Ethanol Industry Outlook

Paul Gallagher

Iowa State University, paulg@iastate.edu

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ETHANOL INDUSTRY OUTLOOK
Paul Gallagher
Professor
Department of Economics
Iowa State University

Introduction
The ethanol industry has quickly risen from obscurity to become a major user of U.S. grain. Corn consumption by ethanol processors will soon be 1.6 billion bushels or 16% of U.S. supply when plants under construction begin processing within the next year. In other words, about the same amount of corn is used for ethanol processing and exports. Iowa has shared importantly in the processing expansion, maintaining about a 30% share of national processing capacity throughout the last three decades.

Accordingly, the ethanol market review and analysis of growth prospects in this paper may be useful to those who are not thoroughly familiar with this new market. First, we discuss the competitive role of ethanol in the gasoline additives market, emphasizing the role of U.S. Clean Air policies. Second, we present some baseline projections of the demand for ethanol, discussing the influence of possible policy changes, MTBE bans and renewable fuel standards, on the ethanol outlook. Third, we review developments external to the ethanol industry could cause major changes in the ethanol outlook. Lastly, we document the profitability record and discuss the sources of variability in ethanol returns. In this fashion, more informed decisions about participation in this important new market may be made.

History of Ethanol Regulation and Demand
The historical demand expansion for ethanol is explained by escalating quality demands for gasoline. Partly, increasing quality requirements stems from the performance demands of gasoline engines. Partly, the requirements for clean fuels flowing from clean air and water regulation in the United States are responsible. Specifically, three air quality and health regulation episodes against substitute additives produced by the petro-chemical industry have eliminated a lot of the competition and improved demand prospects for ethanol.

First, regarding automobile performance, serious consideration of ethanol as blending agent for increased octane began in the 1930s. Petroleum-based regular gasoline had an octane value of 60 at that time. Ethanol blending for increased octane and a slower-burning fuel was technically interesting because ethanol's octane rating (114) is the highest of all major additives in the market today. The octane rating is an index of how long it takes a particular chemical to burn relative to an octane baseline. However, a chemical company developed a lead-based compound for increasing octane, and ethanol was unable to compete on a cost basis at that time.

Thirty-five years later, the U.S. EPA banned lead in gasoline because it causes cancer. The Clean Air Act of 1970 included the lead ban. At this time, most of the modern gasoline additives, Alkylates, Polymers, MTBE and ethanol, were introduced to the marketplace. Refineries made two other adjustments to increase the octane content of gasoline without lead. First, they added the refinery by-product butane. Second, they increased output of reformer gasoline and diverted this benzene-rich product from plastic production.
Second, the EPA revised gasoline standards with favorable implications for ethanol in the Clean Air Act of 1990. A benzene maximum on the recipe for reformulated gasoline reduced the use of a major octane substitute. An oxygen minimum for reformulated gasoline expanded ethanol's demand as a clean-burning additive. The act also specified reductions in four harmful categories of auto emissions: Volatile organic compounds (VOC), toxic chemicals (TOX), nitrous oxides (NOX), and sulfur oxides (SOX). According to our simulation study, ethanol scores highly with regard to the EPA's criteria pollutants; increasing ethanol blends increase VOC somewhat, but TOX reduced because of reduced benzene concentration. NOX and SOX also decreased because ethanol does not contain nitrogen or sulfur.

Third, there is an increasing conviction that MTBE has adverse consequences for water quality. MTBE has been found in drinking water due to leaking gasoline tanks in inherent water-seeking characteristics of the chemical. Also, there is some (incomplete) evidence that MTBE is a carcinogen. However, eighteen states, including California and NY, have banned MTBE. Ethanol demand has benefited, because a major substitute product with high octane and oxygen content has been removed from the market.

National Ethanol Demand Outlook

Our recent simulation study looked at competition in the additives market and growth prospects for ethanol the next decade with a reasonably ‘normal’ petroleum and gasoline markets. The key provisions of the baseline projections are gradually declining petroleum prices, a growing gasoline market, and continuation of current EPA clean air regulations (but no state MTBE bans). Two policy alternatives were also considered in the same economic environment. First, a national MTBE ban was considered, on the grounds that the technical evidence against this product may mount. Second, the effects of the renewable fuel standard from pending federal energy legislation on additives market and ethanol was considered as a possible future policy change.

The main implications of our study for ethanol demand are shown in the last row of table 6. The actual demand in 2000, before the expansion of ethanol, was 1.65 billion gallons. With baseline market assumptions, demand would grow to 4.37 billion gallons by the end of the decade. And policy changes could cause a slight increase in demand, to 4.54 billion gallons with the national MTBE ban and 5.04 billion gallons with the renewable fuel standard.

Implications for Processing Capacity Adjustments in the U.S. and Iowa

Nationally, considerable progress has already been made getting processing capacity in place to meet growing demand. The capacity to produce 3.9 billion gallons of ethanol will be in place within a year when current construction and expansion projects are completed. This is 90% of the baseline demand for the end of the current decade.

