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How Low Will Corn Prices Go?

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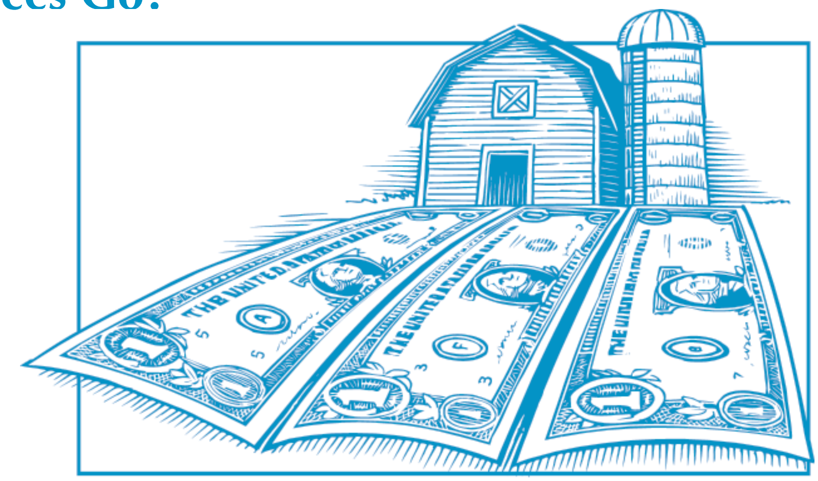

The recent dramatic decline in crop prices is a boon for livestock producers but a bust for crop producers, particularly for producers who just agreed to pay high rents. More generally, the tremendous volatility in all commodity markets makes it nearly impossible for producers and the food industry to plan for the future. But farmers need to begin planning for their 2009 crop, and food producers need to make procurement plans for the remainder of this marketing year. The type of plan that will be profitable depends on the answers to a number of key questions: Have we seen the end of high corn prices? Will prices continue to decline, and if so, how low will they go? Have we seen the end of the food versus fuel debate?

Making predictions about commodity prices in such a volatile market may seem foolhardy. However, there are key factors that can be examined to gain insight into where prices may be headed. But before we examine these factors, it is instructive to review exactly how the market price of corn—the major feedstock for ethanol—is determined.

Determining the Market Price of Corn

Corn is fed to domestic livestock, converted into ethanol, fed to livestock in export markets, and used as a food ingredient. Each user within these groups has a maximum price he or she can pay for corn. This maximum price is the threshold price that if exceeded causes the user's demand for corn to fall to zero. That is, the user shuts the operation down or switches to an alternative to corn.

The market price of corn is determined by the user with the lowest maximum price such that the total demand for corn at this price equals the total supply of corn. This last user is often referred to as the marginal user of corn. Most domestic livestock feeders have a very high maximum price they can pay for corn because they must keep their animals alive and alternative feeds are generally priced relative to the corn price. Food manufacturers also have a high willingness to pay for corn because corn represents such a small share of their total costs. This high willingness to pay for corn explains why corn prices can climb so dramatically when shortages occur. Conversely, when corn supplies are plentiful, the price of corn can drop dramatically because there are not many important corn users with a low maximum price of corn.

Prediction of corn prices is difficult in any year because we cannot know for certain which user of corn will be the user with the lowest maximum price. Looking at the 2009 crop, we do not know who the marginal user will be because we do not know what total supply will be. However, we may find some clues about who the marginal user in 2009 will be by looking at projected supply and demand balances for both 2008 and 2009.

Non-Ethanol Users of Corn

The USDA projects that in the 2008 marketing year, the domestic livestock industry will consume about 5.4 billion bushels of corn, corn exports will be about 2 billion bushels, and other uses (food, seed, and non-fuel industrial) will be about 1.3 billion bushels. Because the variation in the maximum willingness to pay for corn by the domestic livestock industry and by the food and seed sectors is not high, we can treat their 2009 demands as approximately fixed at these levels. Potential importers of U.S. corn in 2009 have more variation in their maximum willingness to pay for corn, so export numbers will vary somewhat with U.S. supplies.

These three demand sources, most of which have a very high maximum willingness to pay for corn, sum to 8.7 billion bushels. This means that if the supply of corn in 2009 falls below 8.7 billion bushels, then the price of corn will skyrocket. In fact, supplies will need to be much greater than 8.7 billion

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bushels to avoid high corn prices because demand from the ethanol sector has not yet been accounted for.

Ability of Ethanol Producers to Pay for Corn

The maximum price of corn for ethanol producers is the price above which they begin to lose money. For a time, ethanol plants will buy corn so long as they cover all their operating costs. In the longer run, though, they must also cover their capital costs. Ethanol plants sell ethanol and distillers grains and buy corn, natural gas, electricity, and labor. Given representative operating cost estimates and the relationship between the price of distillers grains and the price of corn, it is straightforward to calculate the price of corn that just covers operating costs. Table 1 shows the maximum price of corn that an efficient ethanol producer can pay at various ethanol prices. As shown, a 50¢ change in the price of ethanol changes the operator's ability to pay for corn by $1.93 per bushel.

In the corn marketing year that just ended on August 31, domestic livestock feeders, food users, and importers used about 10 billion bushels of corn. Corn production was about 13 billion bushels. Ethanol producers used the difference, about 3 billion bushels. If non-ethanol users last year had high maximum prices for corn, then the ethanol industry was the marginal user of corn. If ethanol was the marginal user, then the market price of corn should be determined by ethanol producers' ability to pay for corn.

