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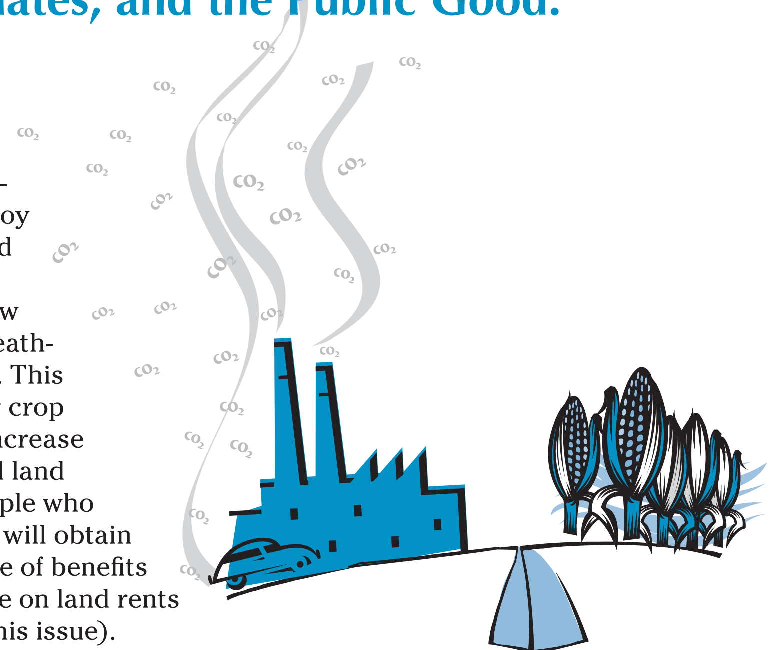
Center for Agricultural and Rural Development

High Crop Prices, Ethanol Mandates, and the Public Good: Do They Coexist?



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The U.S. Department of Agriculture recently released estimates that tell us the nation's farmers are responding to high corn prices by planning a 15 percent increase in their corn acreage. If these intentions translate into actual plantings, and if growing conditions are at least reasonable, then 2007 corn production will be more than sufficient to meet all demands, and corn prices should moderate. Lower corn prices would be good news for livestock feeders and ethanol plants because their profit margins would be greater than either expected.

But a record 2007 corn crop may provide only one year of respite from tight margins. Corn use by ethanol plants is projected to increase by 1.7 billion bushels in 2007 and by at least another 900 million bushels in 2008. Corn acreage in 2008 will have to increase by at least three million acres above 2007 intended levels just to keep up with demand. If crude oil prices remain high, and we do not change federal biofuels policies, then U.S. corn-based ethanol production will likely rise to 14 billion gallons within five years. This level of ethanol production combined with other demands for U.S. corn will induce U.S. farmers to produce about 14 billion bushels of corn. The only way that this level of corn production can be sustained is with high corn prices.

Crop farmers should enjoy unprecedented income levels for the next few years if the weather cooperates. This boom time for crop farmers will increase land rents and land prices, so people who own cropland will obtain the lion's share of benefits (see the article on land rents on page 6 of this issue).

In contrast, hog, cattle, dairy, and poultry producers will find persistent high feed costs and tight margins. Eventually, livestock, milk, and egg prices will have to rise to cover the higher costs. This price increase will only come about through lower production levels.

High corn prices, combined with demand saturation once ethanol is blended at a 10 percent level throughout the country, should eventually stop investment in ethanol plants. Investment will only start again if government policy mandates greater ethanol use or the nation's car fleet becomes capable of using blends of more than 10 percent ethanol.

There is a growing backlash against our current set of ethanol subsidies among environmental advocates. Ethanol's environmental friendliness has been attacked because of the amount of energy it takes to grow corn and to produce ethanol. And expanded corn production could negatively affect soil and water resources as farmers till more acres and take land out of the Conservation Reserve Program and the Wetlands Reserve Program. Intensification of production could also lead to larger nutrient and soil losses, as farmers attempt to increase their yields.

Do the higher food costs, higher land prices, environmental losses, and a smaller livestock industry associated with increased corn-based ethanol make any sense? Are the benefits of increased ethanol worth the costs? Most politicians in Washington view the trade-offs as being worthwhile, as evidenced by a push for ever-higher biofuels mandates.

However, as with all policy decisions, it is instructive to pause and consider exactly what we are trying to accomplish with our biofuels policies. What are the benefits from increased biofuels production? Will our current set of policies obtain these benefits at the least cost, or would an al-

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IN THIS ISSUE

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ternative set of policies be more efficient? And finally, do the costs exceed the benefits?

Benefits from Biofuels

There are two primary public benefits from increased production and consumption of biofuels. The first benefit is that using biofuels instead of fossil fuels can decrease the rate at which greenhouse gases (primarily carbon dioxide) build up in the atmosphere. Carbon dioxide is emitted from both biofuels and fossil fuels, but atmospheric carbon is used to grow the plant material used to produce biofuels, so net emissions of carbon dioxide are lower for biofuels than for fossil fuels.

The magnitude of the net gain is lower than one might expect for corn-based ethanol because corn does not grow from photosynthesis alone. Fossil fuels are used to produce the diesel fuel, pesticides, fertilizer, electricity used to pump irrigation water, and propane that are used to produce and deliver corn to ethanol plants. The net gain is further reduced by the energy used to run an ethanol plant and to dry distillers grains. Most studies conclude that ethanol produced from current plants does reduce net greenhouse gas emissions, but the magnitude of the gain is smaller than what many would hope for.

