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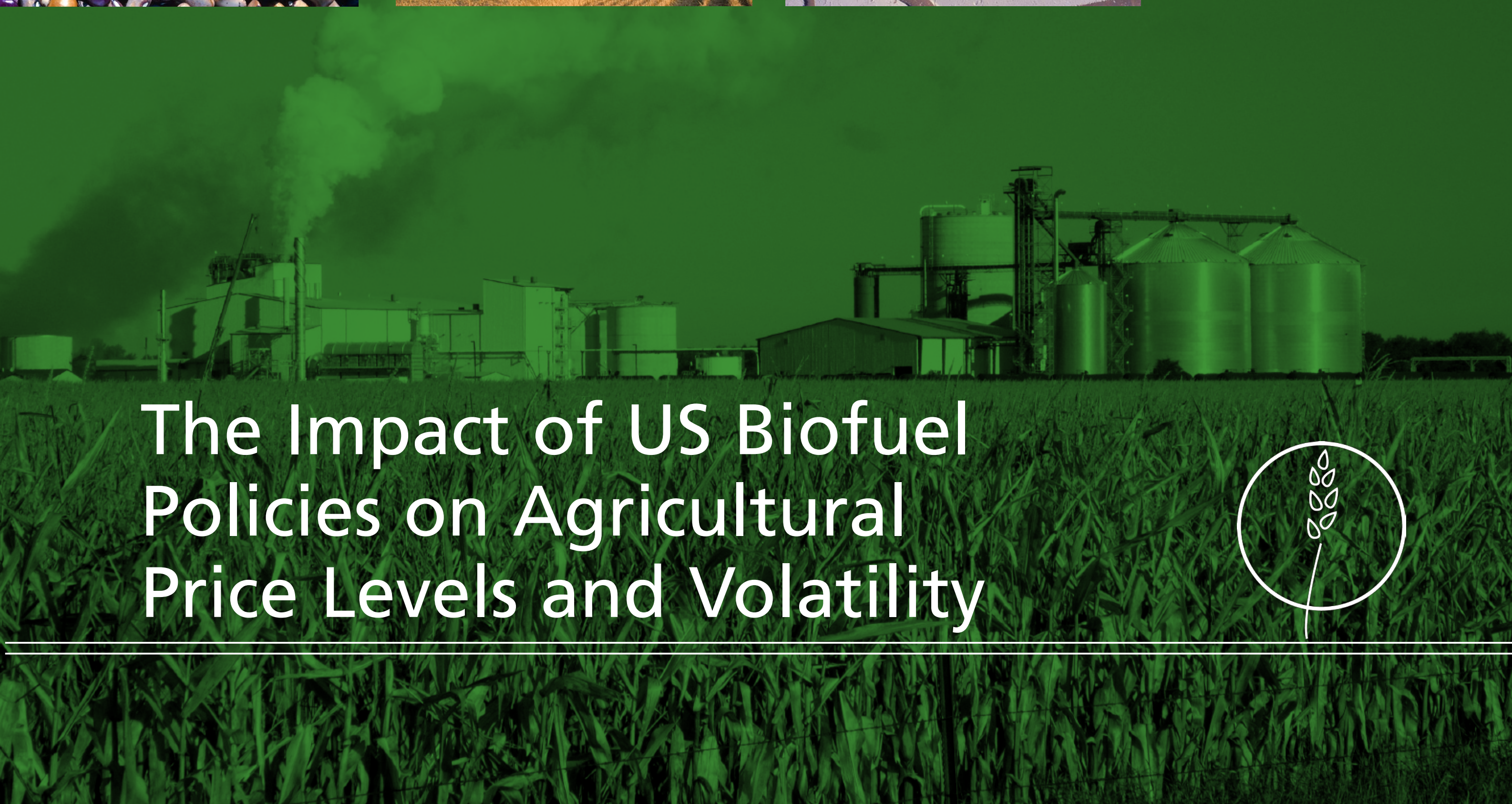

The Impact of US Biofuel Policies on Agricultural Price Levels and Volatility

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EXECUTIVE SUMMARY

The fact that the world has had two agricultural commodity price spikes in the last three years has heightened the importance of knowing the extent to which biofuels and biofuel policies are contributing factors. It is indisputable that biofuels contribute to higher agricultural commodity prices because the biofuel industry represents a large and growing share of demand for maize, vegetable oil and sugarcane. But biofuel production levels are not driven solely by government subsidies. Biofuels are the only large-scale substitute for liquid transportation fuels, so when crude oil prices rise, so too does the demand for biofuels. Furthermore, high agricultural commodity prices are not caused solely by expanded biofuel demand. Strong food demand growth and weather-related supply problems have also contributed to high prices.Knowledge of how and to what extent biofuel policies impact prices of raw agricultural commodities and consumer food prices is needed before decisions about reform of such policies can be made.

This report makes three contributions to understanding the extent to which US biofuel policies contribute to higher agricultural and food prices. First, estimates of the impact of US ethanol policies on crop and food prices are made for the 2005 through 2009 US crop marketing years. These estimates are made by "backcasting" what prices would have been had the subsidies not existed over this period. A comparison of the new equilibrium prices and quantities with what actually occurred reveals that the impacts of these subsidies were quite modest. The largest impact of subsidies occurred in the 2007 marketing year when maize prices would have been $0.30 per bushel (7.1 percent) lower than they actually were. This is a modest impact because the average maize price in 2007 was more than $2.00 per bushel higher than the average price in 2004 or 2005. This implies that ethanol subsidies have not been the major driver of higher commodity prices. The effects of US ethanol subsidies on the prices of wheat, rice and soybeans were even smaller, with a 2.8 percent price impact on soybeans in 2008 being the largest impact on these other crops. The impact of US ethanol policies through higher feed costs on consumer prices of eggs, beef, pork and broilers was even smaller. The largest impact on any of these products was a two-cent-per-dozen (1.1 percent) increase in egg prices. All other product prices were impacted by much less than 1 percent. These results indicate that US ethanol subsidies during this period had little impact on consumer prices and quite modest impacts on crop prices. However, these results do not imply that market-driven expansion of ethanol did not have an impact on agricultural or food prices.

The second contribution is to provide estimatesof the impact on agricultural commodity prices and food prices from market-driven expansion of ethanol. This was accomplished by backcasting what prices would have been had ethanol production been frozen at 2004 levels. The difference between the resulting market-clearing prices and the prices under the no-subsidy scenario provides an estimate of the impact from market-driven ethanol expansion. The price effects of market-driven expansion of ethanol are much larger than the price effects of ethanol subsidies. If US ethanol production had somehow not been allowed to expand beyond 2004 levels, then maize prices in 2009 would have been about 21 percent lower than they actually were. Wheat and soybean prices in 2009 would have been about 9 and 5 percent lower, respectively.

These results show that ethanol expansion had a significant impact on price levels. But even if ethanol had not expanded, crop prices would not have stayed low during this time period. Maize prices in 2009 would have been 40 percent higher than they were in 2004; wheat prices would have been 45 percent higher; and soybean prices would still have been 57 percent higher than they were in 2004. Also, because feed costs make up a relatively small share of retail prices, the impact of lower crop prices from a lack of ethanol expansion on retail prices would have been modest. The largest impact on the food prices studied here would have been on eggs in 2009. Retail eggs prices would have been eight cents per dozen (about 5 percent) lower if ethanol had not been allowed to expand. The largest impacts on broilers would also have been in 2009 when retail prices would have been three cents per pound (1.6 percent) lower than what they were.

Together these two sets of results indicate that there is truth to the widely held idea that ethanol has contributed significantly to higher crop prices and modestly higher food prices. But this does not imply that ethanol subsidies had the same effect. Higher crude oil prices would have increased the demand for biofuels and would have created strong market-driven investment incentives that would have resulted in a large expansion of the US ethanol industry even without the subsidies. The investment incentives were only modestly higher with subsidies.

The final contribution of this reportis improved insight into how current US biofuel policies are expected to affect crop prices in the near future. This insight is obtained by running a new model of the maize, soybean and biofuel sectors. The model finds current-year and one-year-ahead market-clearing prices and quantities of US and Brazilian ethanol, US biodiesel, world maize, soybeans, soybean oil and soybean meal prices. The model is run many times under a wide range of US yields and gasoline prices that capture estimated distributions of these random variables.

US biodiesel production from soybean oil occurs under current market conditions only because US consumption of biodiesel is mandated. The cost of producing biodiesel from soybean oil would otherwise be prohibitive. Soybean oil prices would fall by an average (across all yields and gasoline prices) of about nine cents per pound (16 percent) if the mandate and tax credit were eliminated. But soybean prices would drop by an average of only 3.2 percent because higher soybean meal prices would offset much of the effects of lower soybean oil prices on soybean crushing margins.

Because of strong domestic demand growth due to expansion of its flex-fuel vehicle fleet and no growth in sugarcane supply, Brazilian ethanol prices are currently much higher than US ethanol prices. This price difference means that removal of the US import tariff on ethanol would have no impact on model-estimated trade flows because the United States does not import Brazilian ethanol under any of the model runs. Under current policies, the US exports ethanol to Brazil. These exports would be even higher if US ethanol subsidies were eliminated because the difference between Brazilian and US domestic prices would be even greater.

Maize prices in the 2011 calendar year would be about 17 percent lower than they are expected to be under current policies if ethanol subsidies had been eliminated before the beginning of the year. One explanation for why the impacts of US subsidies is so much larger than that estimated by the backcasting exercise is the tight market conditions that currently exist. When gasoline prices are high, as they currently are, demand for ethanol is high, which creates a tight market condition for maize. Under these tight conditions, the added demand incentive from the blender tax credit can have a significant impact on maize prices. Similarly, the model results show that if market conditions are tight because of poor maize yields, then the mandate will have a larger-than-average impact on market prices because it forces all the adjustment to tight supplies onto the livestock sector.

These results indicate the need for more flexible US biofuel policy. There is no rationale for the blender tax credit. It does little to help the biofuel industry as long as mandates are in place except in years when high gasoline prices have already stimulated demand beyond mandated levels. In this situation, the extra demand stimulus does help biofuel manufacturers but at great cost to the livestock sector because it pushes world maize prices even higher than either energy prices or mandates would support. Doing away with the blender tax credit would avoid pushing crop prices even higher during high demand periods. Elimination of the blender tax credit would also eliminate any justification for maintenance of the US ethanol import tariff. Elimination of both would lead to a more flexible US ethanol policy that would reduce the impact of biofuels on price levels and price volatility.

Additional flexibility in US policy could be introduced by relaxing blending mandates when feedstock supplies are low. It makes no sense to force all adjustment to low feedstock supplies on the livestock sector when consumers have gasoline as a ready substitute for lower biofuel supplies. One option to increase flexibility in US mandates is to increase the limits by which fuel blenders can bank or borrow blending credits when meeting their blending obligations. Currently, blenders can meet up to 20 percent of their current year's blending obligations from "banked" credits that were generated in previous years by blending in excess of their obligated amounts. Increasing this limit would increase flexibility in the mandates. In addition, blenders can borrow blending credits from their future obligation as long as they pay back this borrowing and meet the future obligation the following year. More flexibility in the mandate could be achieved by extending the time before such borrowing needs to be paid back in the future.

1. INTRODUCTION

The question of what impact biofuels and biofuel policies have on agricultural commodity prices never seems to be satisfactorily addressed. Opponents of biofuels regularly argue that biofuels only exist because of subsidies, that their existence increases agricultural prices, and that food prices are subsequently higher because of higher prices for raw ingredients. Biofuel supporters point out that higher agricultural prices have a small impact on food prices because their value makes up such a small share of the final consumer food dollar.[1] Although this is true for developed countries, in poor countries, because many people in eat relatively unprocessed food, their food prices are much more responsive to increased commodity prices.