Figure 1 shows the ethanol industry's break-even corn prices and actual market prices since March of 2005. Note that before the fall of 2006, there is no evidence that the ethanol industry was the marginal user of corn. The reason is that corn supplies were more than adequate to supply the industry. During this period, the export market was likely the marginal user of corn. The

Table 1. Break-even prices of corn

Price of Ethanol $/gallon	Break-Even Price of Corn $/bushel
1.00	1.73
1.50	3.66
2.00	5.59
2.50	7.51
3.00	9.44

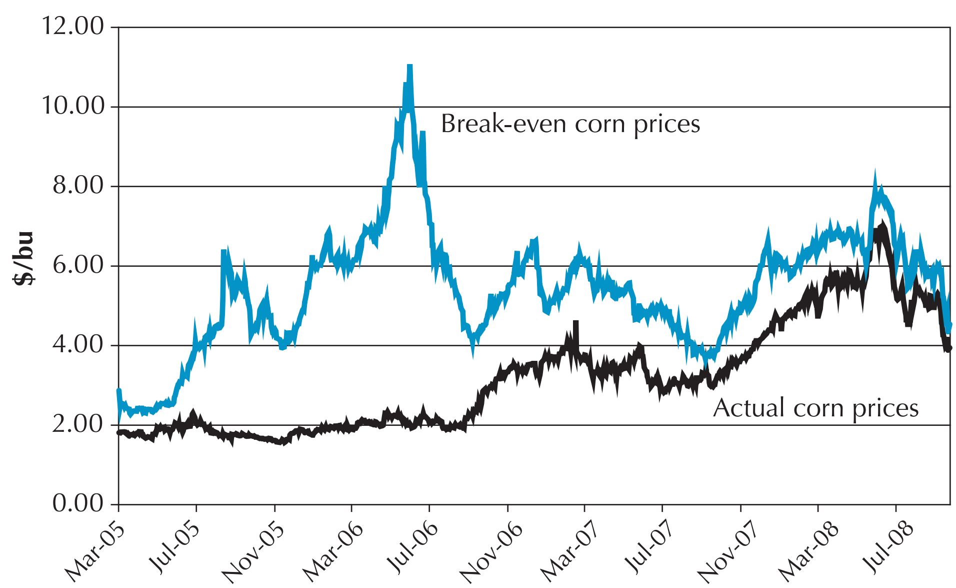

Figure 1. Break-even and actual corn prices

large gap between the break-even corn prices and actual corn prices explains why it was so profitable to produce ethanol during this time.

More recently, there is a much closer relationship between the ability to pay for corn to produce ethanol and the price of corn. Since the fall of 2007, it is clear that the ethanol industry has been the marginal user of corn. Variations in the break-even price of corn explain about 85 percent of the variation in the price of corn over the last year. The remaining variation is largely accounted for by uncertainty about the size of the 2008 crop. Note also that the difference between the break-even corn price and the actual corn price has been narrowing over time. This narrowing illustrates the very tight margins that currently exist in the ethanol industry.

The marginal user of corn for the remainder of the current marketing year (ending July 31, 2009) will either be the ethanol industry or speculators who will buy corn and store it until the following year if corn prices get too low. If the ethanol industry is the marginal user then to predict the market price of corn, all we need to do is predict the break-even price of corn in the ethanol industry.

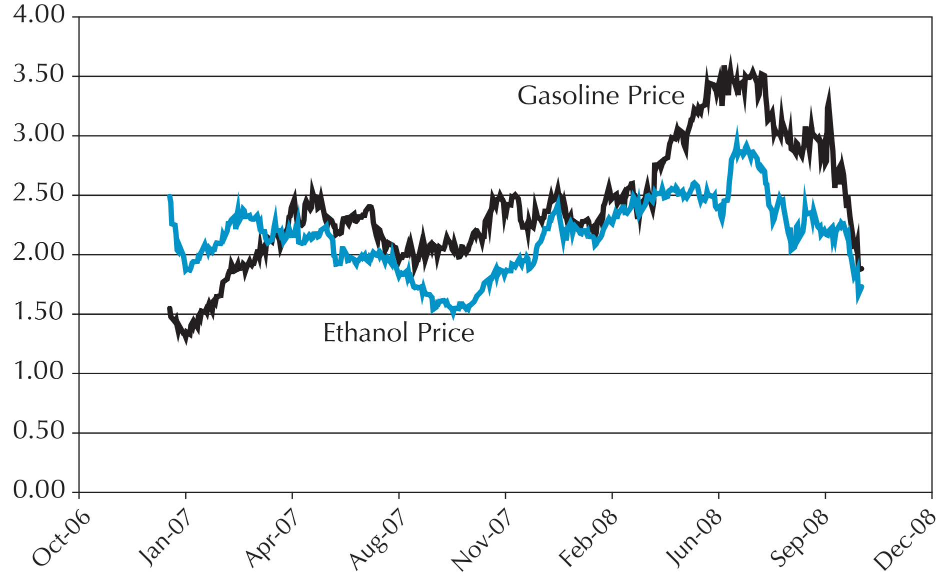

Figure 2. Relationship between gasoline and ethanol prices

Predicting the Ethanol Industry's Ability to Pay for Corn

The key factor that determines the ethanol industry's ability to pay for corn is the price of ethanol. Because ethanol is a substitute for gasoline and because the price of gasoline closely follows the price of crude oil, it seems logical that knowing the price of crude oil alone should allow us to predict the price of ethanol. But the relationship between crude oil and ethanol prices is not that straightforward. As shown in Figure 2, the variable relationship between gasoline and ethanol prices complicates matters. Before April of 2007, ethanol prices were higher than gasoline prices. Since April of 2008, ethanol prices have been much lower than gasoline prices. One explanation for this change is that the rapid expansion in ethanol production has forced ethanol to compete directly with gasoline as a substitute fuel, and the price of ethanol has been forced down to create an incentive for blenders in the Southeast to expand their blending infrastructure.

An equation that has been used to predict prices sets the price of ethanol at 68 percent of the price of gasoline (to account for ethanol's lower energy value) plus the blenders tax credit (to account for the per gallon benefit of the ethanol subsidy). But this equation has over-predicted the price of ethanol by about 8 percent since June of 2008.