The second benefit of biofuels is increased energy security. There are sound economic reasons why the United States should focus on energy security and not strive for energy independence. After all, our fellow NAFTA members, Canada and Mexico, are our two largest energy suppliers. They can produce and sell us energy for far less cost than we would be paying for energy if we decided to shut our borders to energy imports. However, the United States and other countries are vulnerable to supply disruptions and price shocks. This vulnerability would decrease if biofuels and other alternative energy sources made up a larger share of our total energy usage. Thus, increased use of biofuels as part of an energy diversification strategy may make sense from a national security perspective.

Few would disagree with the idea that reducing greenhouse gas emissions and increasing energy security are goals worth some sacrifice. The question is whether current policies will actually achieve these twin goals.

Are Current Policies Appropriate?

There are a number of federal policies that encourage increased production and consumption of biofuels. Foremost among these is the 51¢-per-gallon ethanol tax credit given to fuel blenders who use ethanol in their blends. Adequate competition between blenders will result in this tax credit being largely reflected in the price paid to ethanol producers, thereby increasing the profitability of ethanol plants. This increased profitability then leads to higher production levels than would otherwise be the case.

Because the fuel tax credit encourages production, it leads to increased diversification of energy sources. Fourteen billion gallons of ethanol represents about 10 percent of U.S. gasoline consumption on a volume basis. If oil prices rise significantly higher than current levels, this contribution of corn-based ethanol could double. Therefore, we can conclude that current policies do lead to an increased diversity of energy sources. The displacement of gasoline consumption with ethanol reduces greenhouse gas emissions. So we can also conclude that the fuel tax credit does lead to lower net greenhouse gas emissions.

The fact that current policy increases energy security and reduces greenhouse gas emissions does not imply, however, that we cannot do better. History has demonstrated that policy objectives can be met most efficiently when private entrepreneurs are allowed to determine the means by which objectives are achieved. So, for example, if the United States has an objective of diversifying its energy sources at minimum cost, Congress should specify a numerical diversification target, the types of energy sources that count toward diversity (would increased coal and nuclear energy qualify?), and the penalties for non-achievement. Competition between alternative energy sources would reveal the most efficient set and allow the United States to meet its policy objectives at least cost. If Congress truly wants increased energy security, then Congress should be neutral to the means by which this is achieved.

Neutrality is even more important in the design of greenhouse gas policy because of the many avenues by which greenhouse gases are emitted. The least-cost set of activities that would meet any greenhouse gas target would be revealed if Congress capped total national greenhouse gas emissions at the desired level, offered current emitters emission allowances that added up to this level, and then permitted these allowances to be traded. Alternatively, a tax on carbon use would also encourage application of the most efficient set of activities to lower greenhouse gases.

Current biofuels policies fail the neutrality test of an efficient policy. Ethanol receives a fuel tax credit but biobutanol (a fuel closer to gasoline in makeup, also made from biomass) does not. Ethanol from Brazil must pay an offsetting import tariff before it can qualify for the blenders credit, even though ethanol from sugar cane reduces greenhouse gas emissions by a much greater amount than corn-based ethanol, and Brazilian ethanol imports surely increase energy diversification. Biodiesel producers receive a $1.00-per-gallon subsidy if they use virgin oil but only $0.50 if they use recycled oil. Methane generated from livestock manure is valued at market prices even though it reduces net greenhouse gas emissions. Ethanol from cellulose receives the same per-gallon subsidy as ethanol from corn even though cellulosic ethanol offers potentially higher net gains in greenhouse gas reductions.

Future policies will eventually be more neutral if the United States becomes serious about increasing energy security and lowering greenhouse gas emissions.

It is understandable that we do not have policy neutrality. The reason for current biofuels policies is less the need for energy diversification than the ability of Corn Belt legislators to help their constituents. And, in fact, we have no effective national policy aimed at reducing greenhouse gas emissions. Thus, it should not be surprising that an ethanol plant that feeds its wet distillers grains to a nearby cattle operation, and which is powered by methane generated from the resulting cattle manure, receives no more incentive than a dry-mill plant that exports dry distillers grains.

Future Policy Choices

Future policies will eventually be more neutral if the United States becomes serious about increasing energy security and lowering greenhouse gas emissions. These new policies will likely favor midwestern corn-based ethanol plants much less than do current policies. Rather than the 51¢-per-gallon ethanol blenders credit, we could see a BTU tax credit for which any alternative energy source could qualify. Rather than offering no additional incentive (other than direct cost savings) for reducing energy use in producing ethanol, those ethanol plants that achieve higher net greenhouse gas emissions could have a competitive advantage. Rather than placing a steep import tariff on imported Brazilian ethanol because it is not homegrown, we could welcome the fuel as an energy-diversifying, greenhouse-gas-reducing fuel.

Ethanol proponents need not fear such a future. The incredible expansion of corn-based ethanol demonstrates that agriculture can contribute meaningfully to a future based more on renewable fuels and less on fossil fuels. Current plants and those soon to be constructed will continue to generate returns to their owners and to contribute to reductions in greenhouse gas and energy security. However, more neutral policies will change the competitive environment for new investments. It is time to develop strategies for how agriculture will compete in a new environment of open competition for incentives offered to reduce greenhouse gas and enhance energy security. It may well be that corn-based ethanol will play a major role in such an environment. But supporters need to begin thinking about the steps they can take today to ensure that agriculture remains a competitive provider of alternative fuels in an era in which policy is much less tilted toward corn-based ethanol. ◆

Impact of High Corn Prices on Conservation Reserve Program Acreage

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Growing demand for corn due to the expansion of ethanol has increased concerns that environmentally sensitive lands in the Conservation Reserve Program (CRP) will return to crop production. Most of the land currently in the CRP was enrolled because of the potential for environmental damage if it were farmed. A return of this land to crop production would likely lead to lower environmental quality. Iowa has a large number of CRP acres, it produces more ethanol than any other state, and it produces the most corn. Thus, an examination of the impacts of higher crop prices on Iowa land moving out of the CRP and the resulting effects on soil erosion, nutrient losses, and carbon sequestration will give insight into what we might expect nationally in the years ahead if crop prices remain high.