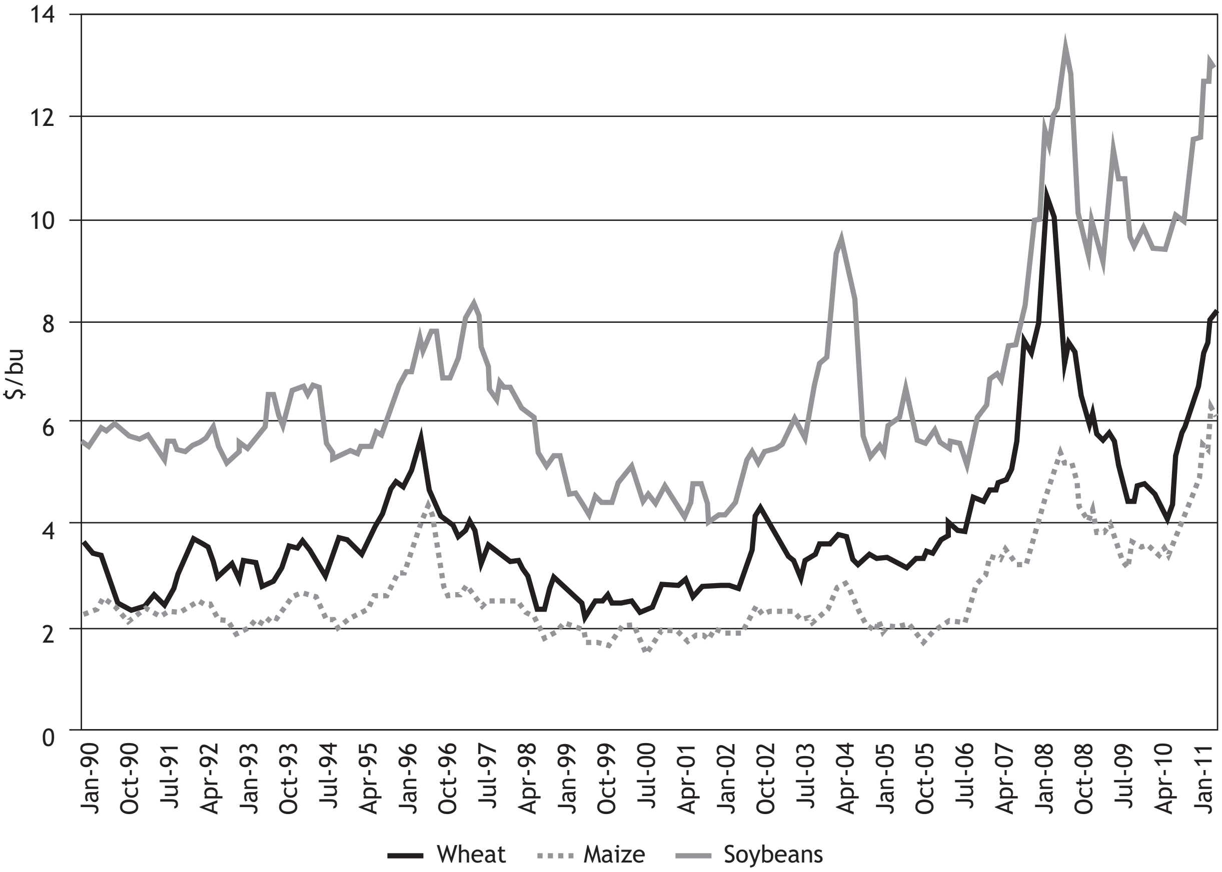
That there is a link between expanded biofuels production and agricultural commodity prices cannot be disputed. After all, such a link is why the biggest supporters of biofuels are farmers. The prices of biofuel feedstocks, including maize, vegetable oils and sugar, are higher today because biofuels are produced. Because of competition for land, the prices of wheat, oilseeds, rice and other major commodities are also higher than they would be otherwise. Furthermore, there is a direct link between processed food prices and higher maize and soybean prices because higher feed costs eventually translate into higher prices for meat, eggs and dairy products.

However, the link between food prices and biofuels subsidies is more nuanced. For example, the US Congress extended the blender tax credit for ethanol and biodiesel in December 2010. The impact of this decision on US biofuel production is complicated because of the existence of the blending mandates. Unless the tax credit pushes US biofuel production beyond mandated levels, the tax credit by itself has no impact on commodity prices or food prices.

More broadly, the effects of energy prices on the demand for biofuels must be accounted for before any conclusions can be drawn about the impact of biofuel subsidies on crop prices. Furthermore, crop prices are not solely determined by biofuel production. World demand and supply for food and feed also determine prices. Demand depends on population and income levels. Supply depends on weather in important growing areas of the world. Thus, all of these factors need to be accounted for in determining the impact of biofuel and ethanol subsidies on agricultural prices.

As shown by Figure 1, the world has seen two spikes in the prices of major crops in the last three years. With the exception of the sharp price increase for soybeans in 2003, the last two spikes follow many years of price stability. Given that the large expansion in biofuel production corresponds in time to these price spikes, it seems reasonable to conclude that biofuels were a major contributor to them. This coincidence underlines the importance of improving our understanding of how biofuel policy affects price levels and volatility.

Figure 1. Monthly Prices Received by US Farmers Since 1990



This report contributes to this understanding by examining market impacts of US biofuels and biofuel policies. Two methods of analysis are employed. The first method looks back in time and estimates what US crop prices would have been during the 2005 to 2009 marketing years under two scenarios.[2] The first scenario examined using this method eliminates corn ethanol subsidies on December 31, 2004. The two subsidies analyzed are the blender tax credit, which is a direct price subsidy paid by taxpayers and received by ethanol buyers, and the ethanol mandate, which specifies minimum amounts of ethanol that fuel blenders must use in their blends. The second scenario caps US corn ethanol production at 2004 levels. These scenarios allow for separate identification of the impact of market-based biofuel expansion on crop prices from the impacts of subsidy-driven expansion. Because this first method provides only one alternative price each year, the degree to which biofuels have affected price volatility – which is a measure or price variability – cannot be meaningfully measured.

The second method of analysis is forward looking and examines the market impacts of the blender tax credit and mandate on the distribution of prices in the 2011 calendar and marketing year. Because we do not know what 2011 crop supplies or average energy prices will be during this period, this analysis is necessarily stochastic. The advantage of a forward-looking stochastic approach is that it allows for estimation of the role of biofuel policies not only on the level of expected prices but also on the variability of crop prices. Before presenting the methods and results of these analyses, an overview of the market for US biofuels and the impact of biofuel subsidies will be instructive.

2. REVIEW OF THE ECONOMICS OF US BIOFUELS AND BIOFUEL POLICIES

An accurate understanding and specification of the supply and market demand curves for biofuels is important in determining the impact of alternative biofuel subsidies because biofuel prices and the prices of biofuel feedstocks without subsidies are determined by the intersection of the two. Of course, if the two curves do not intersect, then there would be no biofuel production without subsidies. Thus, we begin with a brief explanation of the supply and demand curve for biofuels. Brazilian supply and demand are included because of their potential importance in the US market for ethanol.

Biofuels Demand

Ethanol made from maize and biodiesel made from waste grease and soybean oil are the two biofuels produced and consumed in the United States. The market demand curve for ethanol reflects the value that fuel blenders place on different volumes of ethanol. This value depends on both market factors and government policies. The two most important market factors are ethanol's value as an octane enhancer and ethanol's value as a substitute for gasoline. An 87 octane gasoline fuel can be created by creating a blend of 90 percent 84 octane gasoline with 10 percent ethanol. Any cost savings that accrue to refineries from being able to produce 84 octane gasoline rather than 87 octane gasoline because of ethanol increases the value of ethanol. On a volume basis, a gallon of ethanol also replaces a gallon of gasoline. But ethanol has a lower energy content than gasoline, so fuel mileage of automobiles running on E10 is approximately 3 percent lower than that of automobiles running on pure gasoline. If blenders only valued ethanol as a substitute for gasoline and if consumers' willingness to pay for blended gasoline reflected this lower energy content, then the value of a gallon of ethanol would equal about two-thirds the value of gasoline. Thus, from a product blending point of view, the value that is placed on ethanol can run from a low of two-thirds the price of gasoline to some value above the price of gasoline depending on the value that is placed on ethanol because of refinery cost reductions.

There is a current upper limit on ethanol demand in the United States because of blending and infrastructure restrictions. Currently, the number of fuel stations that sell 85 percent blends (E85) that can be used by US flex-fuel vehicles (FFVs) is quite limited so the proportion of such vehicles that use E85 is unimportant. If all US gasoline supplies contained 10 percent ethanol, then US consumption would approach 14 billion gallons. This "blend wall" is the current limit on US ethanol demand.

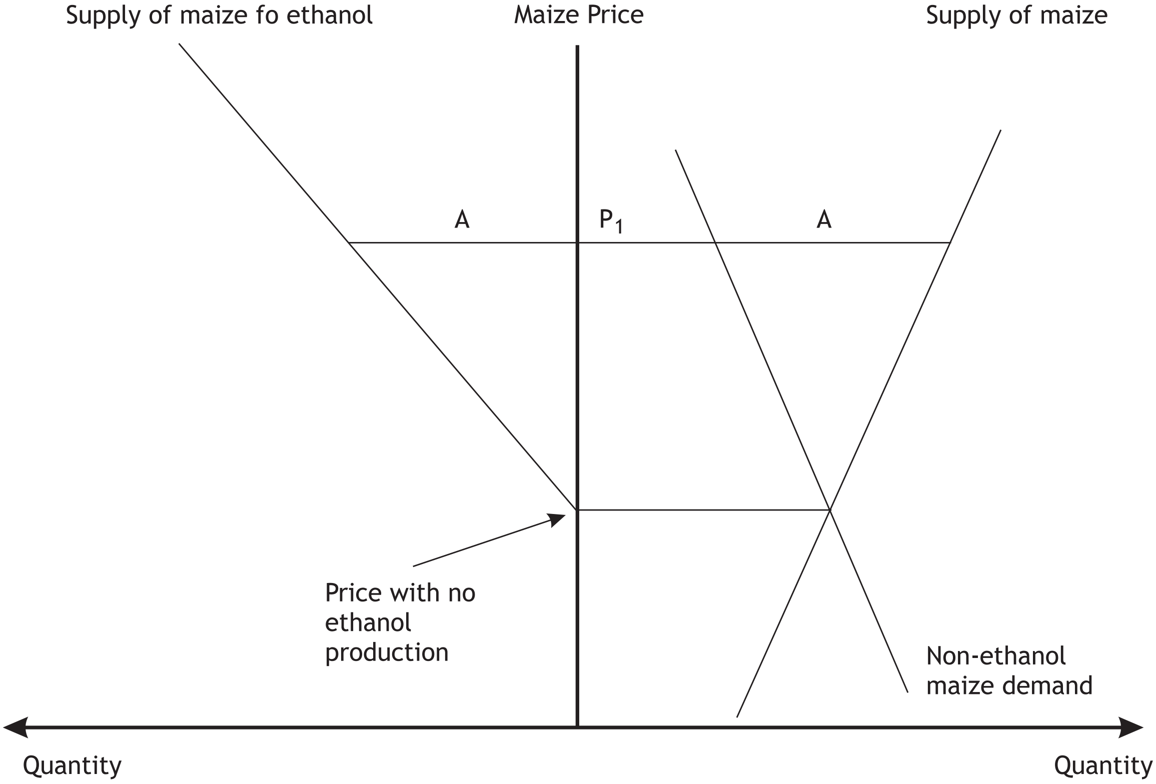
Biodiesel also offers two market values to diesel fuel blenders. It provides lubricity attributes for diesel fuel and it provides a direct substitute for diesel energy, albeit at about an 11 percent average price discount to diesel.

The demand for ethanol in Brazil is more complicated because a rapidly rising share of the Brazilian vehicle fleet is comprised of FFVs. Approximately 40 percent of the Brazilian light vehicle fleet is flex fuel (Babcock, Barr and Carriquiry, 2010). The proportion of FFV owners who will run their vehicles on ethanol rather than gasoline depends on the price of ethanol relative to the price of gasoline (Salvo and Huse, 2011). If the price of ethanol is too high, then consumers will switch to gasoline. For example, from November 2009 to March 2010, the price of ethanol relative to gasoline in Brazil rose from $0.56 to $0.73. The proportion of FFV owners who used ethanol dropped from 70 to 44 percent. The sharp increase in the price of ethanol during this time period reflected the poor sugarcane harvest that occurred. This shows that consumption of ethanol in Brazil responds readily to changes in ethanol prices.