If ethanol continues to be priced 8 percent below its energy value, then if we know the wholesale price of gasoline, we can predict the price of corn. Table 2 provides these estimates for crude oil prices between $50 and $120 per barrel, accounting for the recent wedge between calculated break-even corn prices and actual corn prices shown in Figure 1. If crude oil prices stabilize at $80 per barrel, the price of corn will stabilize at approximately $3.77 per bushel. As shown, if crude oil climbs once again to $120 per barrel, then we should see corn prices climb again to the $6.00-per-bushel mark.

Table 2. Predictions of corn prices for alternative crude oil prices

	Price of:		
Crude $/barrel	Gasoline $/gallon	Ethanol $/gallon	Corn $/bu
50	1.26	1.20	2.18
60	1.52	1.36	2.71
70	1.77	1.52	3.24
80	2.02	1.67	3.77
90	2.27	1.83	4.30
100	2.53	1.99	4.82
110	2.78	2.15	5.35
120	3.03	2.30	5.88

The estimates in Table 2 should be alarming to corn farmers: if crude oil falls to $50 per barrel, then the ability to pay for corn by the ethanol industry will fall back to around $2.15 per bushel. Because this price is much lower than current production costs, crop farmers would face severe financial stress. But we should never see corn prices

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Who's Using All the Ethanol?

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Guest Contributor

U.S. consumers are on track to consume 138 billion gallons of gasoline in 2008 (down from 142 billion gallons in 2007) and approximately 9 billion gallons of U.S.-produced ethanol plus perhaps another 800 million gallons of imported ethanol. Fuel blenders have a strong incentive to use all this ethanol because they receive a 51¢-per-gallon subsidy (the blenders tax credit) from taxpayers. In addition, since February of this year, the price of ethanol has been less than the price of gasoline. U.S. Environmental Protection Agency (EPA) regulations allow blended fuel to contain up to 10 percent ethanol. California regulations allow up to 5.7 percent blends.

Benefit of Blending

The net benefit of replacing a gallon of gasoline with a gallon of ethanol depends on whether gasoline blenders perceive that ethanol is a perfect substitute for gasoline on a volume basis or an energy basis. At a 10 percent blend, it is doubtful whether most consumers perceive a change in gas mileage, so it is likely that gasoline blenders value ethanol on a par with gasoline on a volume basis. Figure 1 shows the per gallon net benefit from using a gallon of ethanol instead of a gallon of gasoline. This net benefit equals the price of ethanol (as reported by the USDA's Agricultural Marketing Service for Iowa) minus the wholesale price of gasoline (as reported by the New York Mercantile Exchange for reformulated gasoline) plus the blenders tax credit. Multiplying the daily benefit by the daily quantity of ethanol used results in an aggregate benefit to gasoline blenders of approximately $7.4 billion from February 2007 to October 2008. To the extent that gasoline producers are also blenders, this benefit works to offset their losses caused by the negative impacts of expanded ethanol production on gasoline prices.

Given the large incentive to use ethanol, it is no surprise that a growing proportion of gasoline contains ethanol. The U.S. Department of Energy reports the proportion of both reformulated gasoline and conventional gasoline that contains ethanol. Reformulated gasoline is sold in regions of the country that are required to use it under the Clean Air Act. As shown in Figure 2, the phase-out of the additive MTBE in the spring of 2006 resulted in ethanol being used in practically all reformulated gasoline. Plentiful ethanol supplies and a large incentive to substitute ethanol for gasoline greatly increased the proportion of conventional gasoline that contains some ethanol from less than 20 percent in the fall of 2006 to more than 50 percent today. Currently, more than 70 percent of U.S. gasoline contains ethanol.

The Blend Wall

The Renewable Fuels Standard (RFS) mandates use of 15 billion gallons of ethanol by 2015. Given that flex-fuel vehicles are primarily driven in regions where E85 is not available, almost all of this 15 billion gallons will be consumed as a 10 percent blend unless the EPA decides to allow higher blends. At a 10 percent blend, 15 billion gallons of ethanol would be blended with 135 billion gallons of gasoline. Unless total motor fuel consump-