Estimating Environmental Impacts

The first step in estimating the environmental impacts of higher crop prices is to estimate the relationship between crop prices and the proportion of CRP land that will return to production. That is, we first need to estimate CRP supply curves for Iowa. The basis we use for estimating these curves is the land's suitability to produce corn, which we measure using the Corn Suitability Rating (CSR). We then estimate the environmental impacts of cropping CRP land through the Environmental Policy Integrated Climate (EPIC) model. EPIC provides edge-of-field estimates of soil erosion, nutrient losses, and carbon sequestration.

Figure 1 shows where CRP land is located according to USDA's Farm Service Agency. Two million acres of Iowa cropland is enrolled in the program. The CSR of each parcel of CRP land was obtained by overlaying a CSR map (Figure 2) on the map shown in Figure 1. There are relatively few CRP acres in the Des Moines Lobe in North Central Iowa. But the land that is enrolled is productive. Because of this higher productivity, enrolling land in the CRP in North Central Iowa is more expensive than enrolling land in southern or northeastern Iowa, which is one reason why there are more acres enrolled in southern and northeastern areas of the state.

We construct the CRP land supply curves for corn prices ranging from \$2 to \$5 per bushel. We assume that soybean prices stay at \$4 above corn prices in all scenarios. Our assessment presumes that profit is the main driver of CRP enrollment decisions. However, there are many reasons why property owners decide to enroll in the CRP program, and, in practice, profit is not always the driving force behind their choices. Therefore, our estimates have to be considered an upper-range projection of the acreage that would go back into production. It is also important to note that this is a long-term equilibrium analysis of the alternative land uses for CRP land. We are abstracting from penalties for early termination, and re-enrollment provisions such as the re-enrollment and extension offer implemented by the Farm Service Agency. Land is assumed to move out of the CRP and into production if the returns to cropping the land exceed the rental rate that the land can get in the CRP.

Figure 3 illustrates the statewide curve. At \$3 corn, we estimate that almost a million acres would go back into production. We cannot know for certain how this land will be cropped. About 460,000 acres of this land is designated as highly erodible, so it would require use of conservation tillage, which is most easily accomplished with a corn-soybean rotation.