Biofuel Supply

The supply curve of ethanol in the United States is best thought of as an excess supply curve of maize. This is drawn in Figure 2. On the right side is US supply of maize, which increases as the price of maize increases, and the demand for maize in all uses except for ethanol. At any maize price above the intersection of these two curves, such as P1, there is a surplus (quantity a) that can be converted into ethanol. This surplus increases the higher is the maize price, which gives rise to an upward-sloping supply curve of maize for ethanol.[3] This framework shows why it is necessarily true that expansion of ethanol can only come about through higher maize prices. Of course, production of ethanol cannot exceed capacity of the industry to produce. So the supply curve of ethanol becomes vertical at this quantity.

Figure 2. Constructing the supply curve of US ethanol



The supply curve of biodiesel is found in a similar fashion except that the primary feedstock for biodiesel, soybean oil, is bid away from other soybean oil uses, and that the supply of soybean oil comes from soybean crushers that have their own supply and demand curves. In addition, a significant portion of US biodiesel is made from waste grease, corn oil or other sources of fats.

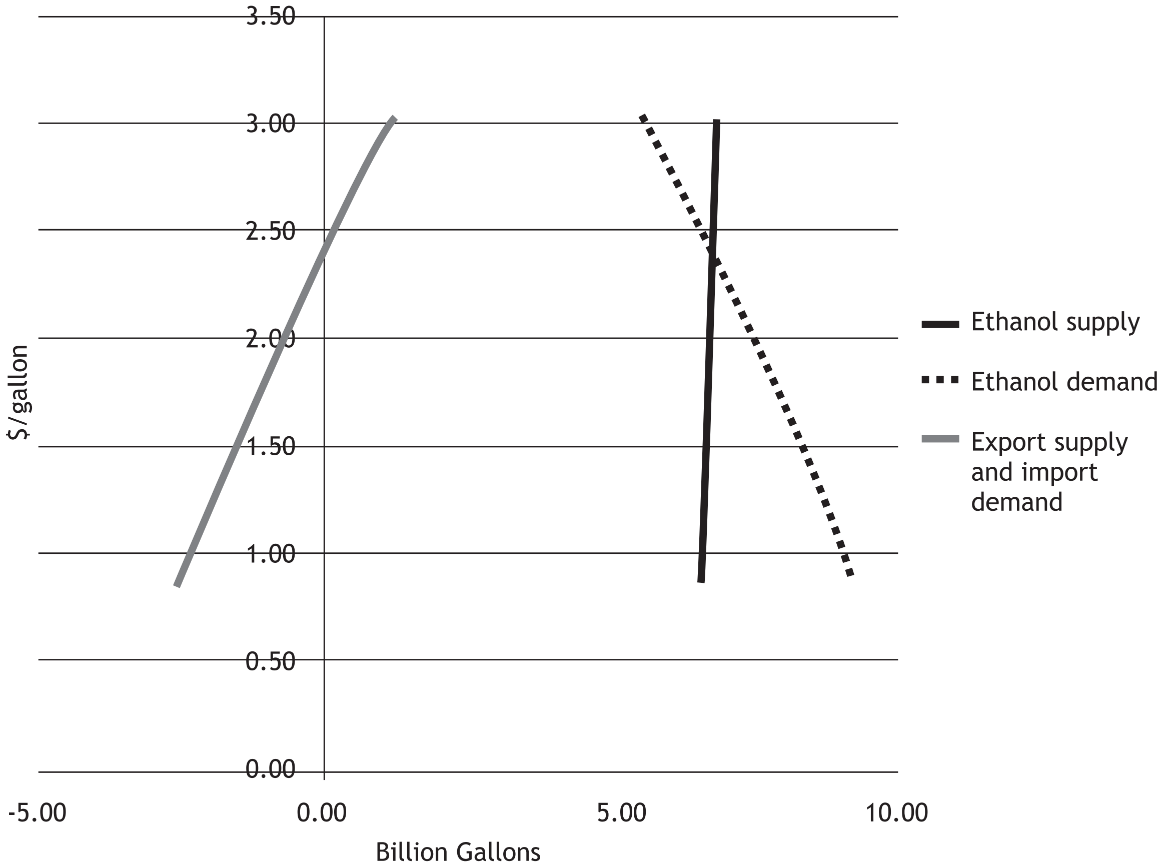
In Brazil, the supply of ethanol depends on the capacity of the industry and the quantity of sugarcane produced. Given both, the supply curve responds quite inelastically to the price of ethanol because Brazil's sugarcane processing facilities have limited discretion about whether they choose to produce sugar or ethanol. There are limits to flexibility because of capacity constraints within plants.

Export Supplies and Demands

Trade in ethanol between Brazil and the United States will take place when the domestic ethanol price in one country without trade exceeds the domestic price in the other country by more than transportation costs plus any tariff. The US tariff on imported ethanol is 2.5 percent plus $0.54 per gallon. Brazil exports can avoid this tariff if Caribbean countries re-export imported ethanol. The additional transportation and handling costs act as an effective tariff of about $0.30 per gallon (Babcock, Barr and Carriquiry, 2010). Brazil currently has no tariff on imported ethanol.

Figure 3, shows a current estimate of the domestic supply and demand curves for hydrous ethanol at the wholesale level in Brazil.[4] As shown, the two intersect at about $2.45 per gallon. If this ethanol were to be exported to the United States and converted to anhydrous (without water) ethanol, the landed price would be about $3.20 per gallon. The current wholesale price of anhydrous ethanol in the United States is about $2.60, which corresponds to a hydrous price of about $2.47 per gallon. Thus, there is currently much more incentive for Brazil to import ethanol from the United States than to export ethanol to the United States.[5] The strong growth in FFVs combined with a lack of investment in plants and sugarcane fields created the situation portrayed in Figure 3. Given the likely strong continued growth in Brazilian ethanol demand, it is not clear how soon Brazil will again be in a position to be a significant exporter of ethanol.

Figure 3. Brazilian supply and demand projections for ethanol in 2011



US Biofuel Subsidies

The two primary means by which subsidies affect the demand for US ethanol and biodiesel are the Renewable Fuel Standard (RFS) and the blender tax credit. The RFS places a floor under the demand for both fuels. In 2011, the floor is 12.6 billion gallons for ethanol and 800 million gallons for biodiesel. Mandated floor volumes of ethanol are enforced by requiring obligated parties (gasoline producers and importers) to collect and turn into the US Environmental Protection Agency a specified number of renewable identification numbers (RINs).[6]

The blender tax credit directly increases the market value of ethanol by the amount of the tax credit. The increase in marginal value of ethanol from the tax credit might increase ethanol production above mandated levels or it might have no impact at all. To see why, consider the current economics for biodiesel. To produce a gallon of biodiesel from soybean oil requires 7.6 pounds of oil. The current market price for this oil is $0.58 per pound, which means that the feedstock price costs $4.41 per gallon. Other costs net of by-product value account for perhaps another $0.60 per gallon. So production costs of biodiesel made from soybean oil total around $5.00 per gallon. The current wholesale price of US diesel is about $3.00 per gallon. If biodiesel is valued by blenders on a par with diesel then biodiesel has a $2.00 per gallon cost disadvantage in the marketplace. This demonstrates that there would be no US biodiesel production without the mandate. The $1.00 per gallon blender tax credit for biodiesel only covers half of this disadvantage. The price of biodiesel RINs covers the rest. If the blender tax credit were eliminated, then all that would happen in the market would be that the price of biodiesel RINs would increase by $1.00 to $2.00 per gallon. The mandate would still determine US production levels, which means that the tax credit has no market impact.

The impact of the tax credit with a mandate is illustrated in Figure 4. With no tax credit in place, the demand and supply of ethanol is given by D and S and the market clearing price and quantity are given by P* and Q* that correspond to point c. With a mandate of Q^M, the price received by producers increases to a and the market value drops to b. The price gap, *a - b*, is made up by the price of RINs. Now suppose that a blender tax credit is enacted that increases demand to D_1. The tax credit equals the vertical distance between D_1 and D. With this tax credit, the mandate still binds so the tax credit has no impact on the ethanol market. All it does is decrease the price gap by the amount of the tax credit, *d - b*, which causes the price of RINs to fall by the same amount. Put another way, if this tax credit were eliminated, then it would not have any impact on the quantity of biofuels produced or on feedstock prices. Only if the tax credit pushes quantity produced beyond mandated levels, as shown by demand curve D_2, will the tax credit have any impact. In this case, the tax credit pushes quantity produced to Q_2. This increased production causes feedstock prices to increase, which means that there is an impact on agricultural prices from the tax credit.

Figure 4. Market impact of the blenders tax credit

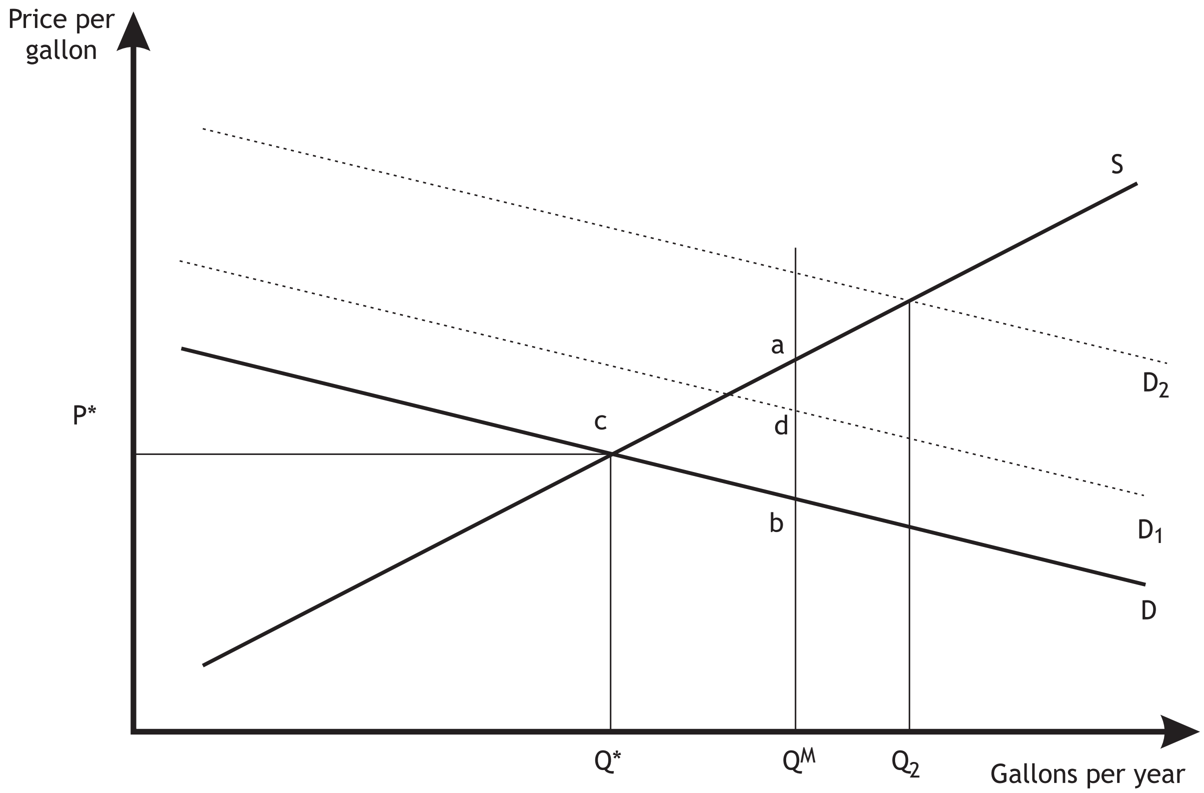


Figure 4 illustrates the importance of considering many different combinations of supply and market demand curves when estimating the impacts of policy changes. If feedstock prices are high and mandates bind, then the tax credit likely has no impact. If gasoline and diesel prices are high and market forces push demand for biodiesel and ethanol beyond mandated levels, then the tax credit can further increase demand, thereby forcing agricultural prices even higher than they otherwise would be. Because nobody can know with certainty what the future holds for feedstock supplies and energy prices, it is impossible to know for certain what the impacts of subsidies will be in the future. Thus, when looking to the future, it is best to use a stochastic model to estimate the impacts of policy changes. But before turning to forward-looking results, results are presented from a “backcasting” exercise whereby history is revisited under alternative biofuel policies.