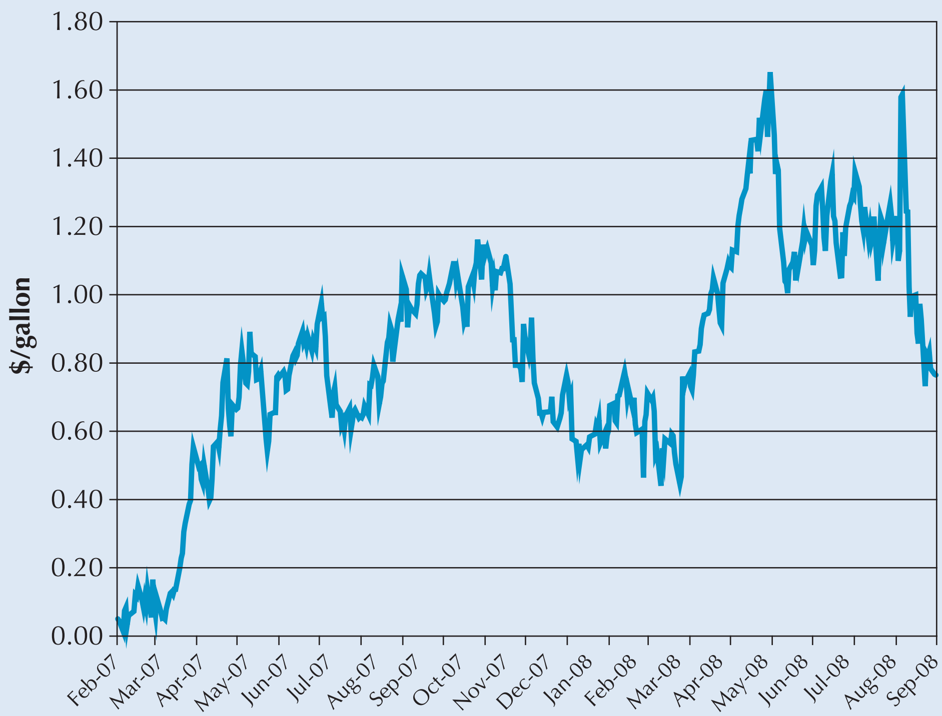

Figure 1. Per gallon benefit to blenders of replacing gasoline with ethanol

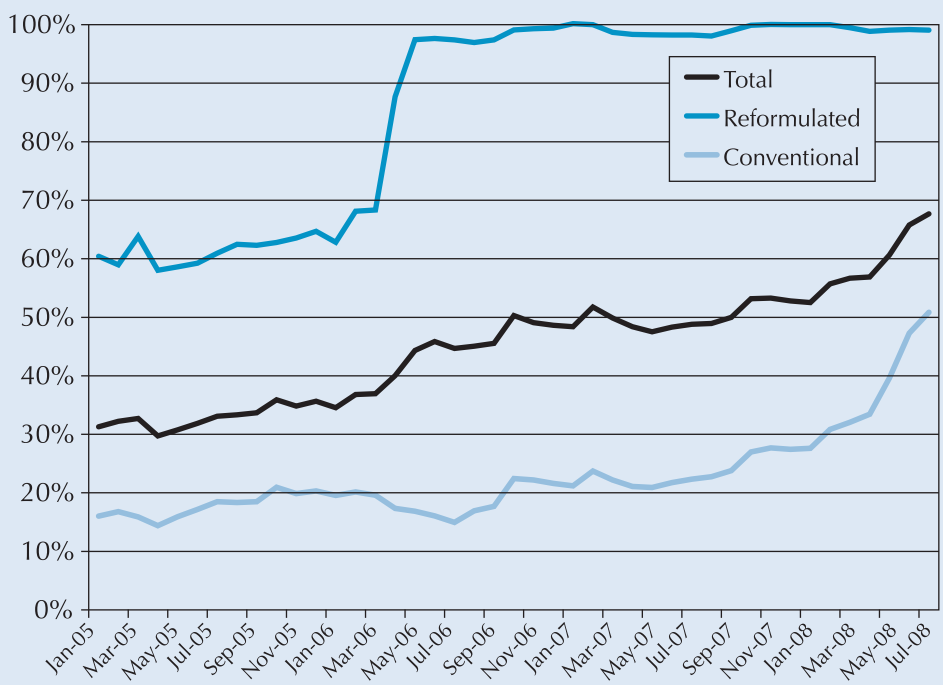

Figure 2. Share of U.S. gasoline containing ethanol

tion grows substantially in the next few years, nearly every gallon of gasoline will need to be blended at a 10 percent blend to meet the RFS. But it would be quite costly to blend every U.S. gallon of gasoline with ethanol. Ethanol is already being shipped to all the low-cost and most of the medium-cost blending locations. Continued large price discounts will be needed to attract investment in blending capability and ethanol transport to the remaining locations. Furthermore, a portion of the U.S. population apparently does not want to use ethanol blends in vehicles. Convincing these people would require hefty price discounts. It seems inevitable that the United States will hit an economic "blend wall" before the 15-billion-gallon mandate is met.

If this blend wall is reached when 85 percent of the U.S. gasoline supply is blended with 10 percent ethanol, and total fuel consumption stays at 150 billion gallons, then about 115 billion gallons of gasoline will be blended with 10 percent ethanol. This would account for a bit less than 13 billion gallons of ethanol, leaving 2 billion gallons of ethanol without a ready market. Forcing this ethanol into the remaining 15 percent of U.S. gasoline would severely drive down ethanol prices. Exporting the ethanol would be difficult because the United States would be vulnerable to charges that it was dumping subsidized ethanol on export markets.

Is the Solution E12?

There is a contradiction between the RFS mandates, EPA blending regulations, and the interests of U.S. ethanol producers. This contradiction is even more evident once we consider the need to find a market for the additional 20 billion gallons of advanced biofuels mandated by the RFS. One short-term solution would be for EPA to simply find that E12 (12 percent ethanol blend) is a substantially similar motor fuel to E10. Then 15.5 billion gallons of ethanol could be blended into the 115 billion gallons of gasoline without causing the price of ethanol to be driven down even more. But this does nothing to make room for the advanced biofuels that may soon be hitting the market. ◆

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Splashing and Dashing Biodiesel

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Volumetric excise tax credits—more commonly known as blenders tax credits—have been in place since 1978 for ethanol and since 2004 for biodiesel. The ethanol subsidy will fall from its current level of 51¢ per gallon today to 45¢ per gallon on January 1. The biodiesel subsidy is $1.00 per gallon (50¢ per gallon for previously used oils or grease). The subsidy is paid on every gallon of ethanol or biodiesel that is blended in the United States with any quantity of fossil fuel. All biofuels blended with fossil fuels are eligible for the subsidy regardless of where the biofuels were produced or where the blend is consumed. The blenders tax credit reduces the tax liability of blenders, so it is equivalent to the U.S. Treasury writing a check to blenders for each gallon of biofuels they use. The purpose of the subsidy is to increase the willingness of blenders to buy U.S.-produced biofuels and to increase the domestic price of biofuels. It has undoubtedly met these objectives for U.S.-produced corn ethanol. But opponents of the biodiesel blenders credit argue that its main effect is to subsidize biodiesel produced in Southeast Asia, South America, and Europe that is destined for European consumption.

Incentives to Splash and Dash

European biodiesel producers were the first to protest against the sharp increase in biodiesel imports coming from the Unites States beginning in 2007. The Europeans argue that the only reason U.S. exports have increased is a misuse of the blenders tax credit through a mechanism called "splash and dash." The practice consists of blending ("splashing") 0.1 percent of U.S. diesel fuel with 99.9 percent of imported biodiesel and then shipping ("dashing") the resulting blend to the European Union.

