 2011, the RFS and blending mandate remain, keeping a floor beneath ethanol demand. Corn ethanol expansion could slow in coming years. But most agree that while government policies were key to the rapid expansion of corn ethanol in the United States, high oil prices now make ethanol a competitive substitute for gasoline. The RFS may well stimulate continued corn ethanol expansion, as would moves toward a 15% blending wall.

In the last six years, the growth of corn ethanol has been dramatic, partly in response to the 2007 RFS. This rapid expansion coincided with the global food price crisis, which drove agricultural commodity prices to record highs in 2007-8. The price spikes sparked food riots and political instability in much of the developing world. Prices spiked again in 2010-11. While most agricultural commodity prices have come down from those peaks, corn prices remain stubbornly high (see Figure 2).

Figure 2.

There is widespread agreement that biofuels expansion worldwide was a major contributor to the increases in agricultural commodity prices, through the direct diversion of food and feed crops to fuel uses and through the competition for land to grow energy-related crops. There is less agreement on what share of the food price increases should be attributed to biofuels expansion. Other significant factors include: rising oil prices; financial speculation (widely cited as contributing to the two price spikes); expanding demand for meat-based diets (and the feed grains to support them) in large developing countries such as China; crop losses due to extreme weather events, possibly related to changing climate patterns; low levels of inventories of key food crops, and very low publicly held reserves; border measures during the crisis that exacerbated price increases; trade policies that had, over time, weakened developing countries' food-production capacity; a long-run slowdown in yield increases for key food crops, in part due to

reductions in agricultural research and development; and the depreciation of the dollar (Wise and Murphy 2012).

Many researchers have attempted to estimate the impact of biofuels expansion on recent increases in food prices, and some have looked specifically at U.S. expansion of corn-based ethanol. A recent report published by the National Academy of Sciences synthesizes the conclusions of eleven studies that examined the 2007 food price spikes, finding a range of 20-40% percent increase in commodity prices as attributable to biofuels expansion internationally (National Research Council 2011). This seems a good characterization of the literature, including studies that incorporate data from more recent years.

Studies of U.S. biofuels expansion have more often focused on assessing the price impacts of biofuels policies rather than simply their expansion. Abbott, Hurt et al. in 2008 estimated that such policies were responsible for about one-quarter of the increase in global corn prices, the remainder attributable mainly to higher oil prices (Abbott, Hurt et al. 2008). Their follow up study from 2011 suggested that two major drivers of food prices in the 2010-11 spike were U.S. biofuels (overwhelmingly corn ethanol) and rising Chinese soybean demand (Abbott, Hurt et al. 2011).

A 2009 study used an IFPRI model to estimate the biofuel contribution to 2006-8 food price increases, concluding that worldwide biofuel production had pushed up corn prices by 27 percentage points and that U.S. biofuels production increased corn prices by more than 22 percentage points (Baier, Clements et al. 2009). In terms of global food prices, they found that just over 12% of the rise in the IMF's food price index could be attributed to biofuels, but that 60% of that contribution came from U.S. biofuels production (Baier, Clements et al. 2009).

Hochman, et. al. found that if corn ethanol were not produced, the price of corn would have been 7.26% lower in 2005 and 12.18% lower in 2007. They point out, however, that supply and demand elasticities could be much lower, in which case the contribution of ethanol use in those years could be as high as 25-30% (Hochman, Rajagopal et al. 2010). Those estimates and lower elasticities are consistent with Roberts and Schlenker, who calculated that the U.S. biofuel mandate caused a 30% increase in the price of agricultural commodities in 2008. They estimated that the mandate resulted in the removal of five percent of the world's caloric production and this reduction in supply was a major contributor to food price increases (Roberts and Schlenker 2010).

With biofuels projected to continue expanding globally, there is concern that such price impacts will persist into the future. In 2008, the Organization for Economic Cooperation and Development (OECD) estimated that if biofuel production remained at 2007 levels, rather than doubling over the next decade as projected, prices for coarse grains (primarily corn) would be 12% lower in 2017 (OECD 2008). More recently, the International Food Policy and Research Institution (IFPRI) used a multi-country, multi-sector computable general equilibrium model to estimate that global biofuels expansion would boost the export price of corn by 17.7% in 2020 (IFPRI 2012).