3 BACKCASTING ETHANOL'S IMPACT ON AGRICULTURAL POLICIES

One method for estimating the impacts of ethanol on agricultural prices is to "backcast" prices using an economic model of the agricultural sector. In contrast to a forecast of future prices, a backcast is an estimate of what past agricultural prices would have been under alternative circumstances. Many studies include projections of the impact of expanded biofuels on future crop prices (see, for example, FAPRI, 2009). Such studies typically estimate impacts by first using an economic model to project agricultural demand and supply under a baseline set of conditions. Supply and demand are then projected using the same model and set of conditions except that the demand for a biofuel feedstock is increased. The price projections are then compared to estimate the change in prices from expanded biofuel production.

The same basic procedure can be used to estimate the impact of biofuels on historical prices. The supply and demand curves in the economic model are first calibrated so that all supply curves intersect all demand curves at historical prices and quantities. For example, the average US price of maize in 2008 was $4.06 per bushel. Planted acreage was 86 million acres and yield was 153.9 bushels per acre. Feed use was 5.182 billion bushels, exports were 1.849 billion bushels, and ending stocks were 1.673 billion bushels. These data reveal market clearing prices and quantities and the positions of demand and supply curves. Because historical supply curves reflect the weather conditions that actually occurred, all weather shocks are automatically accounted for by this procedure. These data also reveal the net effect on US maize demand from supply decisions of all other farmers in the world.

After each year's calibration is accomplished for all commodities and years in the backcasting period, the model is re-solved under a different policy than what actually was in place. New equilibrium crop yields, crop acreage and price levels under two alternative policy scenarios were estimated. The first scenario eliminates US ethanol mandates and tax credits on December 31, 2004. This date was chosen because it precedes the sharp run-up in prices that began in the fall of 2006 (see Figure 1). The results from this scenario give insight into the impact of US ethanol subsidies on agricultural prices during the 2007/08 price spike and the subsequent sharp drop in prices. The second scenario freezes US ethanol production at 2004 levels. A comparison of the resulting prices with prices estimated under the first scenario reveals the extent to which market-driven expansion of US ethanol drove prices higher. Together these two scenarios provide an estimate of the historical impact of US ethanol and US ethanol subsidies on agricultural prices.

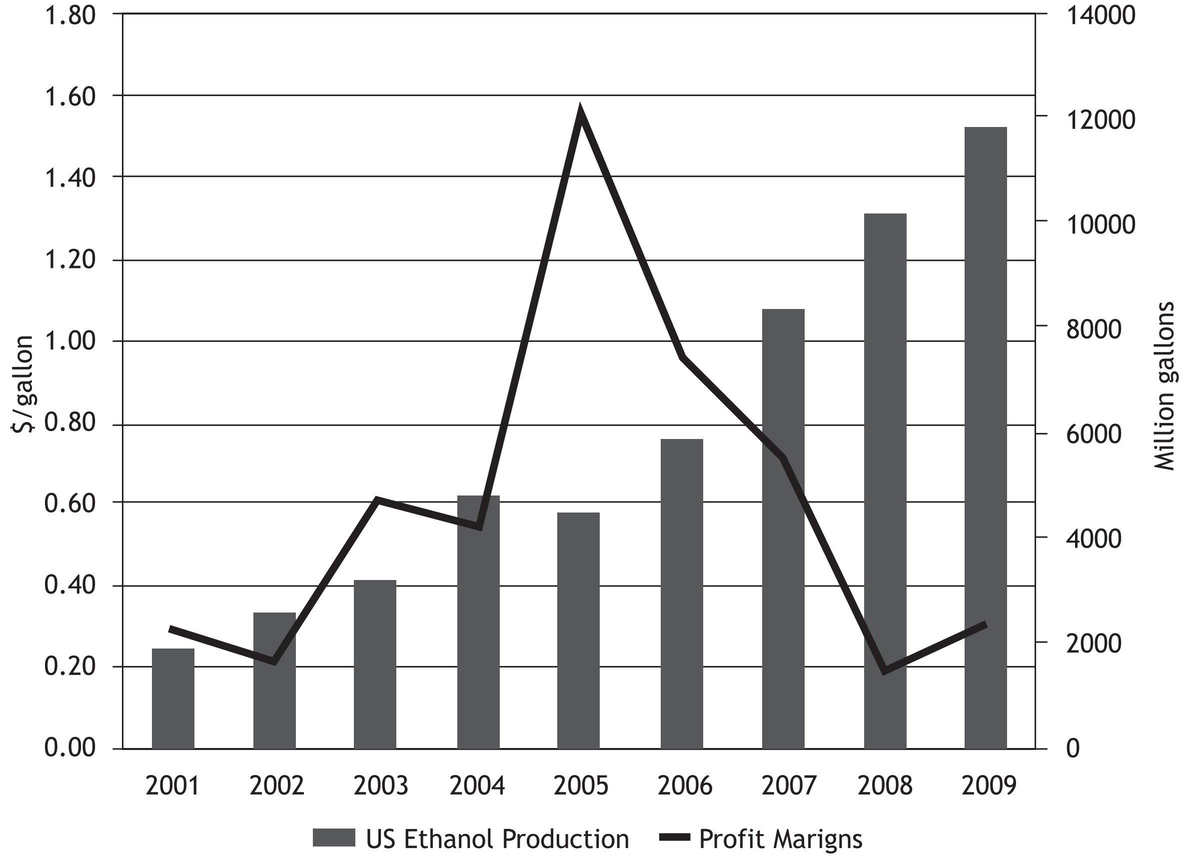
The model that was used to answer these questions is the same basic model that researchers at Iowa State University's Center for Agricultural and Rural Development (CARD) used to support the US Environmental Protection Agency's finding that ethanol and biodiesel meet the greenhouse gas targets under the current RFS. The CARD-FAPRI (Food and Agricultural Policy Research Institute) model is a detailed annual model of the US agricultural sector that is linked to commodity-specific models of supply and demand for all important importing and exporting countries. For this analysis, non-US commodity models were represented by reduced-form export demand and import supply equations.

US ethanol production was not high before 2005 despite the existence of subsidies and low feedstock costs because low energy prices kept profit margins low. Figure 5 shows the sharp increase in profit margins in 2005 that led to a dramatic increase in investment and the production of ethanol. Construction of most US ethanol plants commenced in 2005, 2006 and

2007 in response to high profit margins. The new plants started to come online at the end of 2006. By 2009, construction of most plants was completed.

After paying for feedstock costs, natural gas, labor, yeast and all other variable costs of production, ethanol plants made an average of $1.56 per gallon in the 2005 marketing year. To put this margin into perspective, in 2004, a 100-million-gallon ethanol plant cost approximately $120 million to build (Eidman, 2007) This means that if this 100-million-gallon plant had come online in the summer of 2005, then the plant could have been paid for in less than one year. Of course, to come online in the summer of 2005, planning for the plant would have had to begin in 2002 or 2003 when margins were much lower. The large margins in 2005, 2006 and 2007, however, greatly accelerated investor interest, which led directly to large increases in production capacity in 2007, 2008 and 2009.

Figure 5. High Profit Margins Led to Dramatic Increase in US Ethanol Production



The high profit margins resulted from a combination of inexpensive maize and expensive ethanol. The phase-out of methyl tertiary butyl ether (MTBE), a petroleum-based octane enhancer and oxygenate, as a gasoline additive in 2004 and 2005 boosted demand for ethanol as its replacement. MTBE fell out of favor because of oil companies were held liable for potential damages to water supplies. The resulting growth in ethanol demand combined with existing demand subsidies and a limited supply of ethanol to greatly increase ethanol prices, thus leading to the wide processing margins. The strong margins in 2006 and 2007 were due to a continuation of the subsidies and higher oil prices, which encouraged discretionary blending of ethanol as a substitute for gasoline. The dramatic decline in oil prices in the latter half of 2008 contributed to the decline in both processing margins and feedstock prices.

It is clear that high profit margins were necessary for expansion of US ethanol production. A key question is the extent to which these high margins were a result of ethanol subsidies or were simply a result of higher crude oil prices and the phase out of

MTBE. If subsidies caused the high margins, then we can conclude that subsidies caused the expansion of the ethanol industry. If the high margins were the result of other forces, then this expansion would have occurred even if the subsidies had been eliminated. By definition, the market effects of the blender tax credit and the mandate are included in the actual historical prices. Thus, a comparison of the model results without the subsidies with the actual historical observations provides an estimate of what markets would have looked like if mandates had never been adopted and if the blender tax credit had been eliminated on December 31, 2004. The model was re-run only from 2005 to 2009 because final 2010 data were not yet available.

Impact of Ethanol Subsidies on US Crop and Food Prices

If there had been no mandate or tax credit from 2005 to 2009, ethanol processing margins would have been lower because both policy tools work to increase the price of ethanol that plants receive. Lower processing margins, in turn, would have decreased the incentive to invest in ethanol plants, which would have held down ethanol production and the demand for maize. Lower maize prices would have resulted in fewer acres of maize being planted and more acres of other crops being planted. This would have resulted in lower crop prices, which, in turn, would have lowered egg and meat prices. Solving the model without the subsidies involves finding new equilibrium prices and production levels across all crops and livestock markets for the 2005 to 2009 period.

Table 1 shows the impacts on profit margins and US ethanol production from elimination of subsidies. As shown, margins would have been lower, but only by a small amount. Profit margins in 2005 and 2006 would still have been large. These wide margins imply that there still would have been strong incentives in place to build ethanol plants without the subsidies. It cannot be known with certainty how much or how quickly the ethanol industry would have expanded in response solely to these large margins in the absence of political signals embodied in the tax credit and mandates. The modeling assumption is that ethanol investment is solely a function of margins. As such, the model likely overstates the speed at which investors would have responded to high ethanol margins. If so, the margins without subsidies in Table 1 in 2008 and 2009 would have been much higher because the price of corn would have been lower than assumed in this analysis.

Under the assumption that investment in ethanol plants is based solely on the Table 1 margins, a large expansion in US ethanol production would have occurred even if the subsidies and mandates had not been in place. The reason is that the return on investment in ethanol would have been so high that investors still would have brought their capital to the industry. As shown, the model indicates that in 2009, ethanol production would have been about 1.2 billion gallons lower without subsidies.[7] The largest difference in production would have been in the 2008 marketing year when subsidies increased ethanol production by more than 2.3 billion gallons.

Table 1. Impact of Subsidies on US Ethanol Profit Margins and Production

	Profit Margins ($/gallon)		Ethanol Production (million gallons)	
Year	History	No Subsidies	History	No Subsidies
05/06	1.56	1.45	4,500	4,132
06/07	0.96	0.82	5,883	5,481
07/08	0.71	0.44	8,367	6,533
08/09	0.19	0.07	10,218	7,878
09/10	0.30	0.22	11,869	10,675

The impact of ethanol subsidies on crop prices over this period are shown in Table 2 for maize, wheat, soybeans and rice. As shown, the largest impact of subsidies was on maize prices in the 2007/08 marketing year when the average price received by US farmers would have been 7.1 percent lower without subsidies. This marketing year covers the spring of 2008 when crop prices rose dramatically, which suggests that the subsidies had their largest impact during times of high prices. Across commodities, the effects of US ethanol subsidies on market prices are quite modest. The reason is that the model allows acreage planted to individual crops to adjust to lower prices. Thus, part of the reason why maize prices do not drop by more because of the drop in ethanol demand is that planted maize acreage declines, thereby boosting prices higher than they otherwise would be. This decline in acreage planted to maize shows up as higher acreage planted to other crops, thereby causing their prices to decline, although, as shown in Table 2, the price effects are modest.