Instead of U.S. taxpayers taking the lead in stopping this misuse of a domestic biofuels program, it is the European biodiesel industry that has argued most strenuously against what it calls an unfair trade practice.

The payoff to splash and dash is large. Consider a 2.5 million gallon shipment of Malaysian biodiesel destined for Europe. At a biodiesel price of $4.00 per gallon, this shipment is worth $10 million. If the tanker makes a port stop in the United States and adds 25,000 gallons of diesel to its load, the company will collect a $2.5 million tax credit, thereby increasing the value of its cargo by 25 percent. This additional payment potentially allows imported biodiesel to compete successfully with E.U.-produced biodiesel. The incentive to re-export imported biodiesel is so high that tankers of biodiesel produced in Europe were shipped to the United States this summer to receive the $1.00-per-gallon subsidy.

Instead of U.S. taxpayers taking the lead in stopping this misuse of a domestic biofuels program, it is the European biodiesel industry that has argued most strenuously against what it calls an unfair trade practice. The Europeans claim the mechanism is damaging local producers, constitutes export dumping, and that the program violates World Trade Organization agreements. The European Biodiesel Board presented a formal complaint before the European Commission, which found sufficient evidence to launch an investigation. The investigation will determine whether placing tariffs (either countervailing or antidumping) on U.S. biodiesel is warranted. On the U.S. side, there is growing opposition as the cost to taxpayers increases to the millions of dollars. Legislation that would prevent imported biodiesel that is subsequently exported from collecting the subsidy passed the House of Representatives and Senate and has been sent to a conference committee. The bill (H.R. 6049) has the support of the National Biodiesel Board. But critics (including European producers) contend that it does not go far enough in solving the problem, because U.S.-produced biodiesel could still receive the subsidies before being shipped overseas.

For the E.U. claims of subsidy-driven triangulation and increased exports to be plausible, we should expect to see simultaneous increases in levels of both imports and exports of biodiesel in the United States. Notice, however, that this does not necessarily provide irrefutable evidence that biodiesel is being routed through the United States with the sole purpose of collecting subsidies. The trade statistics can also be used to provide a rough estimate of how much U.S. taxpayers are spending to subsidize fuels to be consumed abroad. The distribution of the benefits across regions can also be approximated.

Estimation of Taxpayer Losses

Obtaining accurate figures of international trade of biodiesel is not easy because biodiesel trade data is combined with data on other goods in trade records. However, reasonable approximations can be made.

U.S. biodiesel trade has increased sharply since 2005. While imports increased by over 210 percent between 2006 and 2007, exports increased by a staggering 684 percent in the same period (Figure 1). The figure also shows that trade will likely experience another significant jump in 2008 since both imports and exports largely exceeded the 2007 figures in the first eight months of the year alone. The European Union is the destination of a vast majority of biodiesel exports. Imports from Southeast Asia surged during 2006 and 2007. South America is currently challenging that dominance, mainly because of the rapid growth of the Argentinean industry.

Further insight into the destination of biodiesel produced or imported into the United States can be gained by incorporating information on domestic production and consumption (Table 1). Clearly, domestic production experienced a strong increase between 2006 and 2007 and is poised for continued growth during 2008. However, consumption figures point to a different story, whereby declines seem likely this year, indicating that U.S. producers are favoring the European Union over domestic destinations for their product. Interestingly, exports have exceeded production levels during the first eight months of 2008, hinting that at least some of the exports originated abroad.

It is reasonable to assume that all biodiesel produced in the United States or imported will claim the blenders credit. In this case, the biodiesel tax credit has cost taxpayers about $1.28 billion between January of 2007 and August of 2008. About $360 million of this amount was awarded to foreign-produced biodiesel.

On the demand side, $504 million was used to subsidize biodiesel consumed in the United States whereas $782 million was used to subsidize biodiesel consumed by the European Union. The implications of closing the splash-and-dash loophole are difficult to ascertain, as this will affect the dynamics of both domestic production and international trade.

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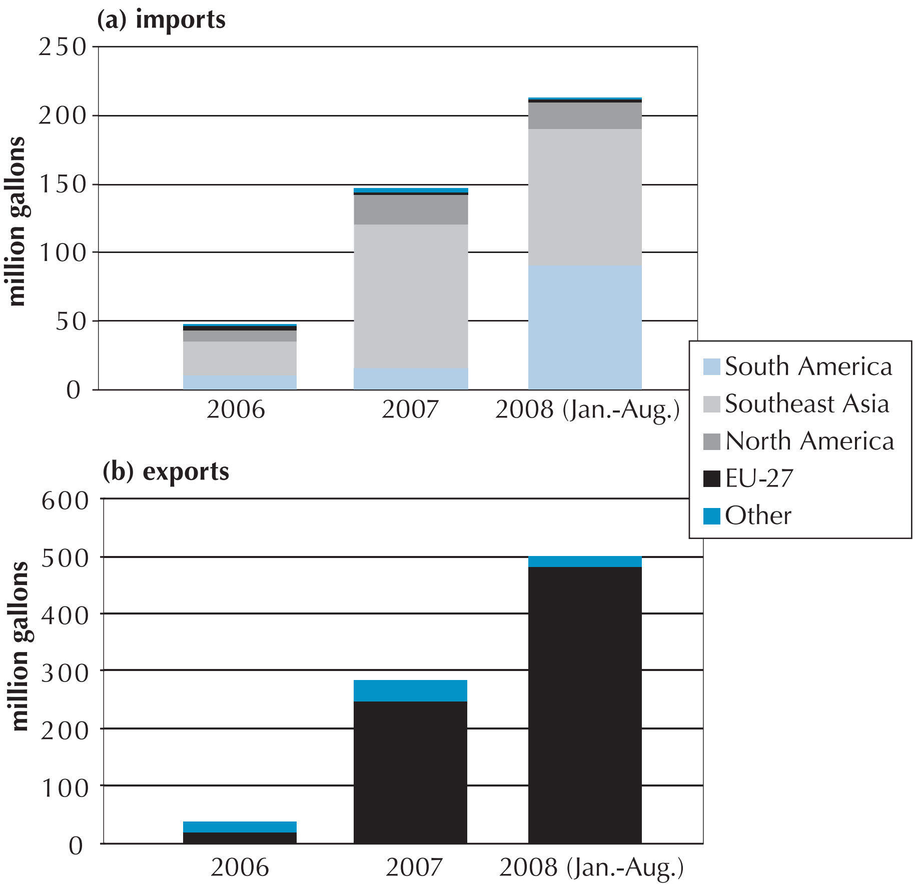

Source: Constructed by the authors using USDA-FAS data.

