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Can Ethanol Power the Rural Economy?

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Ethanol is creating a buzz at the farm gate, and on Main Street and Wall Street. Spikes in gasoline prices, turmoil in major oil-producing countries, and support for a renewable fuels standard have caused ethanol production to expand at an astonishing pace. The resulting surge in profitability has attracted a new class of investors to rural America.

While ethanol's success has been fierce, its profits can swing wildly with rising and falling prices for corn and crude oil. And ethanol's future depends on other powerful forces—rapidly evolving markets, uncertain environmental policies, and emerging technologies.

Can ethanol be counted on to help power the stalled economies of rural America? This article looks at the economics of ethanol and discusses some of the factors that may endanger the stability of this hot industry.

Ethanol 101

In the United States, ethanol is produced in bio-refineries through a process of fermenting and distilling the simple sugars from biomass feedstock—most commonly corn. It can also be made from sorghum, barley, wheat, and sugarcane. In 2006, ethanol production consumed roughly 20 percent of the U.S. corn crop.[1]

Ethanol is a clean-burning oxygenate fuel. When blended with unleaded gas—typically at 10 percent—ethanol's high oxygen content helps gas burn cleaner and reduce harmful emissions. Ethanol also slows the rate at which the gas burns, boosting octane and reducing engine knock.

Another formula produces E85, a blend of 85 percent ethanol and 15 percent gasoline. E85 can be used in flexible-fuel vehicles that run on any blend of gas with up to 85 percent ethanol. Flexible-fuel vehicles continue to become more available. Still, some industry analysts believe the marketplace for ethanol as a fuel additive is limited, given current technologies and corn production levels.

When made from corn, ethanol production also creates byproducts that can enhance production revenues. One byproduct is distillers dried grains, or DDGs, which are used in feed rations for livestock, primarily cattle. Another byproduct is carbon dioxide, which can be sold to soft drink producers and other industries.

While profits have fueled the recent ethanol expansion, environmental policy has been the industry's foundation. The Clean Air Act Amendments of 1990 required that reformulated gasoline be sold in areas where ozone requirements were not being met. Reformulated gasoline contains an oxygenate, typically ethanol or

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MTBE (methyl tertiary butyl ether). Until the early 2000s, refiners preferred MTBE over ethanol because it cost less and was more chemically stable. But when studies showed that MTBE contaminated ground water supplies, the chemical was banned in 25 states, including California, the largest consumer of reformulated gasoline. Many refiners switched to ethanol to meet the reformulated gasoline requirement.

The Energy Policy Act of 2005 eliminated the reformulated gasoline requirement. But the new law still required refiners to blend gasoline to keep emissions low. Thus, while the law did not specifically require oxygenated gasoline, the demand for ethanol remained.

The Energy Policy Act further underpinned ethanol's demand by establishing the Renewable Fuels Standard. The RFS required that 4 billion gallons of renewable fuels be blended into the nation's fuel supply in 2006 and 7.5 billion gallons by 2012. These requirements ensured demand for ethanol and other renewable fuels, such as biodiesel produced from soybeans.

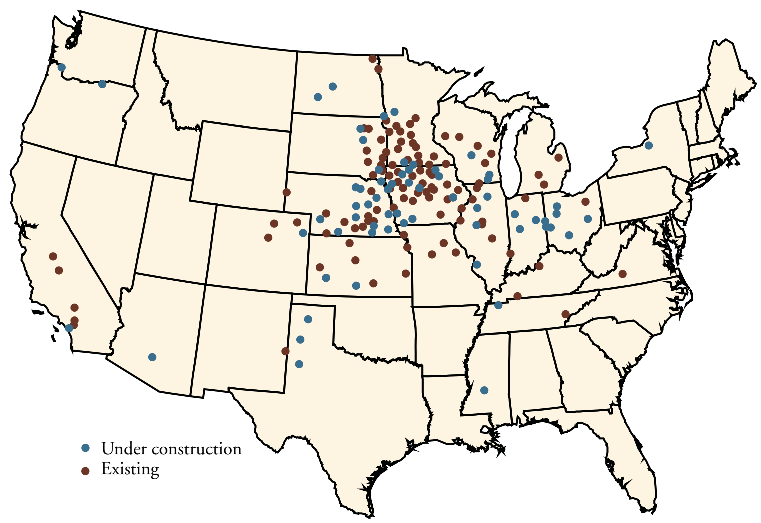
In short, environmental policy and rising profits have rekindled interest in ethanol. From 2000 to 2005, ethanol production jumped 140 percent, and the industry is on pace to add another 20 percent in 2006. The result will be an annual production capacity of more than 4.5 billion gallons of ethanol (Renewable Fuels Association).