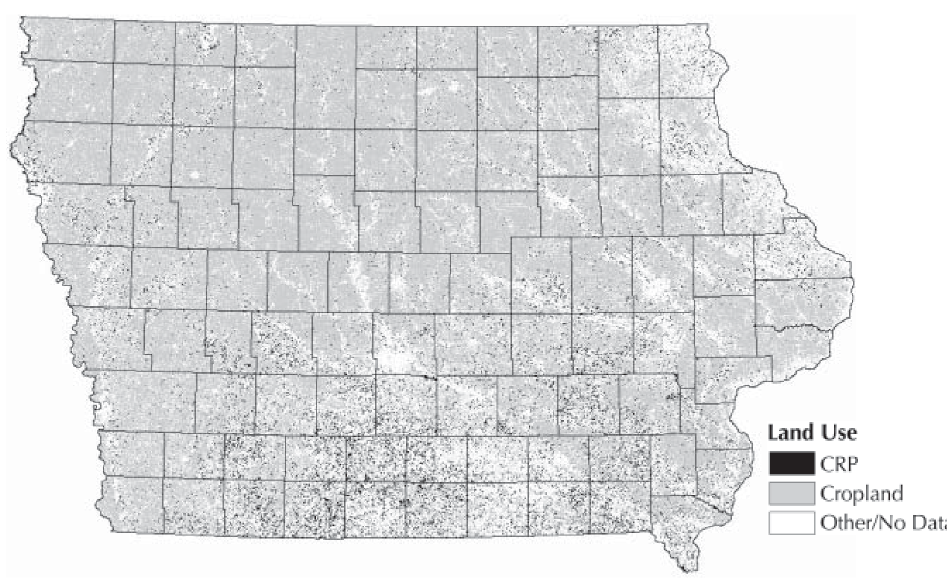

Figure 1. Location of CRP acreage in 2004

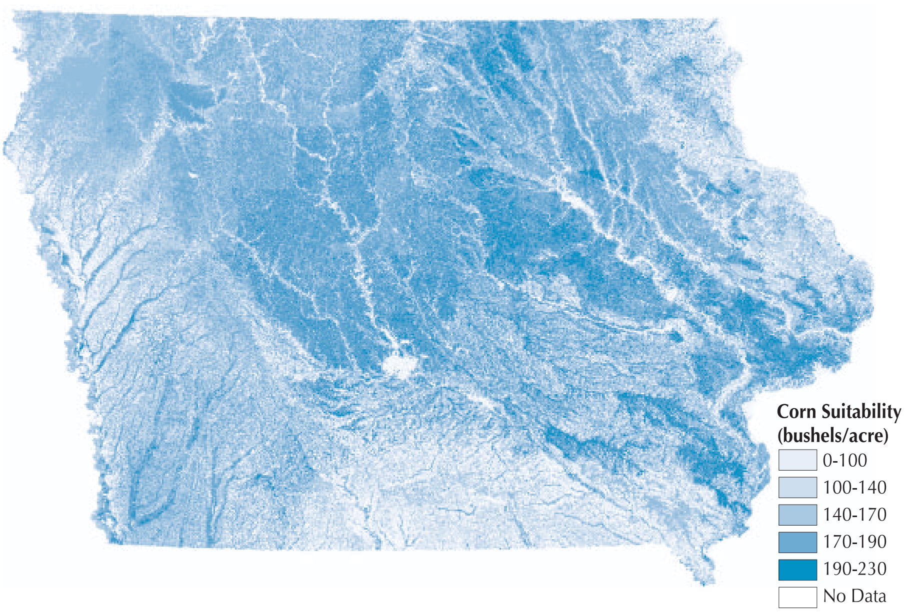

Figure 2. Corn suitability

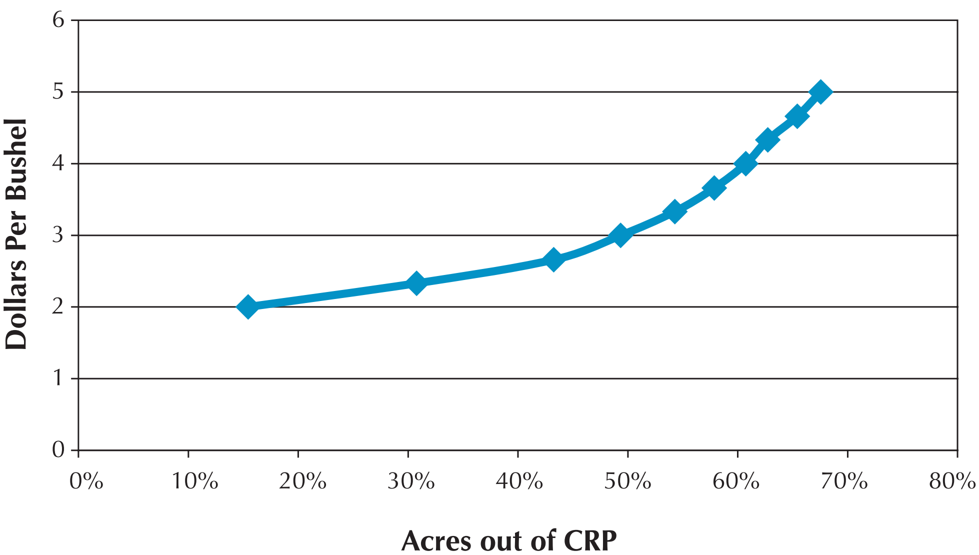

Figure 3. Acreage taken out of CRP as a function of corn prices

Costs of Retaining and Losing CRP Acres

Currently, CRP annual payments total about $200 million. One way to limit land coming out of the CRP is to increase CRP rental payments. At $3-per-bushel corn, we estimate that USDA would have to pay $314 million to reduce the loss of CRP acreage to less than 200,000 acres. For higher corn prices, even doubling the payments becomes a relatively ineffective policy. For example, we estimate that for corn prices of $3.66 per bushel, doubling the rental rate paid to farmers would hold program costs constant, but only 675,000 Iowa acres would be enrolled.

To estimate the environmental impact of cropping land previously set aside from production, we used the EPIC model to estimate 30-year averages for soil erosion, nitrogen and phosphorous loss, and carbon sequestration. For simplicity, we assume a uniform fertilizer rate application of 133 pounds per acre for nitrogen and 30 pounds per acre for phosphorous for corn acres. Fertilizer applications occur in the spring.

Our results indicate that, on average, land that would leave the program first would have relatively small environmental impacts. However, incremental impacts would increase dramatically as higher corn prices bring into production more and more environmentally fragile land. For example, sediment losses increase from less than 5 million tons at $3 corn to over 30 million tons at $5 corn, when over 1.35 million acres would go back into production. We estimate that if all CRP land in Iowa were put back into a continuous corn rotation, the sediment losses would exceed 78 million tons.

Nitrogen losses follow a similar pattern. Losses increase from around 62,000 tons to over 294,000 tons at $5 corn. If all CRP land in Iowa were put back into a continuous corn rotation, the nitrogen losses would exceed 438,000 tons.

At $3 corn, there is over a 400 percent increase in sediment losses, almost a 500 percent increase in phosphorous losses, and a 270 percent increase in nitrogen losses. Changes in carbon losses in percentage terms are much smaller, ranging from a decrease of 2 percent for $2 corn to a decrease of 9 percent for $5 corn. Note that as prices increase, there is progressively less and less acreage put into production. However, environmental damages per acre become progressively higher, as corn prices increase and bring additional, more environmentally sensitive land into production. The marginal impacts increase rather steeply, reflecting the increasing environmental sensitivity of the land brought back into production.

It is also interesting to note that if all the CRP land were returned to

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Agricultural Situation Spotlight

Land Rents: How High Will They Go and Who Gains?

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The outlook for corn and soybean farmers looks exceedingly bright because of continued strong growth in U.S. ethanol production. December corn futures contracts are trading above $3.80 through 2010. Soybean futures are trading above $7.50 through 2009. The reason for this price strength is that U.S. corn plantings are projected to exceed 93 million acres from 2008 and beyond because of strong demand.

Higher corn and soybean prices will affect Iowa agriculture in a number of ways. The first impact will be felt by land renters as they renew their contracts late this summer. Higher crop prices have increased the returns to crop production. These increased returns will translate into increased competition for land, which in turn will drive up land rents.

Calculating Potential Changes

An idea of the possible magnitude of the changes in land rent can be made by calculating the impact of higher commodity prices on the returns over variable costs of production. Farmers who are considering whether to expand their farming operations will generally bid no more than they expect to earn after paying variable expenses. Thus, the change in returns over variable costs due to higher prices provides a good guide to how land rents may change.