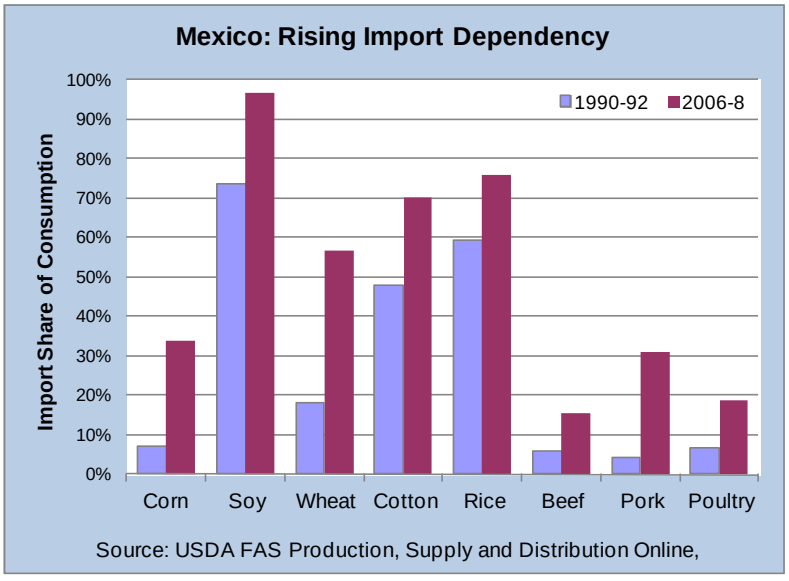
Here we rely on estimates from Bruce Babcock, from a 2011 study that modeled both the impacts of U.S. biofuels policies on corn prices from 2005-6 to 2009-10 and the separate impact of ethanol expansion since 2004 (regardless the cause). We describe his findings in more detail in a later section (Babcock 2011).

Mexico: The rising cost of import-dependence

Mexico serves as a useful case study of the costs of rising import dependence in today's high-priced food environment. Because one of Mexico's most important food imports is corn, Mexico also offers an opportunity to examine the ways in which U.S. ethanol expansion contributes to higher food imports. Mexico now imports more than one-third of its corn, overwhelmingly from the United States under the terms of trade liberalization negotiated as part of the North American Free Trade Agreement (NAFTA). Since 1994, when the agreement took effect and trade protections began to be removed, corn, other basic grains, and meats have flowed south from the United States. Meanwhile, Mexico has expanded its exports of fruits and vegetables to its northern neighbor. With the implementation of NAFTA and other complementary economic reforms, Mexico's dependence on corn imports has grown from 7% in the early 1990s to 34% in recent years (Wise 2010).

Corn is not the only agricultural product that has seen significant increases in import dependence. Import dependence in five key crops and three meats grew dramatically with the implementation of NAFTA (see Figure 3).

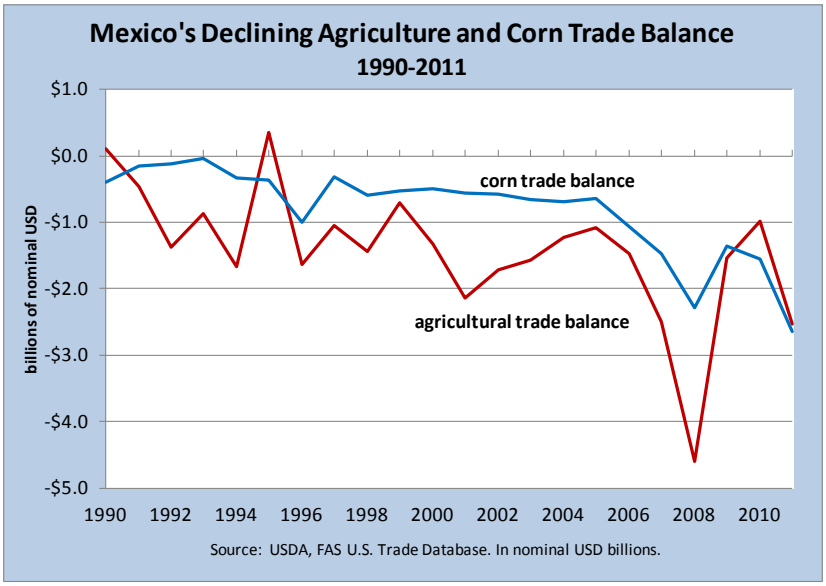
Figure 3.