Why is ethanol attractive to rural communities?

Given the explosion of growth in the industry, some rural communities are pinning their hopes for future prosperity on ethanol. Ethanol's dividends can include new local markets for grain, new waves of investment in the local economy, new jobs, greater tax revenues, and increased wealth for rural towns. Realistically, though, which of ethanol's promises can bear fruit?

To be sure, there has been a strong wave of investment in new plants and existing plant upgrades. In 2000, 54 ethanol plants operated in the United States. Today, 107 plants are online, 49 are under construction, and eight expansions are under way (Map 1). Existing capacity is 5.1 billion gallons of ethanol per year. The new facilities and plant expansions will add 3.8 billion gallons to capacity each year, upping the industry's annual capacity to 8.9 billion gallons—compared to just 1.75 billion gallons in 2000.

Map 1
Ethanol Bio-Refinery Facilities (As of December 2006)



Source: Renewable Fuels Association

For many rural communities, these new plants and upgrades have created jobs, broadened their tax base, and added wealth to the community. Indeed, a 50-million-gallon-per-year ethanol plant employs 35 to 40 people and costs $73.5 million to construct (Swenson and Eathington).

Farm groups have long supported ethanol production because of its potential to boost local crop prices. At a time when producers were seeking new ways to add value to locally grown commodities—in an attempt to enhance local competitiveness in today's global markets—ethanol promised to add value to corn. Indeed, in 2006, roughly 20 percent of the U.S. corn crop went to ethanol production (USDA). During the fall harvest, the surge in crop prices seemed to validate ethanol's potential.

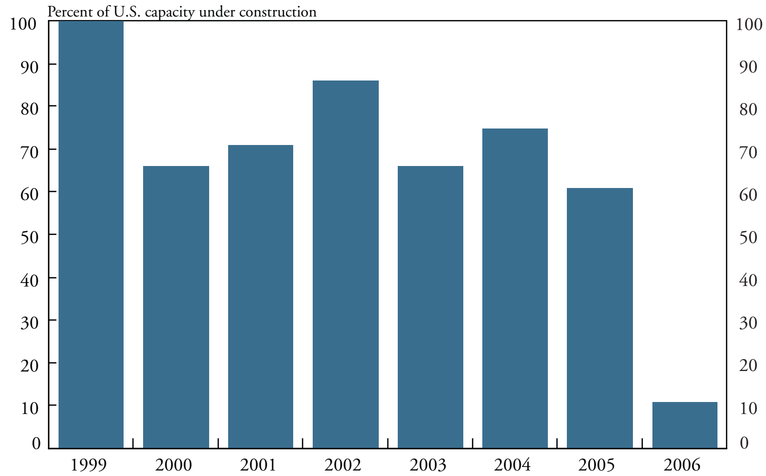
But higher prices can also bring unwanted side effects. First, higher prices can tempt producers of other crops, such as soybeans, to shift production to corn, thereby swelling future supplies and dampening prices. Second, higher prices can boost feed costs for livestock. Last year, as corn and other crop prices surged during the fall harvest, U.S. feed costs also soared. From August to December 2006, feed costs jumped 24 percent. Cattle feeders were partly immune to the high prices because DDGs partially replace corn in the cattle feed ration. But hog and poultry producers were left to bear the brunt of the feed price surge.