Figure 1. United States imports (a) and exports (b) of biodiesel by main destination for the 2006–2008 (January–August) period

Table 1. Supply and utilization of biodiesel for the 2006–2008 period

	Exports	Imports	Production	Consumption[a]
		(million gallons)		
2006	36	47	199	209
2007	283	146	487	350
2008 (Jan.-Aug.)	498	212	440	154

Source: Constructed by the authors based on USDA-FAS and U.S. Census Bureau data.
[a]Calculated as a residual assuming stock levels are zero.

Costs and Benefits of Fixing Gulf Hypoxia

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Each spring and summer in the Gulf of Mexico, nutrient-rich effluent from the Mississippi and Atchafalaya Rivers stimulates algae growth. The rates of growth are typically so high that when the algae die and decompose, they consume more dissolved oxygen than can be replenished by the ocean. The Gulf hypoxic zone or "dead zone" is created when dissolved oxygen levels become too low to support sea life. The extent of the 2008 hypoxic zone is shown in the chart below.

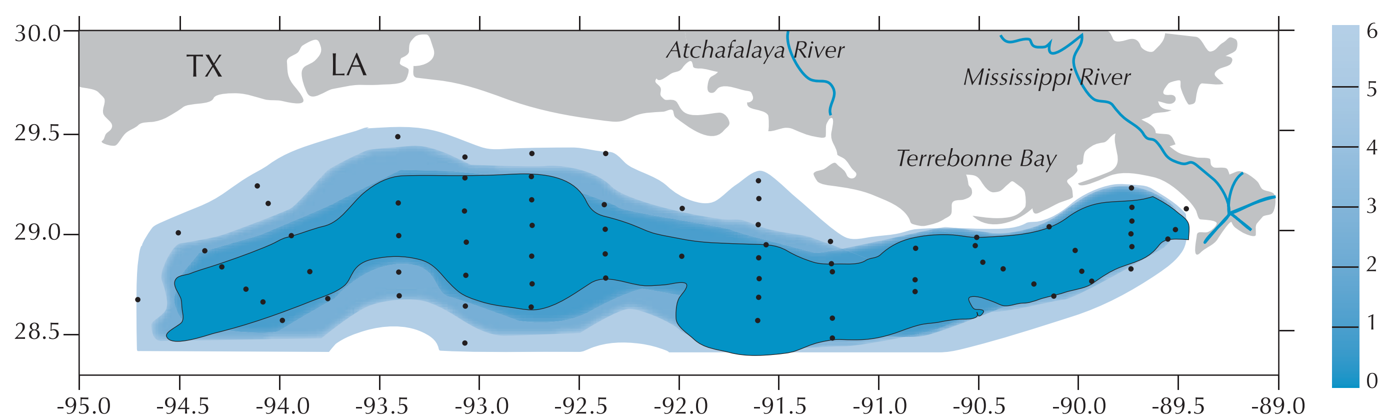
In a recent article in *Science*, Robert Diaz and Rutger Rosenberg report that the Gulf of Mexico is just one of 405 hypoxic zones identified around the world. In the 1980s, Diaz counted only 162 such zones. The hypoxic zone that has received the most attention in the United States is in the Chesapeake Bay, where hypoxia was first identified in the 1930s.

The increase in the number of hypoxic zones around the world is a result of increased nitrogen and phosphorus finding its way into rivers and, eventually, oceans. Excess nutrients come primarily from loss of applied nitrogen and phosphorus on farm fields, golf courses and lawns, and nutrient discharges from sewage treatment plants. A 1999 study by the National Oceanic and Atmospheric Administration concluded that only 10 percent of the nutrients that contribute to Gulf hypoxia can be traced to point sources such as sewage treatment plants and industry discharge sites. An updated analysis performed in 2006 and included in a scientific reassessment undertaken by the U.S. Environmental Protection Agency's Science Advisory Board (*Hypoxia in the Northern Gulf of Mexico: An Update,* 2007) implicates point sources for about 14 percent of the nitrogen loads and 27 percent of the phosphorous. Even with these updated estimates, nonpoint sources contribute the lion's share of nutrients, and agriculture is the largest contributor of non-point losses.

Nutrient losses from agriculture occur in a variety of ways. Heavy rainfall events leach soil nitrogen into tile lines that discharge into ditches and streams. Eroded soil that is rich in phosphorus finds its way into rivers and streams. Rainfall can wash surface-applied manure off farm fields. The evidence is overwhelming that extensive Gulf hypoxia would not occur if all farm-applied nutrients stayed on the farm and were used by crops or were stored in wetlands or other natural sinks.

Cost-Benefit Analysis for Environmental Challenges

Weighing the benefits against the costs of alternative decisions is a common-sense guide that helps us run our everyday lives in an efficient manner and provides us with goods and services at the lowest cost. Making decisions without this kind of analysis would waste time, money, effort, and natural resources. This logic has led governments to use cost-benefit analysis to determine whether actions to correct environmental problems should be taken. After all, it would be foolish to correct a difficult-to-fix environmental problem if the benefits of fixing it were small. Targeting scarce resources to those problems in



Sources: N. Rabalais, Louisiana Universities Marine Consortium. Map by B. Babin.
Notes: Map of bottom water oxygen levels in mg/l (or ppm). The dark blue area outlined in black shows where readings are less than 2, where hypoxia exists.