The impacts on egg and meat prices are shown in Table 3. The only discernable difference in egg and meat prices from ethanol subsidies is in 2008 when egg prices would have been two cents per dozen lower than they were. The reason for such a small price impact is that feed prices make up a small share of retail prices and because the feed cost impacts from ethanol subsidies over this period are small.

Table 2. Impact of Ethanol Subsidies on Crop Prices from 2005 to 2009

	Marketing Year				
	05/06	06/07	07/08	08/09	09/10
Wheat					
History	3.42	4.26	6.48	6.78	4.92
No Subsidies	3.41	4.22	6.33	6.63	4.89
% difference	-0.4	-1.0	-2.3	-2.3	-0.6
Maize					
History	2.00	3.04	4.20	4.06	3.60
No Subsidies	1.96	2.95	3.90	3.88	3.60
% difference	-2.0	-2.9	-7.1	-4.5	0.0
Soybeans					
History	5.66	6.43	10.10	9.97	9.42
No Subsidies	5.60	6.33	9.94	9.69	9.26
% difference	-1.0	-1.5	-1.6	-2.8	-1.8
Rice					
History	7.65	9.96	12.80	16.80	13.79
No Subsidies	7.65	9.95	12.76	16.71	13.75
% difference	0.1	-0.1	-0.3	-0.5	-0.3

Note: Price units are $ per bu except for rice, which is expressed in $ per cwt.

Table 3. Impact of Ethanol Subsidies on Egg and Meat Prices from 2005 to 2009

	Marketing Year				
	05/06	**06/07**	**07/08**	**08/09**	**09/10**
Eggs					
History	1.22	1.31	1.68	1.99	1.66
No Subsidies	1.22	1.31	1.67	1.97	1.65
% difference	0.0	0.0	-0.5	-1.1	-1.0
Broilers					
History	1.74	1.57	1.65	1.75	1.78
No Subsidies	1.74	1.57	1.65	1.75	1.78
% difference	0.1	0.2	0.2	0.0	-0.1
Pork					
History	2.83	2.81	2.87	2.94	2.92
No Subsidies	2.83	2.81	2.87	2.93	2.92
% difference	0.0	0.0	0.0	-0.1	-0.2
Beef					
History	4.09	3.97	4.16	4.32	4.26
No Subsidies	4.09	3.97	4.16	4.32	4.25
% difference	0.0	0.0	0.0	-0.1	-0.2

Note:Price units are $ per dozen eggs and $ per pound retail prices.

Impact of Market-Based Ethanol Expansion on Crop and Food Prices

To measure how expansion of the ethanol industry has impacted corn prices, the CARD-FAPRI calibrated model was re-run with ethanol production fixed at 2004 production levels. A comparison of results from this "no-expansion" scenario with the no-subsidy results and with actual prices and quantities provides separate estimates of the impact of ethanol on crop and food prices from subsidies and from market forces. Because the no-expansion scenario imposes a much larger change on the market than the no-subsidy scenario, the results from this scenario should be viewed with some caution. Keeping this caveat in mind, Tables 4 and 5 show the results.

Table 4. Crop Price Impacts from Fixing US Ethanol Production at 2004 Levels

	Marketing Year				
	05/06	06/07	07/08	08/09	09/10
Wheat					
History	3.42	4.26	6.48	6.78	4.92
No Expansion	3.40	4.10	6.17	6.39	4.47
% difference	-0.5	-3.8	-4.7	-5.8	-9.2
Maize					
History	2.00	3.04	4.20	4.06	3.60
No Expansion	1.95	2.64	3.76	3.30	2.84
% difference	-2.5	-13.3	-10.6	-18.7	-20.9
Soybeans					
History	5.66	6.43	10.10	9.97	9.42
No Expansion	5.61	6.35	9.66	9.70	8.97
% difference	-0.9	-1.2	-4.3	-2.8	-4.8

Table 4. *Continued*

	Marketing Year				
	05/06	06/07	07/08	08/09	09/10
Rice					
History	7.65	9.96	12.80	16.80	13.79
No Expansion	7.66	9.95	12.68	16.68	13.62
% difference	0.1	-0.1	-0.9	-0.7	-1.3

Table 5. Egg and Meat Price Impacts from Fixing US Ethanol Production at 2004 Levels

	Marketing Year				
	05/06	**06/07**	**07/08**	**08/09**	**09/10**
Eggs					
History	1.22	1.31	1.68	1.99	1.66
No Expansion	1.22	1.30	1.64	1.92	1.58
% difference	0.0	-0.7	-2.3	-3.3	-4.8
Broilers					
History	1.74	1.57	1.65	1.75	1.78
No Expansion	1.74	1.57	1.64	1.73	1.75
% difference	0.1	-0.1	-0.5	-1.1	-1.6
Pork					
History	2.83	2.81	2.87	2.94	2.92
No Expansion	2.83	2.80	2.86	2.93	2.90
% difference	0.0	-0.1	-0.2	-0.4	-0.6
Beef					
History	4.09	3.97	4.16	4.32	4.26
No Expansion	4.09	3.97	4.15	4.31	4.24
% difference	0.0	-0.1	-0.2	-0.3	-0.4

Note: Price units are $ per dozen eggs and $ per pound retail prices.

The crop price impacts in Table 4 are much larger than the price impacts from subsidies reported in Table 2. Because ethanol production grew rapidly over time, the price impacts also grow over time. If ethanol production had been fixed at 2004 levels, maize prices in 2009 would have been more than 20 percent lower than they were. Wheat prices would have been 9 percent lower and soybean prices would have been about 5 percent lower. Ethanol production has little impact on rice prices because US rice land does not compete strongly with land for other commodities.

Another way of viewing these results is given by Figures 6 and 7, which break down the total percentage change in wheat and maize prices relative to their 2004 levels into the share caused by market expansion of ethanol, the change caused by ethanol subsidies, and the change caused by all other factors. Charts for rice and soybeans are not presented because practically all of the price changes were caused by other market factors. As shown in Figure 6, ethanol subsidies have contributed little to the rise in wheat prices. Expansion of ethanol contributed about 30 percent to the difference in wheat prices between 2009 and 2004.

Figure 6. Causes of Wheat Price Increases Since 2004

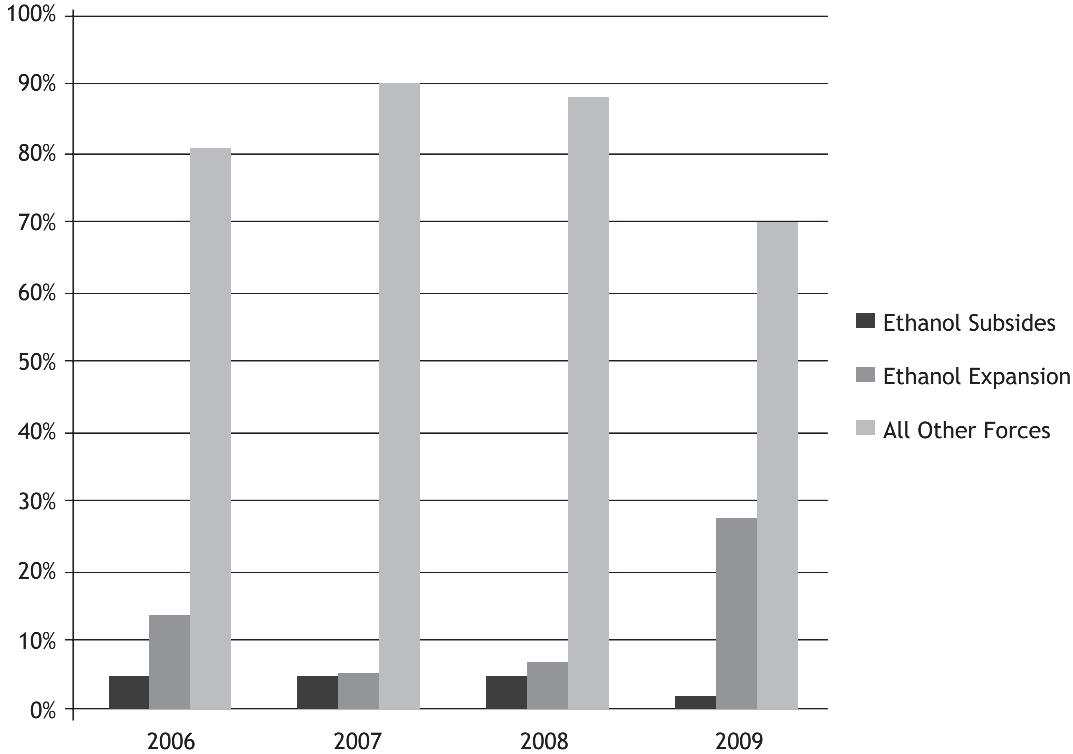
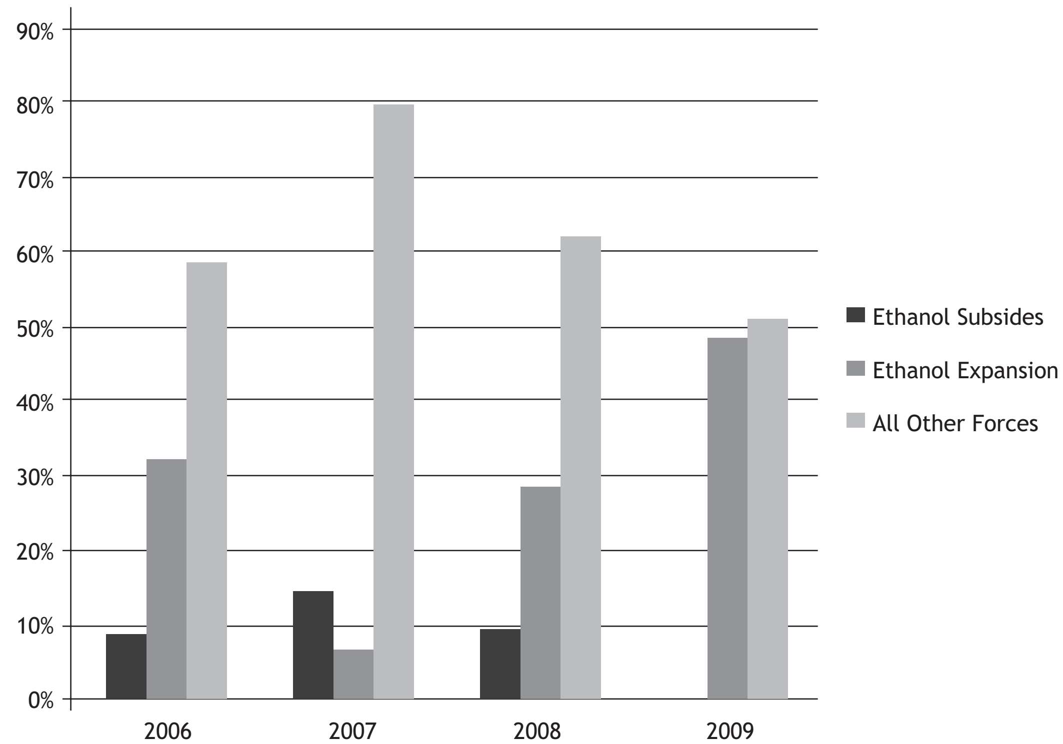


Figure 7 shows that the contribution of ethanol subsidies to maize price increases has also been small, reaching a maximum of 13 percent in 2007. Market-based expansion of ethanol contributed about 50 percent to the difference in maize prices between 2004 and 2009. The direct conclusion of these results is that ethanol subsidies have had little impact on crop prices and that market-based expansion of ethanol had a large impact on maize prices, a modest impact on wheat prices and practically no impact on soybean and rice prices over this time period.

Figure 7. Causes of Maize Price Increases Since 2004



To conclude this backcasting exercise Table 5 reports the impact on egg and meat prices if ethanol had been frozen at 2004 levels. Except for egg prices, the estimated impacts are quite small. The maximum change in egg prices is less than 5 percent. The cost of maize as a share of the retail price of these products is highest for eggs, which explains why egg prices are affected more by ethanol expansion than are the three meat prices. The model allocates the change in production of dry distillers grains, which is a by-product of ethanol production, to different livestock species according to a least-cost feed ration. Overall, these results indicate that the effects of both ethanol subsidies and market-driven expansion of ethanol on US food prices have been small.