Recently, CARD researchers conducted a study on the likely impacts of expanded ethanol on corn and soybean prices. Results show corn prices of about $3.40 per bushel on average over the next five years and soybean prices of around $7.00 per bushel on average. Using current estimates of production costs and corn yields of 165 bushels per acre for corn following corn, 180 bushels per acre for corn following soybeans, and soybean yields of 55 bushels per acre following two years of corn, projected crop returns over variable costs of production would average around $315 per acre. If instead we use low commodity prices to reflect the recent past—$2.10 per acre for corn and $5.50 per acre for soybeans—returns over variable costs of production will average around $160 per acre.

Because farmland is a major financial asset, the net worth of Iowa would grow significantly. To the extent that this increase in net worth is leveraged into productive investments, income growth in Iowa should also eventually increase.

At first glance, you might think that we should see land rents go up by the difference in per acre returns, which would imply that the average Iowa land rents would more than double given that the state-average land rent was approximately $140 per acre in 2006. However, the 2006 land rent includes expected benefits from government farm programs, including direct payments, loan deficiency payments, and countercyclical payments. If the 2007 farm bill looks much like the 2002 farm bill, and if higher prices are with us to stay, then Iowa farmers will receive only direct payments because prices will not fall low enough to trigger the other payments.

Direct payments average about $25 per planted acre in Iowa. The average payment received from marketing loans and countercyclical payments under the 2002 farm bill was approximately $35 per acre. Because farmers will receive direct payments under both high and low prices, the effect of these payments will be neutral to any increases in land rents. However, under high prices, farmers will receive $35 less in payments than before. Thus, Iowa farmers should expect to receive an additional $155 per acre from the market due to higher prices, and $35 less per acre in government payments due to higher prices. This nets out to an increase in returns of around $120 per acre. If Iowa land rents increase by $120 per acre, they would approach $300 per acre in many parts of the state. How likely is it that we will see $300-per-acre land rents in 2008? The answer depends on whether crop farmers can actually capture projected additional returns over costs.

Nobody can guarantee that corn prices will average $3.40 per bushel or that soybean prices will average $7.00 per bushel. However, farmers can lock in today's prices for the next three years by buying futures contracts. This suggests that there are at least some farmers who can afford to pay higher rent because they have already locked in price levels that justify higher rents. Of course, price is only one side of the revenue equation. There is also the risk that farmers may not be able to produce a crop. But the probability of a crop loss is no greater under high prices than under low prices, and so this risk should not really influence farmers' willingness to pay more for land. The one uncontrollable part of the future profit equation is production costs. If seed, fertilizer, fuel, and pesticide costs continue to rise, as they have over the past few years, then future margins will be lower than anticipated.

Impacts of Higher Land Rents

Higher land rents, and the inevitable increase in land prices that follow, will have little impact on the competitiveness of Iowa agriculture. Because the value of Iowa farmland is determined primarily by the value it generates in current and anticipated future production, higher property values are a reflection, rather than a determinant, of the competitiveness of Iowa agriculture.

It might seem intuitive that higher land rent would hurt farmers who rent land. But if higher land rents simply reflect higher expected returns over variable costs, then farmers who rent their land will be largely unaffected by changes in rent. On average, the extra they make from the marketplace will just be handed over to land owners in the form of higher rental payments.

The clear beneficiaries of higher crop returns would be existing land owners because the returns to owning land would increase. Because farmland is a major financial asset, the net worth of Iowa would grow significantly. To the extent that this increase in net worth is leveraged into productive investments, income growth in Iowa should also eventually increase.

Higher land rents could significantly reduce the amount of Iowa cropland that is enrolled in the Conservation Reserve Program (CRP) and the Wetland Reserve Program. Past experience has demonstrated that farmers will remove land from CRP if the land can earn significantly more in crop production than it can earn in the program. Reductions in CRP land will likely increase soil and nutrient losses and reduce wildlife habitat.

One option that USDA will be considering to offset the negative impacts of land coming out of conserving uses is to use the money saved from expiring contracts to increase bid rates for the most environmentally sensitive land. If USDA follows this path, conservation programs may be smaller but the per acre environmental benefits that they provide could be much greater. ◆

Impact of High Corn Prices
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production of continuous corn, the environmental damages would be much higher than what we estimate with corn prices as high as $5 per bushel, as we noted earlier for sediment and nitrogen losses. In the case of carbon sequestration, losses would increase from over 87 million tons at $5 corn and 1,350,000 acres back in production to 133 million tons for the almost two million acres currently in CRP. This suggests that no matter how high corn prices ever get, some land in CRP is simply too fragile to be cropped.

Change in Strategies

The results of our work carry implications for large parts of the United States but are particularly relevant for the Corn Belt. Our results indicate that land currently enrolled in the CRP offers significant environmental benefits that could be lost under higher commodity prices. Maintaining current levels of environmental quality will require substantially higher spending levels. Even allowing for the cost savings that would accrue as CRP land leaves the program, a change in targeting strategies will likely be required to ensure that the most sensitive land does not leave the program. In particular, high corn prices may accelerate the trend that started with the 2002 farm bill in which CRP targeting has shifted from the idling of whole fields for conservation purposes to implementing in-field practices, such as filter strips and grassed waterways that are seen as supporting working lands by reducing environmental impacts. (To preserve whole fields in the CRP, higher payments would have to be considered.) Because this will keep only part of the land out of production, it is not certain that more money will have to be devoted to CRP payments. For example, at $4-per-bushel corn, doubling soil rental rates would keep over a million acres in the program, as opposed to less than 700,000 acres with current payment levels, and the program costs would be over $26 million lower than they are now. ◆

U.S. Biodiesel Production: Recent Developments and Prospects

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Biodiesel has recently experienced a major surge worldwide. A rapid expansion in production capacity is being observed not only in developed countries such as Germany, Italy, France, and the United States but also in developing countries such as Brazil, Argentina, Indonesia, and Malaysia. Interest in and expansion of the production of the renewable fuel has been fostered by mandates and financial incentives offered by governments. This interest can be mostly attributed to the commonly cited advantages of biofuels, mainly that they

- reduce the emission of gases responsible for global warming,
- promote rural development,
- contribute toward the goal of energy security,
- are renewable, and
- reduce pollution.