Bottom dissolved oxygen (mg/L), July 1-27, 2008

which benefits exceed costs by the greatest amount yields the greatest good per unit of effort expended. But a number of unique difficulties arise in using cost-benefit analysis to solve environmental problems.

The first difficulty arises because unlike private decisions in which costs and benefits are both borne by the private decision maker, environmental problems are typically caused by people who do not experience the outcome of their actions. Upstream polluters receive the benefits of low-cost waste disposal, but downstream users suffer the consequences. In the absence of legal obligations, the costs of getting upstream polluters to take actions to reduce their pollution should also be considered in addition to the benefits of water quality improvements to downstream users when comparing the costs and benefits. A political problem often arises after a decision is made to take corrective action, because the party asked to pay the costs of cleanup will naturally try to get some other party to pay.

Perhaps the greatest difficulty arises because of the complexity of accurately measuring benefits of actions to improve environmental quality. Unlike most privately purchased goods and services, environmental goods (such as clean air, clean water, and pleasing landscapes) typically do not have an observable market price associated with them that can be used to determine their value. If an environmental improvement results in an increase in the production of a traded good, then the increase in production is one measure of the benefits. For improvements in other goods, economists have learned how to estimate benefits of, say, clean water in lakes, by observing how much extra people are willing to pay to travel to lakes with clean water relative to similar lakes with degraded water. Similarly, differences in real estate values can often be used to reveal how much people value clean air or vistas. But these approaches can be limited because the benefits of environmental improvements are not limited to just those who actually use them for production or recreation.

Of even more concern to some scientists is evidence that points to a "regime" shift in the Gulf. This refers to situations in which the entire structure and functioning of an ecosystem changes because of some rapid external influence.

Many people who have never traveled to the Everglades still would not want to see this natural area destroyed. Maintaining the Everglades has value to some people either because they want to have the option of visiting there in the future or just because the knowledge that this natural area exists generates value. Estimation of these types of values is quite difficult and prone to large uncertainties, but this does not mean that those values are necessarily small and should not be considered in a cost-benefit comparison.

A review of the benefits and costs of eliminating the hypoxic zone in the Gulf of Mexico shows why, in the absence of strong regulatory requirements, we should expect little action to be taken quickly.

Benefits of Eliminating Gulf Hypoxia

While there is abundant evidence that the size and duration of the Gulf of Mexico hypoxic zone is large and caused by human actions, research to clearly identify the impacts on the ecosystem of the Gulf, including the effects on the size and diversity of fish stocks and the ability of the system to rebound after a long hypoxic event, is still incomplete. Furthermore, understanding thoroughly the benefits of reducing the dead zone to the goal articulated by the EPA requires knowledge about

- the resulting changes in recreational opportunities and commercial fishing that come about from these changes in fish stocks; and
- how important the preservation of this ecosystem is to current and future residents of the region and the rest of the country.

What evidence is available? A number of recent studies have established links between hypoxic conditions and declines in habitat quality that likely affect the diversity and quantity of life. From a commercial fishing perspective, declines in Brown shrimp populations and catches appear to be directly linked to hypoxic events, with estimates in one study of a loss of up to 25 percent of shrimp habitat on the Louisiana shelf. The commercial fishing industry in the Gulf is one of the most valuable fisheries in the country, with an annual value of over $650 million, and Brown Shrimp is one of the most valuable of those fish stocks. Further, changes in catch rates or population levels of a single species can mask effects on the entire food chain that may not be as easily measured as those directly related to commercially caught fish.

Of even more concern to some scientists is evidence that points to a "regime" shift in the Gulf. This refers to situations in which the entire structure and functioning of an ecosystem changes because of some rapid external influence. In the case of Gulf hypoxia, scientists are concerned that a regime shift would mean that even larger and longer-term reductions in nutrients would need to be made in order to restore the Gulf to its original functioning.

Concerns about the effects of the dead zone on the living resources of the Gulf are all well and good, but might there be any benefits closer to home from undertaking actions that would improve the conditions in the Gulf? Interestingly, here the evidence is perhaps more compelling that changes would be beneficial. Lakes and streams in Iowa are among the most impaired in the country, and there is significant pressure from the EPA and environmental groups to improve this situation. A number of the agricultural practices that could help address Gulf hypoxia would contribute directly to improvements in local water quality. Other local benefits would also accrue from changes in agricultural landscapes. For example, a major investment in strategically placed wetlands and buffers would likely reduce the risk of flood damage and provide habitat to a number of species that hunters and recreationists enjoy.

Costs of Eliminating Gulf Hypoxia

Because agriculture is the primary source of nutrients that cause Gulf hypoxia, those involved in agriculture would need to take action in any clean-up program. The main sources of lost nutrients are nitrogen losses from leaching and run-off, phosphorus in eroded soil, and animal manure runoff. Focus on control of nutrients in the Upper Midwest is warranted because most of the cropland that contributes to Gulf hypoxia is located in this region.

Controlling nutrient losses from animal manure is straightforward. Manure that is applied to farm fields at agronomic rates, at times when it can be incorporated into the soil and not be subjected to heavy rain events, will not lose nutrients. Manure storage must be of adequate capacity to hold all generated manure until it can be safely applied. However, many livestock producers do not have adequate manure storage facilities or ready access to farm fields that grow crops that can use the nutrients. Producers in nutrient-surplus regions have particular difficulty finding adequate crop acreage. The costs of controlling nutrient runoff in these regions would be large, involving installation of methane digesters or moving livestock to nutrient-deficit regions. High fertilizer prices provide a good incentive to livestock and crop producers in nutrient-deficit regions (all of the Corn Belt) to invest in adequate storage facilities and application equipment to fully utilize manure nutrients.