When NAFTA was negotiated, corn and most other agricultural commodities were relatively cheap. In fact, agricultural commodity prices generally were mired in a decades-long slump, which ended only recently with rising prices in the mid-2000s and

then sharp spikes in 2006-7 and 2010-11. Before then, importing corn was a relatively inexpensive policy option. Rising prices changed all that. Mexico's food import bill just from the United States was $2.6 billion in 1990, grew to $6.4 billion in 2000, and by 2011 had jumped to a record $18.4 billion. Even with the rapid increases in Mexico's agricultural exports to the United States, the country's agricultural trade balance worsened, going from a small surplus in 1990 to a deficit of $1.3 billion in 2000, to a disastrous $4.6 billion in the price-spike year of 2008, and remained high at $2.5 billion in 2011. The costs of corn imports account for a rising share of Mexico's agricultural trade deficit, reaching $2.6 billion in 2011. In the last two years, Mexico's corn import costs accounted for the entire agricultural trade deficit. (See Figure 4.) Under NAFTA, the volume of imports had increased dramatically, and now so had the unit price.

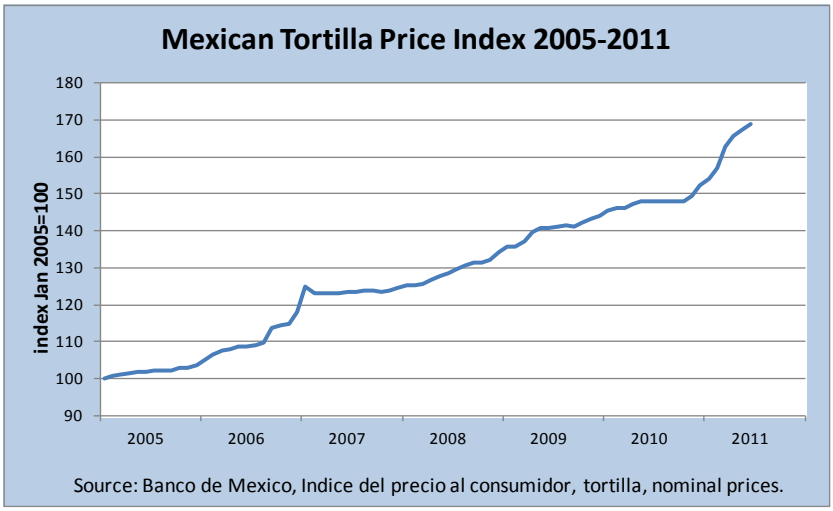
Figure 4.



The first price spikes hit Mexicans hard, in part because corn tortillas remain the most important staple in the Mexican diet, particularly for the poor. Though tortillas are made mostly from Mexican-grown white corn and imports are overwhelmingly yellow corn for animal feed and processed foods, rising international prices transmit to the Mexican corn market because white and yellow corn can be substituted in some uses. When imported yellow corn becomes expensive, for example, livestock producers will feed domestically grown white corn to their animals. While there is usually a small price premium for white corn in the Mexican market, prices tend to move in tandem.

In early 2007, tortilla prices spiked during a wave of panic buying, producing widespread protests in Mexico. These led to government-imposed price controls, which were only partially effective. In nominal terms, the price of tortillas rose 69% from 2005-2011 (See Figure 5.)

Figure 5.



Estimating the Impact of U.S. Ethanol Expansion

What share of Mexico's rising corn-import bill is the result of U.S. ethanol expansion? As noted earlier, estimates of biofuels' contribution to recent price increases vary considerably. In general, they fall in a range of 20-40%, as the National Academy of Sciences concluded in its survey. The literature suggests that U.S. ethanol is probably the most significant contributor among global biofuels. But in recent years when U.S. ethanol production expanded significantly (2005-11), there were also many other factors contributing to increases in agricultural commodity prices and corn prices.