Ethanol production also raises questions about the location and structure of the livestock industry. DDGs are a valuable byproduct of ethanol, but they spoil quickly and are expensive to transport. As a result, cattle feedlots and ethanol bio-refineries have begun to co-locate. Some industry analysts warn that ethanol production could increase cattle production in the Corn Belt at the expense of production in the southern Plains. Such a structural shift could hinge on the availability of slaughter capacity in the Midwest.

Ethanol facilities are also viewed as a way to keep rural wealth invested in rural America. During the 1990s and early 2000s, farmer-owned cooperatives often invested in new ethanol facilities (Novack). Equity drives were held, and farmers invested capital in the local plant, creating a value-added opportunity for them to reap bigger returns on their corn crops.

Over the years, though, ownership in ethanol plants has evolved. Plants have become larger, and fewer start-up operations are owned by farmers. Farmer cooperatives work well for raising capital to build smaller plants—those that produce 40-50 million gallons per year. But with the shift to larger plants (plants capable of producing over 100 million gallons per year), raising the needed capital solely from farmers in the region is more difficult. The surge in ethanol profitability has attracted the interest of investors outside the local community. From 1999 to 2005, about 70 percent of the ethanol plants under construction were farmer-owned. In 2006, farmers owned just 10 percent (Chart 1).

Chart 1
Farmer-Owned Ethanol Production Capacity



Source: Renewable Fuels Association

Ethanol's profits

Profits are influenced by the costs and revenues of production. In the ethanol industry, those factors are the prices for feedstock (mainly corn), natural gas, and ethanol.

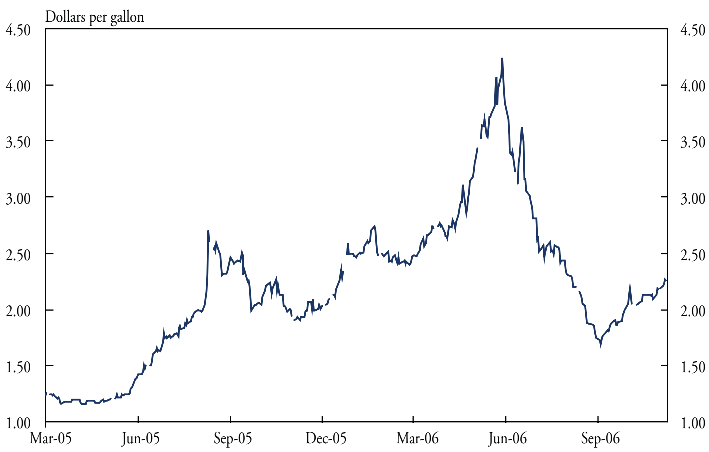
Feedstock costs are the largest expense in ethanol production and are measured on a net basis. Net feedstock costs are calculated as the difference between the cost of corn or other feedstocks and the revenue generated from selling DDGs. A 2002 USDA study reported that net feedstock costs typically account for more than 50 percent of the costs of ethanol production.

Natural gas is the second-largest cost for ethanol producers. A majority of ethanol bio-refineries are powered with natural gas. USDA estimated that in 2002 natural gas expenses accounted for 12 percent of production costs.

Ethanol is the primary source of revenue for ethanol plants. Fluctuations in the price of ethanol can have a dramatic impact on a facility's bottom line. With the expansion in the industry in recent years, ethanol prices have become more volatile, ranging from $1.20 per gallon in March 2005 to more than $4.20 per gallon in June 2006 (Chart 2).[2]