There are many well-known ways to reduce soil erosion. Installation of grass waterways, terraces, and adoption of conservation tillage can all greatly reduce soil erosion rates. Because a relatively small share of crop land is subject to high rates of soil erosion, the costs of reducing soil loss vary dramatically across cropland.

Nitrogen loss from cropland is the most difficult to control because nitrogen-laden soils in the Upper Midwest are needed for high yields, but nitrogen-laden soils are also susceptible to large losses from unexpected rainfall events. One key to controlling losses is to reduce the time between nitrogen fertilizer applications and rapid plant uptake. Rapid uptake of nitrogen by corn does not occur in most of the Corn Belt until the last two weeks of June. Nitrogen that is applied at or just before corn planting in the first part of May will be subject to losses for four of five weeks. Nitrogen that is applied in the early spring or in the fall is subject to losses for at least an additional six weeks. Applying nitrogen in a side-dressed fashion in the middle of June would reduce losses substantially. However, application costs would increase, as would the risk of yield losses from poor timing of applications. An alternative to controlling soil losses in tiled fields is to route drainage water into constructed wetlands that have the ability to capture and utilize excess nitrogen, thereby cleaning the water before it travels into streams.

What Should We Do?

Definitive research that demonstrates either that the benefits of reducing Gulf hypoxia exceed the costs or that the costs exceed the benefits simply does not exist. And while economists have made great strides in their ability to estimate benefits and costs, such definitive research for a problem as complex as Gulf hypoxia may not be forthcoming. Furthermore, recent high prices for agricultural commodities signal farmers that more fertilizer needs to be applied to crop land, not less. Both the uncertainty about costs and benefits and the current need to maintain high production levels gives advocates of the status quo the upper hand in the Gulf hypoxia debate.

But the evidence seems quite strong that our inability to keep fertilizer nutrients on the farm is doing significant damage to many coastal waters. Over time, as food shortages recede, we may decide to move to a common-sense approach to managing farmland and livestock production. By locating livestock in nutrient-deficient crop locations, by controlling soil erosion to maintain long-term soil health, and by reducing soil nitrogen losses or by treating nitrogen-rich runoff before it enters streams and rivers, we should be able to achieve both healthy coastal waters and profitable farms.

For More Information

To learn more, go to http://www.epa.gov/msbasin.◆

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How Low Will Corn Prices Go?
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drop this much, even if crude oil does drop to $50 per barrel. The reason is that at such a low corn price, speculators would likely move into the market to buy corn for delivery in the 2009 marketing year. Furthermore, at $2.15 per bushel corn farmers would not plant enough corn in 2009 to meet the almost 13-billion-bushel demand.

Backstopping Prices with Ethanol Mandates

Under the new Renewable Fuels Standard, U.S. gasoline blenders must blend 10.5 billion gallons of ethanol in the 2009 calendar year. In 2010, this mandate increases to 12 billion gallons. This means that 11.5 billion gallons must be produced from 2009 corn supplies. With crude oil at $50 per barrel, it is doubtful that Brazil will export large amounts of ethanol to the United States because of the import tariff, so the U.S. ethanol industry will need to produce much of this amount. An ethanol level of 11.5 billion gallons requires 4.2 billion bushels of corn. With at least 8.7 billion bushels of non-fuel demand for corn, 12.9 billion bushels of corn will be needed in 2009. At a trend yield of 154 bushels per acre, this will require 83 million harvested acres or about 90 million planted acres. Simply put, U.S. farmers will not plant 90 million acres of corn if the price of corn is $2.15 per bushel because this corn price would not cover the additional production costs of planting corn after corn. Given recent experience, it will likely take a price of more than $3.50 or $4.00 per bushel to induce farmers to plant the required acres. At $2.00 corn, the United States would be lucky to see 75 million acres planted.

So what is the outlook for corn prices? If crude oil prices rise, so too will corn prices. If crude oil prices fall, corn prices will fall through the remainder of the 2008 marketing year, but only to a point. They cannot fall too far because speculators would move into the market. Recall that 2009 prices must be high enough to induce farmers to plant enough acres in 2009 to meet ethanol mandates. Thus, there is a limit to how far 2008 prices can go before corn buyers will begin to buy 2008 corn for delivery at the 2009 prices. At this point, 2008 prices will not fall any further.

The bottom line is that ethanol mandates place an effective floor under corn (and soybean) prices. This floor price is particularly relevant for new-crop futures prices before the 2009 crop is planted because of the need to buy corn acres to meet ethanol mandates. Post-planting prices will reflect crude oil prices and expectations about corn yields. Farmers looking to 2009 should look at their own costs and returns to figure out how high corn prices will need to be to ensure that 90 million acres of corn are planted in 2009. ◆

Splashing and Dashing Biodiesel
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Additionally, the decision about whether or not to restrict the subsidy to only biodiesel consumed in the United States will have a large impact on the biodiesel industry because the export market is taking an increasingly large proportion of production.

Sorting Policy Impacts

Available data indicate that a large proportion of the biodiesel imported into the United States is later re-exported to the European Union. The E.U. market is also the main outlet for much of the biodiesel produced in the United States. Together, these export volumes explain why E.U. producers have been so opposed to U.S. biodiesel subsidies. While E.U. producers have sound reasons to protest, U.S. taxpayers should also know that they are subsidizing biofuels that allow the European Union to meet its biofuels targets at a lower cost. When evaluating alternative policy options for addressing the splash-and-dash controversy, an essential question to ask is, Do the benefits to U.S. taxpayers from a domestic biodiesel industry outweigh the costs of subsidizing biodiesel produced or consumed in other countries?

For More Information

See the article by Erin Voegele, "EU Launches Investigation of U.S. Biodiesel Industry," *Biodiesel Magazine*, July 2008. ◆

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