Another feature that proponents of biodiesel put forward is that the fuel can be used without modification in engines currently in use.

The European Union has arguably been the global leader in biodiesel production. However, as shown in Figure 1, the United States has increased its production from 2 million gallons in 2000 to an estimated 250 million gallons in 2006. While 250 million gallons is smaller than the E.U. production (Germany alone estimates its 2006 production at about 690 million gallons), it represents significant growth. The trend has recently accelerated, and production grew at a pace of 113 million gallons per year between 2004 and 2006. According to the National Biodiesel Board, there are 105 plants in operation as of early 2007 with an annual production capacity of 864 million gallons. An additional 1.7 billion gallons of capacity may come online if current plants in construction are completed.

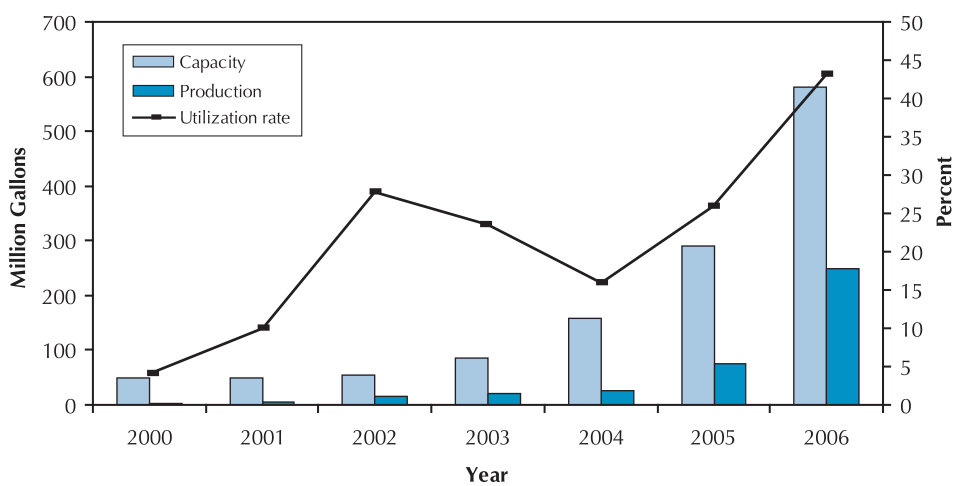
The rapid growth in the industry has been fueled by a series of government-provided financial incentives combined with historically high energy prices. As shown in Figure 1, despite these economic incentives, the industry carries a significant (though decreasing) idle capacity. A review of the main policy incentives contributing to the rapid increase in U.S. production, an estimation of current margins for a typical biodiesel plant, and discussion of opportunities and threats faced by the biodiesel industry will prove useful in increasing our understanding of where the U.S. biodiesel industry is headed.

Policy Drivers

The rapid expansion of biodiesel production observed between 2000 and 2006 was triggered by a 1998 amendment to the 1992 Energy Policy Act and cash support from the USDA Commodity Credit Corporation's (CCC) Bioenergy Program. Further support was created through the American Jobs Creation Act (the Jobs Act) of 2004 and the Energy Policy Act of 2005.

The 1992 Energy Policy Act requires that a portion of the new vehicle purchases by certain fleets (mostly owned by federal and state governments and alternative fuel providers) be alternative fuel vehicles. Originally, biodiesel was excluded as an alternative fuel, but the 1998 amendment allowed fleet managers to comply with part of their alternative fuel usage requirement by using biodiesel, as long as it was used by heavy-duty vehicles in blends, including at least a 20 percent blend (B20).

The CCC Bioenergy Program provided payments to producers to encourage biodiesel production. Plants with capacity under 65 million gallons per year were reimbursed 1 bushel of feedstock for every 2.5 bushels used for increased production (those over 65 million gallons were reimbursed 1 bushel for every 3.5 bushels used for increased production). Although initially only biodiesel made from



Source: National Biodiesel Board.
Note: Capacity given is on September 1 of each year.

Figure 1. U.S. biodiesel production and installed capacity for 2000 to 2006

Table 1. Net operating returns for a biodiesel plant

Biodiesel Price ($/gal)	Feedstock Price ($/lb) 0.20	0.25	0.30	0.35	0.40
2.00	0.16	-0.21	-0.59	-0.96	-1.33
2.40	0.56	0.19	-0.19	-0.56	-0.93
2.80	0.96	0.59	0.21	-0.16	-0.53
3.20	1.36	0.99	0.61	0.24	-0.13
3.60	1.76	1.39	1.01	0.64	0.27
4.00	2.16	1.79	1.41	1.04	0.67

oil crops was eligible for payments, the 2002 farm bill extended the list of allowed feedstocks to include animal by-products, fats, and recycled oils of an agricultural origin. The program ended in June of 2006.