To estimate the U.S. ethanol impacts on corn prices, and their subsequent impacts on Mexico's corn import bill, we rely on recent results from Babcock's "backcasting" model. Babcock's partial-equilibrium modeling has the advantages that it covers multiple years (through crop-year 2009-10), it examines U.S. corn ethanol, and it estimates price impacts not just of U.S. ethanol policies but separately the impacts of U.S. ethanol expansion since 2004. Specifically, it poses the modeling question: what would corn prices have been if corn use for ethanol had not expanded beyond its 2004 levels? (Babcock 2011)

As Table 1 shows, Babcock estimates that U.S. corn prices would have been lower if ethanol had not expanded, with the price impacts growing from 2.5% in 2005-6 to 20.9% by 2009-10. The two biggest jumps were in 2006-7 and 2008-9. These percentages are generally consistent with the rising share of U.S. corn going to ethanol. We use Babcock's estimates to extrapolate an additional year based on the assumption that the price impact varies in proportion to the share of corn going to ethanol. Our price

estimate for 2010-11 is conservative because the share of corn to ethanol grew slightly in 2010-11, but we keep the price impact the same at 21%.[2]

Table 1.

Costs of U.S. Ethanol Expansion in Mexican Corn Imports, 2005-11

	2005-6	2006-7	2007-8	2008-9	2009-10	2010-11	Total
	(1)	(2)	(3)	(4)	(5)	(6)	
Average price ($/bushel)	2.00	3.04	4.20	4.06	3.60	5.18	
Price w/o ethanol expansion ($/bushel)	1.95	2.64	3.76	3.30	2.84	4.10	
Difference (percent)	-2.5	-13.3	-10.6	-18.7	-20.9	-20.9	
Difference ($/bushel)	0.05	0.40	0.44	0.76	0.76	1.08	
Difference ($/metric ton)	2.0	15.7	17.3	29.9	29.9	42.6	
Mexico: net corn imports (1000 mt)	11,664	12,267	8,215	7,836	8,314	9,907	58,203
Cost of US ethanol expansion ($ millions)	23	193	142	234	249	422	1,264

Sources: Prices from Babcock, "The Impact of U.S. Biofuels Policies on Agricultural Price Levels and Volatility," ICTSD, 2011 (column 6 extrapolated from Babcock); Mexico net imports: FAS.

We then calculate how much lower the average price would have been for each crop year if ethanol expansion had stopped at 2004 levels. We multiply these savings per metric ton by the volume of Mexico's imports for each year.[3] As noted earlier, during this period prices were rising and Mexico's corn imports were high, in part due to the full implementation of NAFTA at the beginning of 2008.[4]

The results show that U.S. ethanol expansion since 2004 cost Mexico about $1.3 billion in higher import bills. If we include preliminary estimates for the first six months of crop-year 2011-12 (September 2011-February 2012), assuming the same ethanol price impact (21%) as in the previous two years, we would add another $254 million to this figure, as corn prices remained high and Mexico's import needs were large due to crop failures in parts of the country. This would bring the total to more than $1.5 billion.

Our estimate is likely to understate the cost, for a variety of reasons. First, Babcock's estimates of price impacts are on the low end of the 20-40% range suggested in the literature. And his estimates rise to the level of 21% only in 2009-10, while many

[2] Our total estimates are particularly sensitive to modeling assumptions for this year, because Mexico's food imports were especially high and so were corn prices.

[3] Here we use net imports by Mexico, adjusting calendar-year data to crop-years (September-August) where necessary using the simplifying assumption that quarterly volumes are roughly equal. Thus our import estimate is an approximation.

[4] Note that our import figures differ from many official sources because we include Mexico's large importation of cracked corn from the United States, a commodity that is not included in most data sources for corn. U.S. cracked corn exports increased dramatically in the six years preceding NAFTA's full implementation because it is a viable substitute for yellow corn in animal feed and it allowed traders to evade NAFTA's tariff-rate quota system designed to limit corn imports from the United States. In those six years, cracked corn accounted for as much as one-quarter to one-third of U.S. exports to Mexico, peaking at 2.8 million metric tons in 2005-6. In 2008-9 cracked corn imports drop to insignificant levels again, substituted by yellow corn with NAFTA fully implemented.

researchers estimate 20-40% impacts starting as early as 2007-8 (see, for example, National Research Council 2011). Because most of these estimates are for biofuels' contribution to food prices generally, one would expect estimates of the expansion of corn ethanol on corn prices to be among the larger of biofuel impacts.