4. A LOOK FORWARD IN TIME

The second method used to analyze the impacts of alternative ethanol policies on agricultural prices is to use a stochastic partial equilibrium model to solve for market-clearing prices. Instead of estimating the effect of policy on the price level, this approach allows for the estimation of policy on the distribution of future prices. The model used for this analysis follows the fundamental supply and demand concepts that were presented in the second section of this report. The supply and demand curves are calibrated to reflect reasonable assumptions about what future market conditions will be. The model solves for market-clearing prices of maize, US and Brazilian domestic ethanol, soybeans, soybean oil, soybean meal and biodiesel made from waste grease and soybean oil. Suppliers of soybean and soybean products are Brazil, the United States and Argentina. Consumers of soybeans and soybean products are the same three countries plus the rest of the world, which is captured in a single demand curve.

Exogenous variables are US yields of maize and soybeans and gasoline prices. Crude oil prices and diesel prices are assumed to be deterministic functions of gasoline prices. Maize yields determine the profitability of producing US ethanol relative to Brazilian ethanol, and soybean yields determine the cost of producing biodiesel. Gasoline prices determine the overall market demand for ethanol and biodiesel because ethanol serves as a substitute for gasoline

Uncertainty about yields and gasoline prices is accounted for by making the model stochastic. What this means is that market outcomes are calculated for many different combinations of yields and gasoline prices. The demand curves and South American soybean supplies are calibrated to the US Department of Agriculture's May 2011 WASDE report.[8] The general structure of the model closely follows the analysis by Babcock, Barr and Carriquiry (2010) but the model parameters are updated and the soybean and biodiesel sectors are new additions. The model also accounts for how the US advanced biofuel mandate will be met. Table 6 provides details about the random variables in the model.

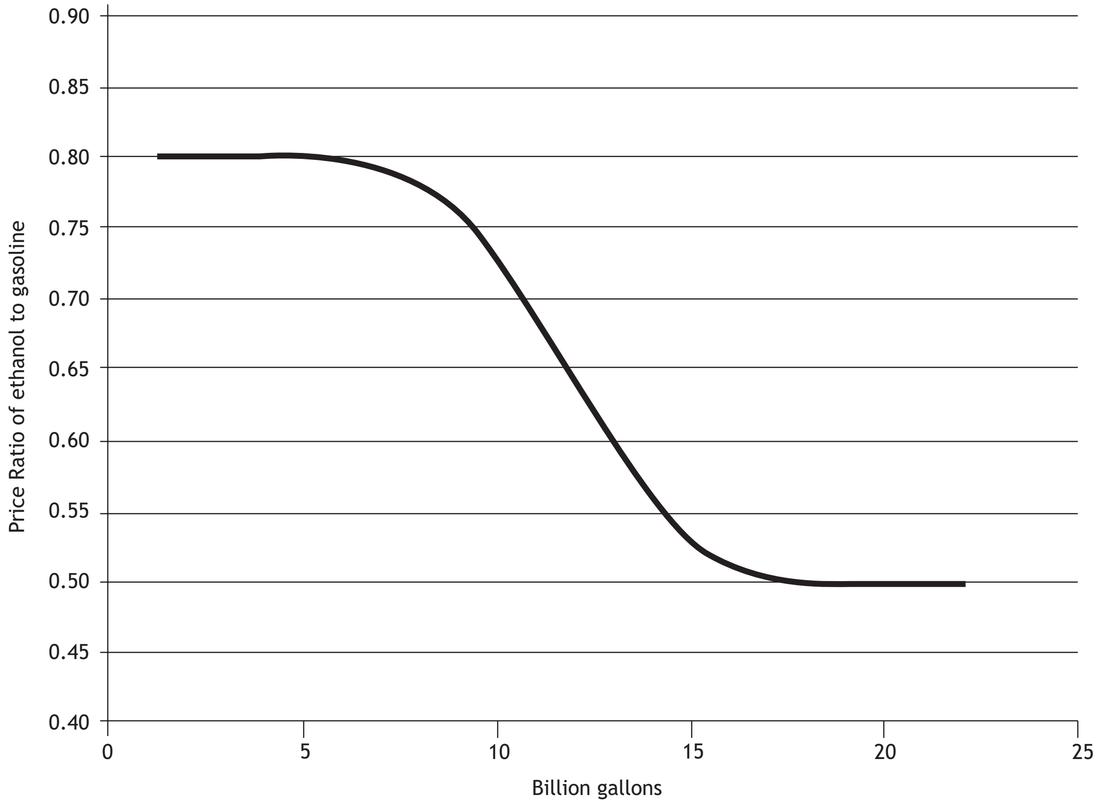
Table 6. Assumptions about Random Prices

Stochastic Variable	Distribution	Mean	Volatility
Gasoline price ($/gal)	Lognormal	3.00	15.0%
Diesel price ($/gal)	Linear function of gasoline price	3.19	15.4%
US maize yield (bu/ac)	Beta	163.4	9.0%
US soybean yield (bu/ac)	Beta	43.5	6.0%

The model is first solved for the 2011 calendar year. Crop supplies for the 2011 calendar year equal stock levels available on January 1, 2011, minus marketing year 2010 ending stock levels plus 2011 production. Production of soybeans and soybean products occurs in Brazil, Argentina and the United States. Only one-third of 2011 US production is available in the 2011 calendar year because the marketing year begins on September 1. Mean crop yields for 2011 equal trend yields using historical data from 1995 to 2010. The correlation between yields was set at its historical level of 0.6 (using data from 1980 to 2010) to reflect the fact that US corn and soybeans are mostly grown in the same locations. Volatilities were estimated from historical yield deviations from trend. The gasoline price volatility was set at a low value of 15 percent to reflect that the model is an annual model, and almost half the year has passed, and significant averaging of prices over the remainder of the year will occur. Markets are cleared for each of 500 draws of the random variables. Because 2011 US acreage for maize and soybeans was fixed at the levels projected by USDA, the only interaction between the two market sectors involves whether biodiesel or sugarcane ethanol will meet the advanced biofuel mandate. For each outcome, market-clearing prices and quantities are recorded. The process is repeated for each alternative policy scenario.

The market demand curve for ethanol in the United States is a function of the price of ethanol relative to gasoline. The demand curve is shown in Figure 8. It reflects the fact that ethanol needs to be heavily discounted when the US market for 10 percent blends becomes saturated. It is assumed that a discount that exceeds the energy content difference at high volumes of ethanol will allow US ethanol to be exported freely. It is likely that this demand curve understates fuel blenders' willingness to pay for ethanol at low volumes, but there are no current observations on which to base this portion of the demand curve. A low value will tend to overstate the impacts of policy changes. The Brazilian ethanol demand curve is shown in Figure 3.

Figure 8. Market Demand for US Ethanol



Current US biofuel policies include blender tax credits of $0.45 per gallon for ethanol and $1.00 per gallon for biodiesel, blending mandates of 12.6 billion gallons for conventional ethanol, 800 million gallons for biodiesel and 144 million ethanol equivalent gallons for advanced biofuels. Because fuel blenders' use of ethanol exceeded mandated levels in previous years, blenders have a large supply of blending credits that they can use to meet the 2011 mandate.[9] Thus, the effective level of the 2011 blending mandate is reduced to 11.2 billion gallons. The two advanced biofuels approved by the US Environmental Protection Agency are biodiesel and sugarcane ethanol from Brazil. Because biodiesel contains more energy than ethanol – a gallon of biodiesel equals 1.5 ethanol equivalent gallons – meeting the advanced biofuel mandate with biodiesel requires 96 million gallons. Whether sugarcane ethanol or biodiesel meets the advanced biofuel mandate is determined by comparing RIN prices. The fuel with the lowest RIN price will meet the mandate.

The first set of results is presented in Table 7. Average values across the 500 market solutions under current policy and two policy alternatives – removal of the blender tax credit but maintenance of the mandate and removal of both the tax credit and the mandate – are presented.

Table 7. Summary of Market Impacts of US Policy Alternatives

	Current Policy	No Tax Credit	No Tax Credit or Mandate
Maize price	6.11	5.68	5.09
US ethanol price	2.39	2.27	2.11
Conventional RIN price	0.04	0.26	na
US ethanol production	12.43	11.78	10.86
US ethanol imports	-0.22	-0.36	-0.57
Brazil ethanol price	2.81	2.71	2.55
Soybean price	13.84	13.84	13.39
Soybean oil price	55.2	55.2	46.5
Soybean meal price	398	398	417
Biodiesel price	5.05	5.05	3.91
RIN price	1.17	2.17	na
US biodiesel production	0.896	0.896	0.04

Note: Units are $ per bushel for crop prices, $ per gallon for fuel and RIN prices, billion gallons for biofuel quantities, cents per pound for soybean oil price and $ per short ton for soybean meal price.

Removal of the blender tax credit decreases the average maize price by about 7 percent. Removing both the tax credit and the mandate results in an average price decline of 17 percent. Removal of the blender tax credit has no impact on the soybean market in 2011 because the mandate determines biodiesel production in all 500 market outcomes both with and without the blender tax credit. Removing the biodiesel mandate decreases US biodiesel production substantially (96 percent). But the decrease has only modest impacts on world soybean prices because soybean prices are determined by both soybean meal and soybean oil prices. As shown, soybean meal prices increase if the mandate is eliminated, thereby offsetting a significant portion of the impact on soybean crush margins from the 16 percent decline in soybean oil prices. The reason why soybean meal prices increase is that the production of distillers grains decreases, thereby increasing the demand for soybean meal. Brazil is a net importer of US ethanol because Brazilian ethanol prices are above US ethanol prices. The quantity of exports increases if the tax credit and mandate are eliminated because their elimination makes US ethanol more price competitive. The expansion in US ethanol exports to Brazil has a meaningful impact on the average Brazilian domestic ethanol price. Removing the ethanol tariff in 2011 has no impact because Brazil's domestic ethanol prices are so far above US prices. Overall, US biofuel policy increases maize prices by a significant amount and soybean prices by a modest amount.

The Table 7 results show that US biofuel policies currently have a meaningful impact on maize prices. Their impact on soybean prices is much lower. However, similar to the results obtained in the previous section, US biofuel subsidies are not the main driver of crop prices. Even if the subsidies were completely eliminated, maize and soybean prices would still be at very high levels. In addition, the much-maligned US import tariff has no market impact in 2011 because Brazil does not have surplus ethanol available for export. Although these average results reflect the overall current market conditions, and are not generally applicable to all future market conditions, they do reveal that care should be taken before generalizations are made about the impact that US biofuel policies have on agricultural prices.