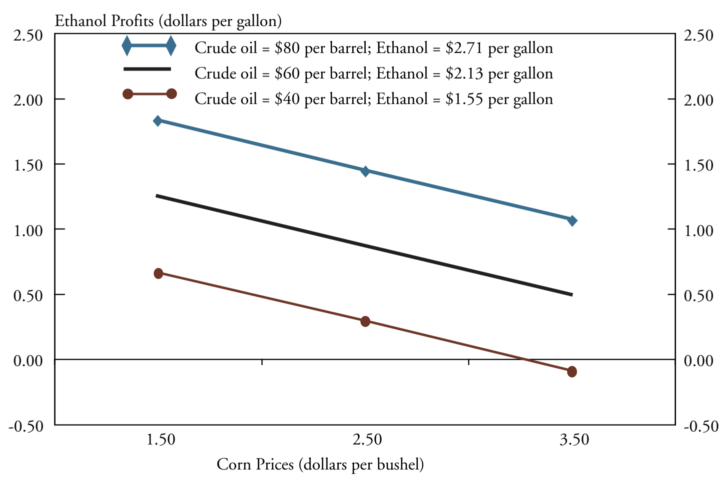
Due to the wide swings in prices, profits from ethanol production have been equally volatile. In the last half of 2006, estimated profits ranged from $3 per gallon to only $.50 per gallon.[3] At the time of writing, June 2007 futures market prices for ethanol and corn indicate ethanol

Chart 2
Ethanol Prices—Nearby Futures Contract



Source: The Chicago Board of Trade

Chart 3
Ethanol Profits Under Varying Corn and Crude Oil Prices



profits could narrow in the months ahead, declining to about 30 cents per gallon.

The high profitability enjoyed in 2006 and expected going forward is based on relatively high crude oil prices. Will ethanol profits disappear if crude oil prices drop? In other words, just how sensitive are ethanol profits to fluctuations in corn and crude oil prices?

To address these questions, we conducted some simulations based on varying the two key components of ethanol profits, ethanol and corn prices. We linked ethanol prices to crude oil prices due to the historical relationship between ethanol and crude prices, while we held natural gas prices constant.[4] We allowed corn prices to range from $1.50 to $2.50 to $3.50 per bushel. Based on the historical relationships, ethanol prices ranged from $1.55 to $2.13 to $2.71 per gallon to correspond with crude oil prices that ranged from $40 to $60 to $80 per barrel, respectively.

The simulations revealed that ethanol profits are highly variable, with the potential for losses under high corn prices and low crude oil prices. Currently, crude oil prices are fluctuating around $60 per barrel, which would historically translate into ethanol prices reaching $2.13 per gallon. As Chart 3 shows, at these prices ethanol production would be profitable in all cases where corn fluctuated between $1.50 and $3.50 per bushel. When crude oil prices were assumed to be $80 per barrel and ethanol prices to be $2.71 per gallon, ethanol profits rose under all corn price scenarios (blue line). When crude oil prices were lowered to $40 per barrel and ethanol prices fell to $1.55 per gallon, ethanol profits also fell (red line). In fact, ethanol profits turned negative when crude oil and ethanol prices were low and corn prices were high, $3.50 per bushel. In this scenario, losses were estimated at 9 cents per gallon.

Ethanol's risks

Clearly, the day-to-day volatility of prices for crude oil, ethanol, and corn pose operating risks to ethanol's profitability. Transportation risks are also an ongoing concern. In the long run, serious policy risks could materialize if legislators rewrite the Renewable Fuels Standard or decide to change ethanol subsidies. And, perhaps most important, corn-based ethanol's competitiveness will always face the threat of new technologies.

Changing market prices pose several risks to the ethanol industry. As discussed earlier, high corn prices, coupled with a drop in crude oil prices, can make ethanol profits disappear overnight. Or, a sustained period of high crude oil prices and high ethanol profits could attract other crude oil substitutes into the market, increasing the competition and driving down profits. Moreover, high crude oil prices and attractive ethanol profits could lure foreign competitors like Brazil into the market.

Large swings in natural gas prices also pose a risk to ethanol profits. When plants are operating near breakeven levels, natural gas costs can play a critical role in determining whether ethanol production is profitable or not. This balance is especially important entering the winter months when natural gas prices typically surge.

With the demand for cleaner-burning ethanol coming from all regions of the nation, especially where MTBE is banned, transportation risks continue to pressure the industry. As the industry booms, other plants have appeared in all corners of the nation, including New York, California, and Georgia. Twenty states now have ethanol bio-refineries. Still, production remains concentrated in the Corn Belt, close to the feedstock source. The top three ethanol-producing states in the nation are Iowa, Nebraska, and Illinois.