The Jobs Act provided incentives for the biofuels industry again on the demand side. Under the act, blenders can claim $1.00 per gallon of biodiesel made from virgin vegetable oils or animal fats and $0.50 per gallon made from recycled oils and fats mixed with diesel. To receive the tax credit, the blender needs to use biodiesel registered as fuel with the Environmental Protection Agency and meeting the ASTM D6751 standard, as certified by its supplier.

The Energy Policy Act of 2005 provided incentives on both the supply and demand sides. On the supply side, the act sought to lower production costs by providing tax credits at a rate of 10¢ per gallon to small producers of biodiesel. The credit is available for the first 15 million gallons produced by a plant with annual production capacity of less than 60 million gallons. This tax credit is set to expire at the end of 2008.

On the demand side, the 2005 act mandated a renewable fuels phase-in (the Renewable Fuels Standard, RFS), requiring fuel producers to include a minimum amount of biofuels, and extended the excise credit to blenders until the end of 2008. Under the RFS, fuel producers were required to include 4 billion gallons of renewable fuels by 2006, increasing the amount to a minimum of 7.5 billion gallons by 2012.

Lobbying efforts are intensifying to extend the tax incentives beyond 2008. There are also state-specific incentives for the use of biodiesel, ranging from requirements to blend biofuels with petrofuels (for example, the requirement for the use of B2 in effect in Minnesota) to further tax credits and cost sharing of investments and research. Other states are also considering the introduction of blend mandates.

The Environmental Protection Agency's diesel regulations, requiring the introduction of Ultra Low Sulfur Diesel (ULSD) for 80 percent of the on-road diesel by mid-2006 (and off-road for mid-2007), are also expected to increase demand for biodiesel as a lubricant additive. ULSD has low lubricity, which can damage diesel engines. Research has shown that blending it with biodiesel to produce B2 could restore the lubricity of diesel fuel to adequate levels.

Industry Margins and Prospects

Since feedstock expenses account for about 80 percent of a biodiesel plant's operating cost, margins are highly sensitive to the prices of oils and fats. Between 75 and 90 percent of U.S. biodiesel production is based on the U.S. production of soybean oil, indicating that margins for many industry participants will be dependent on soybean oil prices. The share is expected to decrease over time, as many new plants will be able to produce biodiesel using multiple feedstocks, thereby giving producers the flexibility to switch among feedstocks as relative costs dictate.

To calculate the net operating returns of a representative plant in the industry, we constructed a simple economic model of a 60 million gallon biodiesel plant. The plant modeled has an operating cost (excluding feedstocks) of 42¢ per gallon and uses 7.48 pounds of feedstock to produce a gallon of biodiesel. We assume that the glycerin that is co-produced is sold (raw), as are other co-products (fatty acids and filter cake), at 5¢ per pound. Net operating returns, calculated as revenues minus operating costs (excluding capital and other fixed costs) for the modeled plant are presented in Table 1.

The table shows that as feedstock prices exceed 30¢ per pound, the price of biodiesel needs to be above $3 per gallon for the plant to make a profit. Operating returns are positive at $2.80 per gallon, but outlays to cover capital and other fixed costs and returns to investors are likely to be more than 21¢ per gallon. The Food and Agricultural Policy Research Institute projects that the price of soybean oil will be 30.7¢ per pound for the 2007/08 crop year and will surpass 34¢ per gallon by the 2009/10 crop year.

As highlighted in the table, the current viability of the biodiesel industry depends on financial support by the government, as the wholesale #2 diesel price has been below $2 per gallon since September of 2006.

Near-Term Outlook

As evidenced by the amount of idle capacity, supply of biodiesel has

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Corn Shortfalls: Historical Patterns and Expectations

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Continued strong growth in ethanol production should keep corn supplies tight for at least the next few years. With low carryover stocks, livestock producers and the ethanol industry are both vulnerable to the high prices that would result from a poor crop. It is too early to make predictions about what the 2007 crop will be, but insight into the likelihood of a short crop can be gained by looking at historical variations in production.

Figure 1 shows the percent deviation in actual corn production from expected levels since 1970. Expected corn production is estimated as the product of U.S. trend yield per harvested acre, U.S. planted acres, and the trend ratio of harvested to planted acres.

As shown, there have been four years since 1970 that saw production shortfalls of at least 20 percent. The shortfall in 1988, a year of hot, dry weather, was the largest, at about 28 percent, followed by the drought-year production of 1983. Next was 1993, a year of excess rain and no heat, and the fourth-largest short crop happened in 1974, which aided the dramatic surge in agricultural prices in that period. Interestingly, there are fewer years with a 10 to 20 percent production shortfall than a 20 to 30 percent shortfall. Figure 1 also illustrates that the potential on the upside for corn production is much lower than potential on the downside. Only in 1979 did crop size exceed expectations by more than 15 percent. Harvests that exceeded expectations by at least 10 percent occurred in 1972, 1982, 1985, 1994, and 2004.