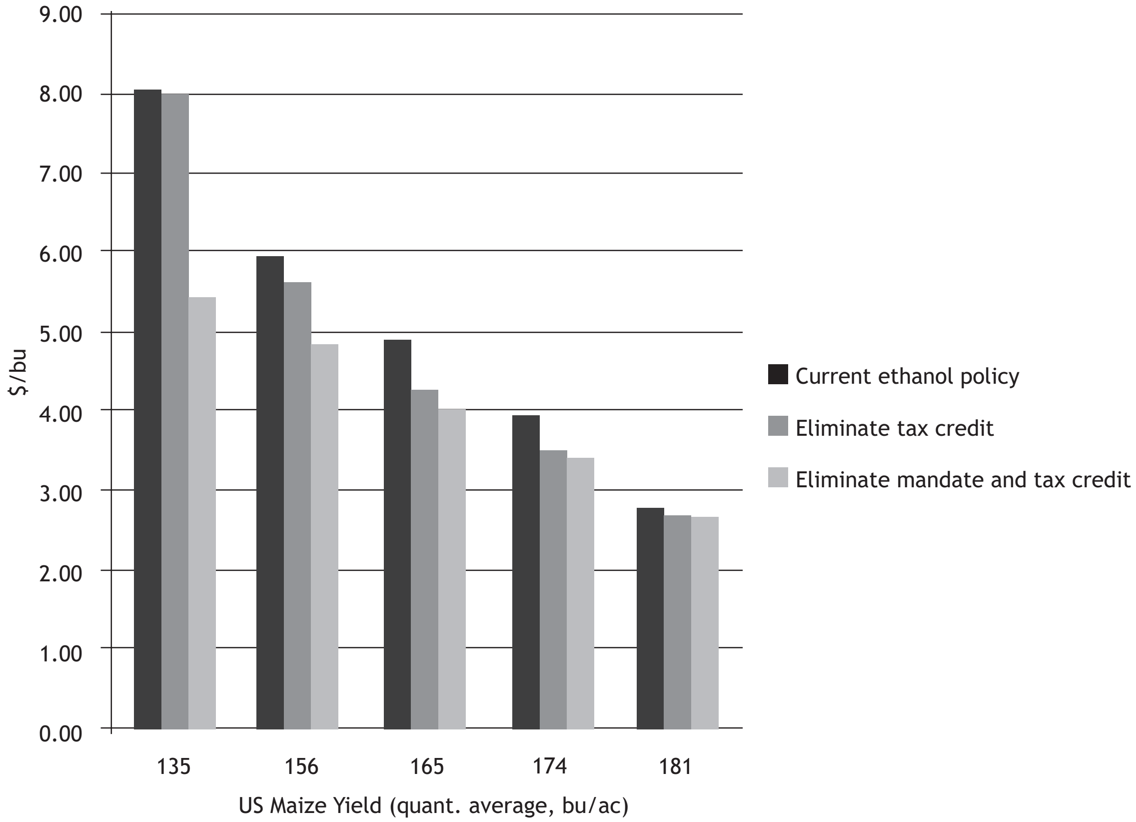
The Table 7 results are averages across all market outcomes. Hence, they mask important interactions between the conditions that give rise to the largest policy effects. One important condition is feedstock supply. When feedstock supplies are tight, mandates are more likely to determine ethanol production levels. Thus, mandates are likely to have their largest impact under tight feedstock supply conditions.

The results presented in Table 7 do not fully reflect the role that variability in feedstock supply has on market outcomes under different policy scenarios because two-thirds of feedstock supply is fixed. That is, only one-third of feedstock supply for the 2011 calendar year comes from the uncertain size of the 2011 crop. A separate set of simulations were conducted for the 2011/12 marketing year for the ethanol market only to gain insight into how current US policy tools impact the market under different feedstock supply scenarios.

Model results were sorted accordingly to the size of the 2011 US maize crop. Because ending stocks from the 2010 crop will be so low, total maize for the 2011 marketing year is quite sensitive to 2011 crop yields. Maize prices corresponding to five quantiles of crop yields are calculated for each policy scenario. The results are presented in Figure 9.

The first aspect of Figure 9 to notice is the wide range in price outcomes in 2011. If yields approach record levels, then market prices will fall dramatically from current levels. If yields are quite low, then prices will soar if current ethanol policies are maintained. Under current ethanol policies, price volatility across the 500 market outcomes is 37 percent.[10] This high volatility results from the lack of carryover stocks from 2010.

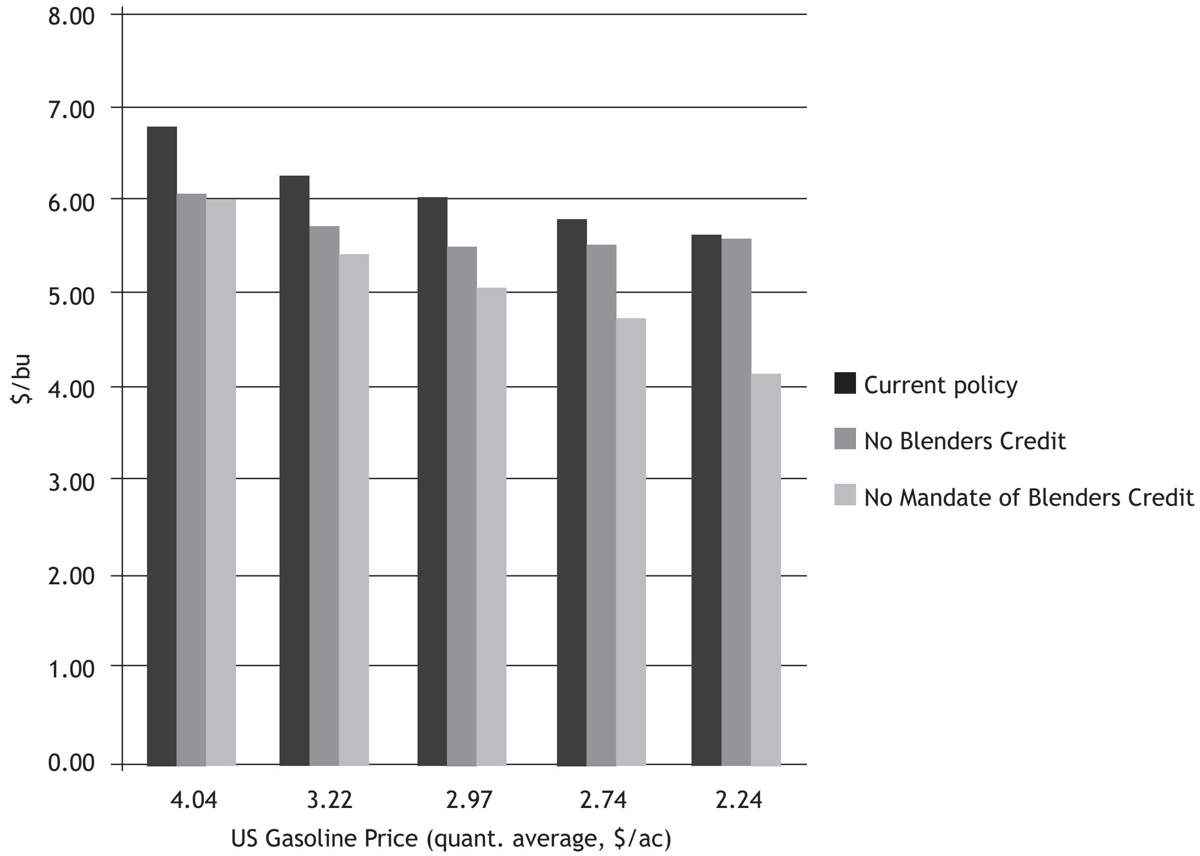
Figure 9. Marketing Year 2011 Maize Prices Conditional on Maize Yield



It is apparent that the effects of US ethanol policy are not constant across scenarios. As expected, elimination of the blender tax credit when supplies are tight has almost no impact because the mandate keeps ethanol production high. But elimination of the tax credit and the mandate under tight conditions dramatically lowers maize prices, from about $8.06 per bushel to $5.46 per bushel or by 32 percent. This means that current US ethanol policy exacerbates tight market conditions by forcing all demand adjustment to tight supplies on non-ethanol users of maize, which disproportionately impacts the livestock sector. Increases in maize yields decrease the impacts of US subsidies and mandates. Under abundant supplies, US policies have almost no impact because US ethanol plants are running at capacity.

The effects of US biofuel policies are not constant across gasoline prices either. Figure 10 shows maize prices across five quantiles of gasoline prices. When gasoline prices are high, so too is the market demand for ethanol so that the mandate does not determine production levels. Addition of the blender tax credit stimulates ethanol demand further, thereby pushing maize prices even higher. When gasoline prices are low, mandates bind and the blender tax credit has very little impact on maize prices. In contrast, mandates have little impact when gasoline prices are high and they have a large impact when gasoline prices are low. This suggests that if maize price stability is a policy objective, then mandates stabilize maize prices with respect to variations in gasoline prices. But as shown in Figure 9, mandates exacerbate the market impacts of tight supplies by forcing all demand adjustment onto the livestock sector.

Figure 10. Marketing Year 2011 Maize Prices Conditional on Gasoline Prices



The price impacts of US policy across various crop yield and gasoline prices are summarized in Figures 11 and 12. Figure 11 clearly shows that the effects of the mandate are highest when feedstock supplies are low. Figure 12 shows that the effects of the blender tax credit are highest when gasoline prices are high. These results give insights into how current US policies can be altered to enhance price stability while maintaining a viable biofuel industry.

Figure 11. Impact of US Policies on Maize Prices Conditional on Maize Yield

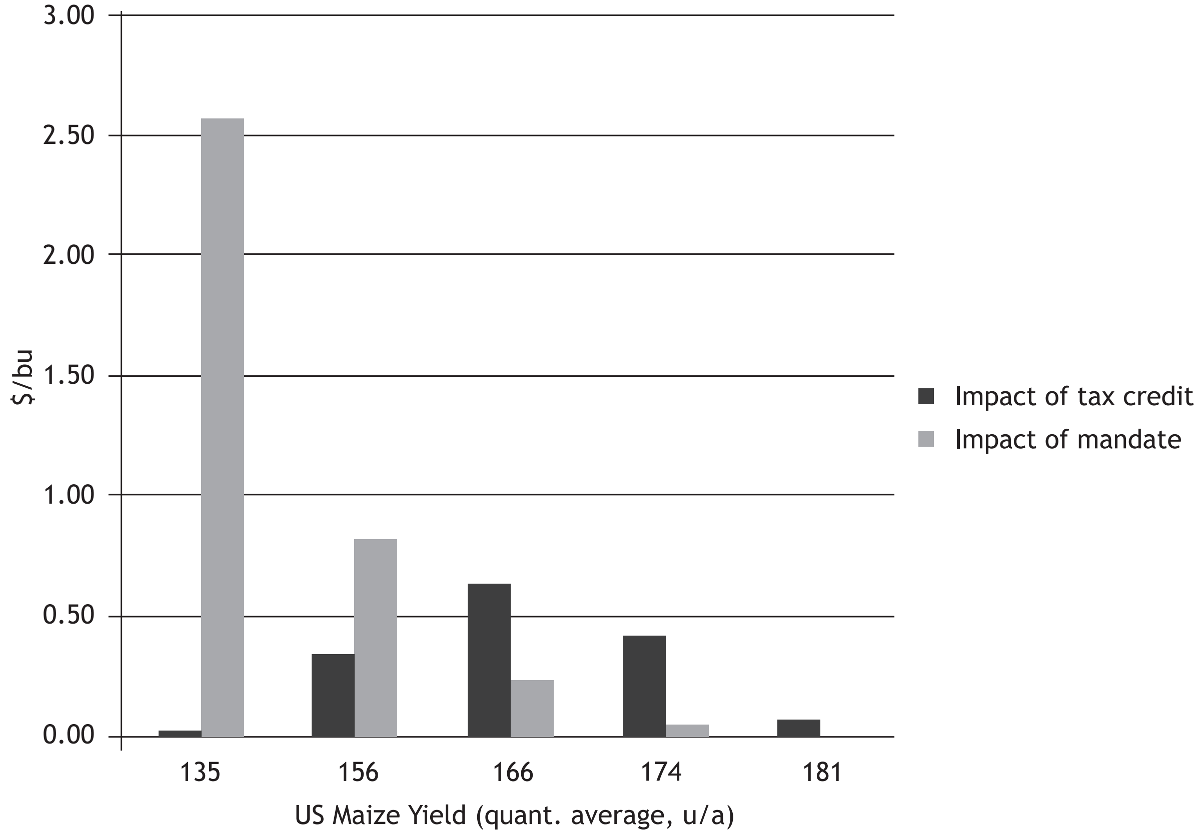
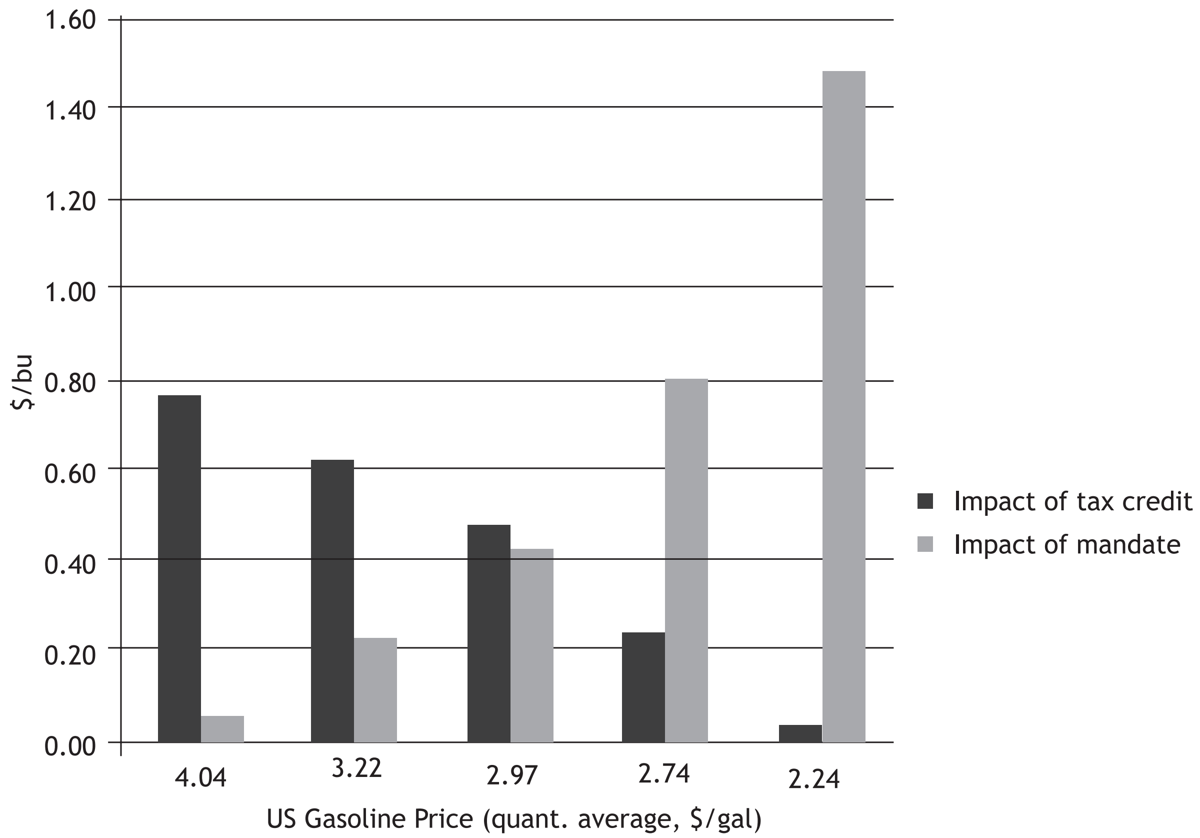