The transportation challenge stems from the fact that ethanol-blended gasoline cannot be delivered from the Midwest to other regions through the nation's pipeline system. Ethanol absorbs water and other impurities—chemicals that are often found in pipelines. Thus, ethanol must be transported by rail or truck, which is more expensive than pipeline delivery. For example, transporting ethanol to California from the Midwest can add an additional 14 to 17 cents per gallon (DiPardo).[5]

Policy risks still remain for ethanol producers, despite the passage of the Energy Policy Act of 2005, which expanded the support for renewable fuels. Future changes to the Renewable Fuels Standard could boost or limit the demand for ethanol. Moreover, the ethanol industry is subsidized. Refiners currently receive a tax exemption of 51 cents per gallon of ethanol blended into gasoline.[6] For gasoline blended with 10 percent ethanol, a refiner receives an exemption of 5.1 cents per gallon. If lawmakers cut or discontinue the tax exemption, profits for ethanol will fall since the tax exemption is currently capitalized into ethanol prices.

A final issue facing the ethanol industry is the impact of new technologies. If refiners can meet clean air requirements and octane needs with a lower cost input, they will most certainly do so. Some refiners claim that cleaner gasoline can already be achieved without oxygenates, although these technologies are more expensive (Yacobucci). If such technologies were to become cost competitive, refiners could choose the cheaper option.

Other new technologies might change ethanol production practices. For example, new enzyme and yeast technologies promise to boost ethanol production yields from corn—a potentially positive development for both corn producers and the ethanol industry. In contrast, other technologies are being developed to commercialize the production of ethanol from cellulosic biomass. These resources range from waste paper and wood to corn stover, wheat straw, and switchgrass. The first cellulosic ethanol plant is under construction, although the viability of cellulosic ethanol production is still under question. The development of cost-effective cellulosic technology would enhance the competitiveness of ethanol, but it could expand ethanol production outside the Corn Belt, challenging the future of corn-based ethanol. According to USDA's "Billion Ton Study," enough biomass is available for ethanol to reduce the country's dependence on oil, while continuing to meet food, feed, and export demands (Perlack and others).

Surging ethanol prices and profits have caught the attention of many rural communities. As ethanol production accelerates and future expansions are planned, many rural communities equate ethanol production with economic opportunity in the 21st century, despite its side effects.

Ethanol production may offer some bright opportunities for rural America. In reality, though, ethanol profits in the future will be highly variable, given the volatility of prices for corn, ethanol, and other energy products. At the same time, its opportunities could quickly fade with changing markets, environmental policies, and technological advances.

Endnotes

[1] In contrast, in Brazil, the feedstock of choice for ethanol production is sugarcane.

[2] Prices were based on nearby futures market contracts.

[3] Estimated profits were calculated by updating USDA's 2002 cost of production estimates using 2006 prices for corn, DDGs, natural gas, and ethanol and including depreciation and loan costs obtained from Whims (2002). After accounting for depreciation and loan costs and 2002 ethanol costs of production, ethanol profits were estimated to be 16 cents per gallon in 2002.

[4] Eidman (2006) indicated that ethanol prices were historically 35 cents above wholesale gasoline prices. The relationship between wholesale gasoline prices and crude oil prices followed the following equation, wholesale gasoline equals 0.036 + 0.029 * crude oil price.

[5] Further increases in ethanol production will also put more demand on rail systems that already face capacity constraints. Increased ethanol production could change the way agricultural commodities are shipped, leading to changes in local transportation costs. For example, as local ethanol plants have used more corn, there have been reports of less traffic going to ports along the Mississippi River.

[6] The tax exemption is a credit on the federal excise tax on gasoline. For historical information on ethanol tax credits see "The 'Volumetric Ethanol Excise Tax Credit' eliminates the impact of the ethanol tax incentive on the highway trust fund," available at *http://www.ethanolrfa.org/policy/papers/view.php?id=168*.

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