Second, these estimates do not take full account of the extent to which U.S. ethanol expansion contributed to price spikes, including from financial speculation, made possible by declining inventories. Corn inventories, in particular, were hard hit by the rapid rise in corn use for ethanol.

Third, McPhail and Babcock (2012) have estimated elsewhere that U.S. biofuels policies make corn markets more susceptible to price volatility by reducing the price elasticity of demand for corn and gasoline. Thus, ethanol expansion has an additional indirect effect on prices not captured in our estimates, making corn prices more volatile in the presence of other supply or demand shocks.

In fact, complex systems scientists from the New England Complex Systems Institute have recently employed a very different methodology to estimate the impacts of both ethanol expansion and financial speculation on corn prices. Drawing on a previously published model that quantifies the contribution of those two factors to overall food price movement in the last six years (Lagi, Bar-Yam et al. 2011), researchers scaled the model to corn price movements and the impact on importing countries' costs. For Mexico they estimate that from 2003-4 to 2010-11 U.S. ethanol expansion cost Mexico about $3.2 billion, while financial speculation added another $1.4 billion to the country's seven-year corn import bill. They estimate that U.S. ethanol expansion raised prices and import costs 27% for the entire period, consistent with the range of estimates in the literature. Financial speculation added another 13%, with the largest share coming in 2007-8 when, according to their modeling, financial speculation alone increased prices and import costs by 80% (Lagi, Gard-Murray et al. 2012).

Conclusion

There is widespread agreement that biofuels expansion, with its direct diversion of food and feed crops and its indirect impact through competition for land and other food-producing resources, has been an important contributor to the rise in food prices over the last six years. Most researchers agree that the expansion of U.S. corn ethanol has had particularly strong impacts. This has a deleterious impact on import-dependent developing countries. Here we have looked at one import-dependent country and one crop to gauge the extent of those impacts.

By any standard, $1.5-3.2 billion in added corn import costs for a country such as Mexico is significant. It has negative impacts on consumers, particularly food-insecure consumers who are not farming and so do not see any gain from higher corn prices. Corn accounts for roughly 60% of the final cost of tortillas, Mexico's staple, so a 20% increase in corn prices from ethanol, transmitted to the Mexican market for white corn, raises tortilla costs by 14%, contributing to food insecurity. As noted earlier, tortilla prices are

up 69% since 2005. Higher corn prices also contribute to rising meat and dairy prices, which have increased 35% in Mexico since 2005.[5]

For import-dependent countries that no longer grow much of their own food, biofuel-induced price increases are simply a large net loss to society, straining government trade balances, using scarce hard currency, raising food prices for consumers, and driving up the cost of government safety net programs. Mexico still grows a great deal of corn, and many Mexican corn farmers see gains from higher prices and from ethanol's contribution to those prices. For farmers, this is a welcome change from earlier low price levels. Elsewhere I have estimated that from 1997-2005, when corn prices were generally low and when the United States exported corn on average at 19% below its costs of production, those below-cost prices cost Mexican producers $6.5 billion (Wise 2010).

The policy goal, of course, should be neither unaffordably high nor punishingly low prices, but rather relatively stable prices that are remunerative for farmers and still affordable for consumers. U.S. ethanol expansion has not contributed to achieving that goal, fueling significant increases in prices and contributing to greater price volatility.

The G-20 countries have largely ignored the international consensus that biofuels policies are contributing to global hunger. The G-20 agricultural ministers in June 2011 took no action on the issue, ignoring the advice of their own commissioned expert report. Their "action plan" said only, "We recognize the need to further analyze" the issue (G20 Agriculture Ministers 2011, page 10). G-20 heads of state followed suit.

The Mexican government, as the current chair of the G-20, has thus far accepted this constrained policy agenda in the lead-up to the June 2012 G-20 summit in Mexico, leaving biofuels policies out of the discussion. As this study shows, such policies are costing Mexico dearly. Mexico should use its position as chair to put biofuels back on the table.

[5] Source: Banco de Mexico, Indice del precio al consumidor.

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