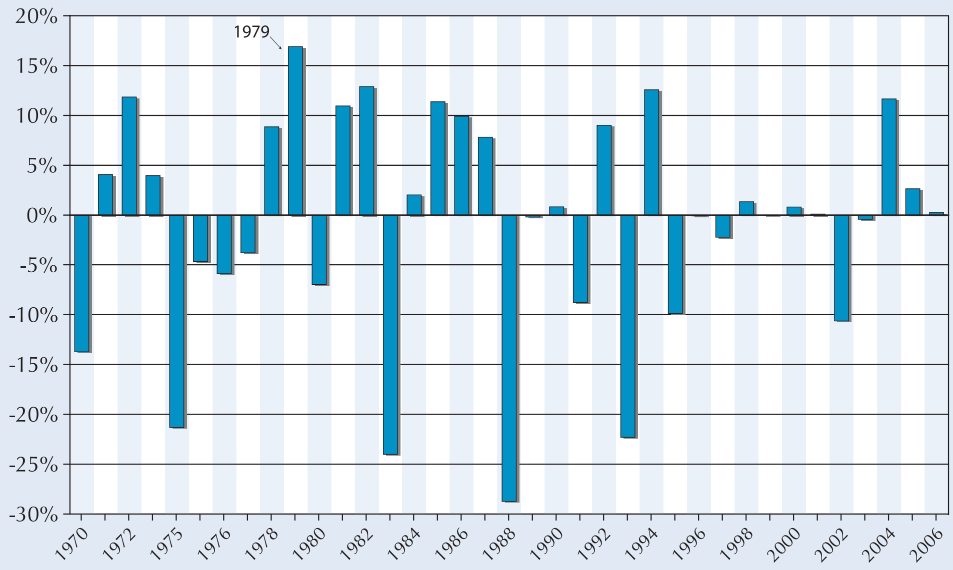

Figure 1. Percent deviation of actual corn production from expected production since 1970

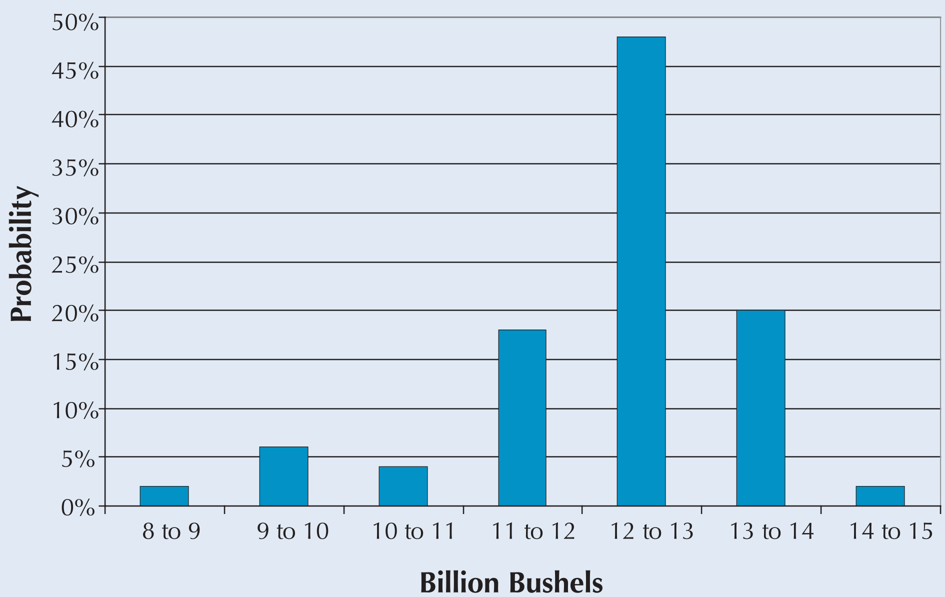

Figure 2. Frequency distribution of U.S. corn crop in 2007

It is interesting to note that production in 2006 exceeded expectations by a small amount. Yet we still had an unprecedented increase in corn prices, as ethanol production grew at a rapid pace.

It is an open question whether future supply shocks will follow the historical patterns. Many feel that current corn hybrids are better able to withstand hot and dry weather of the type seen in 1983 and 1988. This has yet to be demonstrated, though, as we have not had a severe drought since 1988. Dry weather in Illinois in 2005 and in the western Corn Belt in 2002 caused significant local yield losses, which suggests that corn crops remain vulnerable to drought. The odds of a repeat of the cold summer of 1993 are likely lower than suggested by a simple historical average because that event was linked to volcanic activity. Increasing corn acreage outside the Corn Belt will tend to increase variability in corn supplies.

If we use historical variations since 1957 as a guide, we can estimate the probability distribution of the size of the 2007 corn crop. Assuming that U.S. farmers plant 90.5 million acres of corn, we expect them to harvest 91 percent of planted acreage. With a 2007 trend yield of 149.4 bushels per harvested acre, expected U.S. corn production is 12.3 billion bushels. Figure 2 shows the probability distribution of the corn crop in one billion bushel increments. As shown, there is a 1 in 50 chance (a repeat of 1988) that the corn crop will fall below 9 billion bushels. There is a 12 percent chance that the corn crop will fall below 11 billion bushels. If the crop does fall short of 11 billion bushels then we should expect corn prices to rise to levels that may cause ethanol plants to shut down. On the other hand, there is a 70 percent chance that the corn crop will exceed 12 billion bushels, in which case prices will be moderate. Of course if planted acreage falls short of planting intentions, then the odds of high corn prices could grow substantially. ◆

U.S. Biodiesel Production
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outpaced demand for the biofuel, and consumption has not picked up until recently. A partial explanation may be found in the relative prices of biodiesel versus diesel fuels and the reluctance of engine manufacturers to approve usage of the fuel until recently. However, quality standards for biodiesel are developing and quality certification systems have started to emerge, prompting engine manufacturers to extend their warranties. More manufacturers are approving the use of B20 in some or all of their engines. This may improve the acceptance of biodiesel. Additionally, mandates for the use of blends combined with the fuel's use as an additive to improve the lubricity of ULSD may create additional demand for the product. However, the economics of today's diesel prices and the prices of potential feedstock sources do not seem promising without continued government support and technological improvements. Projected increases in vegetable oil prices, especially soybean oil, will continue to squeeze margins for biodiesel producers. ◆

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