Figure 12. Impact of US Policies on Maize Prices Conditional on Gasoline Price



5. ALTERNATIVE POLICY OPTIONS FOR ADDRESSING VOLATILITY

The results developed in the previous two sections show that US ethanol policies modestly increased maize prices from 2006 to 2009 and that under tighter market conditions, such as we have seen in 2010 and so far in 2011, market impacts of the policies will be larger. The effects of US biofuel policies on other crop prices and the overall impact on food prices has been modest, although higher feed costs will eventually be fully reflected in modest increases in egg, milk and meat prices.

The fact that current policies have their largest impacts on crop prices when other market forces have also driven market prices higher suggests that US biofuel policies increase price volatility, particularly on the upside when demand for feedstocks is high or supplies are short. That current biofuel policies work to destabilize maize prices is unfortunate because the existence of a large biofuel industry could lead to increased price stability rather than decreased stability.

Because ethanol and biodiesel are close substitutes for gasoline and diesel, the demand for maize and vegetable oil by the biofuel industry is much more sensitive to price than is the demand for livestock feed and the food sector. That is, the demand for feedstocks by the biofuel industry is potentially much more elastic than the demand for feed and food. A historically inelastic demand for major agricultural commodities is a primary reason why agricultural prices are so volatile. Adding an elastic demand from the biofuel industry therefore should stabilize prices. But this elastic demand will only manifest itself if markets are free to adjust. When maize supplies are tight because of poor yields, ethanol production should be allowed to decline, which implies that gasoline blenders would reduce the percentage of ethanol in their blends. This reduction would free up feed for the livestock industry, and the price impacts of low yields on crop prices would be relatively small. If supplies are plentiful and prices would otherwise drop dramatically (animals can only eat so much feed), the biofuel industry would ramp up production and blenders would find it profitable to increase the percentage of ethanol in their blends. The surplus of crops would be much smaller, thereby ameliorating any price drop.

Market stability works best when the most elastic market does most of the adjusting to supply and demand shocks. But current US policy does not allow this type of adjustment. When feedstock supplies are tight, mandates are binding so the biofuel sector does very little adjustment.[11] When gasoline prices are high and the market demand for ethanol increases, blender tax credits push demand even higher, thereby increasing the amount of adjustment that needs to take place by the livestock sector. Thus, the potential of using biofuels to stabilize prices is not being achieved.

Another problem with US biofuel policy is that the most economical form of biofuels, ethanol, cannot be used at higher volumes by the US automobile fleet because of a lack of availability of FFVs and 85 percent blends and a fuel policy that until very recently capped US ethanol consumption at about 14 billion gallons. A more elastic demand for feedstock can be achieved only if production and consumption of biofuels is allowed to increase when supplies of feedstock are plentiful and allowed to decrease when feedstock supplies are tight. However, caution should be taken with respect to expanding the use of biofuels in the US vehicle fleet. If such an expansion is accomplished using maize as a feedstock, and the expansion is enforced by mandates rather than the market, then this expansion would likely exacerbate the problems caused by a combination of mandates and tight feedstock supplies.

The recent decision by the US Environmental Protection Agency to allow 15 percent ethanol blends in newer vehicles does increase upside flexibility if its implementation is accompanied by investments in new fuel pumps that can increase blend ratios when ethanol is inexpensive. However, the existence of ethanol mandates and blender tax credits as well as the import tariff that keeps Brazilian ethanol out of US markets (when it is less expensive) reduces the ability of world feed markets to cope with unexpected supply disruptions.

A straightforward path toward a more flexible policy exists. There really is no justification for the blender tax credit. Its impact is mainly felt when demand for biofuels is already high because the tax credit then pushes demand beyond mandated levels, thereby destabilizing feedstock prices further. Furthermore, this type of demand subsidy can reduce fuel costs, which works counter to conservation efforts. When mandates bind, the blender tax credit acts as a lump-sum payment to fuel blenders, subsidizing the blending that they are already obligated to do. Elimination of the blender tax credit would save taxpayers money and would stabilize maize prices when gasoline prices are already high. This policy alternative is consistent with the recommendations contained in Appendix D of the report for the G-20 by various international organizations titled "Price Volatility in Food and Agricultural Markets: Policy Responses". The current proposal being considered by the US Congress to make the blender tax credit countercyclical to world oil prices (increasing when oil prices decrease and decreasing when oil prices increase) would decrease upward price pressure on maize prices when oil prices are high but would not reduce price pressure when maize supplies are low.

The current tight market conditions in Brazil along with Brazil's growing demand for ethanol suggest that there is little to be lost politically or economically to letting the US ethanol import tariff expire. At this time and for the next year or two, there simply will be little Brazilian ethanol available for export. This will continue to be the market situation unless domestic demand in Brazil weakens, sugar prices fall substantially, the Brazilian currency falls or investment in ethanol and sugar facilities dramatically increases. Allowing the tariff to expire while the US is exporting ethanol to Brazil will stabilize US crop prices if market conditions in Brazil change to allow them to have exportable surplus once again.

The last piece of a more flexible policy is to adopt a flexible mandate policy, as recommended in Appendix D of the G-20 report referenced above. It makes little sense to enforce a mandate when livestock feeders are going out of business because of a sharp increase in feed costs. As shown in Figure 11, waiving the mandate when maize prices are rising because of tight supplies will dramatically reduce the overall market impacts of this policy tool. The knowledge that the mandate will be enforced when feedstock supplies are more abundant will give the biofuel industry confidence that their industry is viable in the long run. As recognized by the international organizations, developing an appropriate mechanism that would trigger a waiver of mandates would be difficult to develop. One option is the RIN banking and borrowing provisions already included in the RFS under which blenders can bank RINs when feedstock supplies are plentiful and use them to meet blending obligations when feedstock supplies are tight. Current limits on banking and borrowing could be expanded to introduce even more flexibility into the current system.

However, introducing more flexibility in the mandate when feedstock supplies are tight will do little to alleviate pressure on prices if high energy prices occur at the same time, which is the situation that we have today. Market-driven demand for biofuels could still drive maize prices high even if the mandate is waived and the tax credit is eliminated or made countercyclical to crude oil prices. But if such a situation occurs, it would be obvious that it was solely market forces at work driving prices higher and not government biofuel policies.

Biofuels and conservation are the only short- to medium-run substitutes for gasoline and diesel in the US transportation sector. When feedstock prices are low and transportation fuel prices are high, it makes economic sense to produce biofuels. A robust biofuel industry also has the potential to stabilize agricultural commodity prices by adding more flexibility to overall demand for crops. In addition, biofuel production has the additional benefit of reducing greenhouse gas emissions to varying degrees.

But current US biofuel policies do not always achieve these objectives. Mandates force biofuels to be produced even when feedstock prices are so high that they make no economic sense to produce, such as is the case currently for US biodiesel. And the blender tax credit has a market impact primarily when the market demand for biofuels is already high, such as is the case currently in the US corn ethanol industry. This exacerbates the impact of high feed prices on the livestock industry. A more flexible policy that includes elimination of the tax credit, granting waivers to mandates when feedstock supplies are tight, and increasing the demand potential for ethanol with higher blends (without subsidies) has the potential to lead to more stable feedstock prices. There is no meaningful economic reason why these steps cannot be quickly taken. Their adoption would lead to a more market-oriented, flexible US biofuel industry.

ENDNOTES

1 This study measures impacts of biofuels on both commodity prices and food prices. Commodity prices are market prices for maize, soybeans, wheat, rice, soybean oil and soybean meal. Food prices in this study include US retail prices for beef, pork, chicken meat (broilers) and eggs.

2 A marketing year begins just before harvest. So, for example, the 2009 marketing year for maize and soybeans runs from September 1, 2009, to August 31, 2010.

3 Gardner (2007) shows how to convert this excess supply of maize into ethanol and how to translate an ethanol price into a corresponding maize price to then find the supply curve of ethanol.

4 Ethanol supply was obtained from UNICA projections. Demand was estimated from monthly consumption data. The resulting demand curve is consistent with Salvo and Huse (2011). Although the demand curve in Figure 3 seems to be linear, it is actually the S-shaped demand curve that is used in the forward-looking analysis.

5 The Brazilian ambassador to the United States, Mauro Vieira, was quoted in the *Des Moines Register* (May 18, 2011) as saying “as long as we need it, we’ll import it”, in response to a question about why Brazil imported so much ethanol from the US in the first part of 2011.

6 See Babcock, Barr and Carriquiry (2010) for an explanation of the market for RINs.

7 Because the analysis begins in 2005, no accounting is done for how subsidies in previous years may have “set up” the industry for rapid expansion beginning in 2005 and 2006.

8 See the May 11 version of “World Agricultural Supply and Demand Estimates” (WASDE) published by the World Agricultural Outlook Board of the US Department of Agriculture. The latest version of this report is available at http://www.usda.gov/oce/commodity/wasde/latest.pdf

9 Up to 20 percent of any current year’s blending obligations can be met by banked RINs.

10 Current (as of June 10, 2011) implied volatilities on new crop futures contracts are 27 percent. This lower number implies that traders have information about 2011 US maize yields that is not reflected in the yield distribution underlying Figure 9. In particular, widespread yield loss due to drought is much less likely than assumed in the Figure 9 yield distribution because of high rainfall amounts in April, May and so far in June, which has built up significant soil moisture reserves. The large amounts of rainfall also make it less likely that very high record corn yields will be achieved in 2011.

11 The banking and borrowing in the market for RINs does give some flexibility to the mandates, particularly if the sector has banked RINs that they can use to meet mandates when feedstock supplies are tight.

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