Similarly, Iowa's ethanol industry has the capacity to produce 854 million gallons, annually. Also, new dry mills under construction and plants planned for construction will soon produce 371.5 million gallons of ethanol each year. Iowa's total production capacity will reach 1235.5 million gallons per year.

Already, Iowa may have nearly filled its share of the ethanol market that will develop with more normal petroleum prices by the end of the decade. The end-of decade national demand
expansion given the RFS would be 3.4 billion gallons, according to table 6. Iowa's projected expansion would be about 1.0 billion gallons; another recent study shows that Iowa maintains a 30% share of capacity in response to a demand expansion (Gallagher, Otto, and Dikeman). Today's actual Iowa capacity expansion, 731 million gallons, is only 274 million gallons short of the end-of-decade expansion associated with RFS. Using slightly more conservative national demand assumptions with today's national policies, Iowa only needs 84 million gallons of additional capacity before the end of the decade.

**Key Variables Affecting Industry Outlook**

Future ethanol demand would probably approximate our baseline projections if external events conform to the assumptions we made about external events that influence the ethanol market. We made assumptions about several important exogenous variables: corn exports, corn yield, petroleum price, MTBE bans, ethanol subsidies and ethanol trade. Now I review and justify our assumptions, while mentioning some alternate assumptions and how the ethanol market projection would be affected.

Perhaps the main finding of our simulation study is that there's room for a growing ethanol industry built on a corn market with steadily expanding supplies and stagnant demand. Specifically, we assumed that corn yield will continue to grow along its historical trend line for the next decade. We also assumed that the export market, stagnant for the last 20 years, will remain stagnant for the next decade. (charts on USDA projections for corn exports and yields). Finally, we relied on Energy Department baseline forecasts showing a growth in gasoline demand, and gradually declining petroleum prices.

However, some analysts have a quite different view of the prospects for corn market surplus. For instance, some trade economists believe that corn trade will get a lot better soon. Others doubt that corn yield growth can continue for another decade, owing to limits on corn response to fertilizer. In fact, some argue for strong export growth and poor yield growth to show that a growing ethanol industry might push for unacceptably high corn prices.

Changing petroleum prices are another source of ethanol demand variability. Strong demand will surely last for the duration of $55/bbl oil because ethanol's competitive position against petroleum based byproduct chemicals improves considerably with high oil prices. However, some of the factors causing unusually high petroleum prices, such as supply disruptions (Venezuela, Iraq, and U.S. gulf), are transitory. So prices within historical ranges can be expected sometime during the next decade. Further, another episode of price cutting and $14/bbl oil during the next decade is not impossible. It would occur when all supply sources are on line and world demand growth ceases. Then Saudi Arabia, with production costs at $6/bbl might consider the possibility of cutting prices and increasing market shares as a means of increasing their petroleum revenues.

Changes in environmental regulations and policies will remain part of the ethanol demand picture in the future. It is possible some areas where there is potential for change. For instance, some believe the demise of ethanol consumption subsidy, or partial gasoline tax rebate for using ethanol blends, is imminent, or at least it would be if these analysts had their way. Elimination is a possibility for the future. But expansion of this subsidy or similar incentives may be equally
likely; the environmental benefits associated with bioenergy consumption are becoming known in the policy world.

**Ethanol Trade**

Next, I review ethanol trade policy with a twofold purpose. First, the existing trade situation and policy is reviewed to show that trade will not likely become a major price-determining force in the United States the existing policies in place. Second, evidence on the competitiveness of the U.S. corn/ethanol industry is reviewed. Then the implications for U.S. performance in a free trade market are discussed.

First, U.S. imports of fuel ethanol are very modest, only about 2% of domestic production in a recent marketing period. Imports may expand some now, because California is looking for alternative sources since the MTBE ban there. A main reason for limited U.S. imports is that there is a substantial import tariff: $0.57/gallon.

But there is also a tariff-quota on ethanol imports from certain poor Caribbean and African countries. These countries are exempt from the ethanol duty until their imports are 7% of U.S. consumption, but they pay the ethanol import tariff for additional imports. Imports will likely expand to the 7% limit soon, because Brazil’s ethanol can be transshipped through a qualified Caribbean Country (e.g., Panama) and still qualify for the quota exemption.

Second, we constructed a competitiveness indicator to evaluate the concern that the U.S. corn-ethanol industry could not compete in the event that the ethanol import duty is removed. The competitiveness indicator is the cost difference between sugar ethanol produced in Brazil and shipped to the U.S. and corn-ethanol produced in the U.S. Thus, the U.S. has a competitive advantage when the indicator, \( d > 0 \), or a disadvantage when \( d < 0 \). Indicator time series calculated with historical prices and current technology suggest that there would be wide swings in cost advantage, but no trends towards one country or another. Further, there is not a statistically significant difference between the mean value of costs.

Free trade in ethanol is not imminent. However, if it did occur, the U.S. corn processing industry could likely survive and possibly thrive. It is likely that there would be periodic swings with an export phase and then an import phase for the U.S. corn processing industry.

**Processing Margins, Variability and Risk**

Profits have caused the dry mill expansion. Typically, the dry mill industry has provided $2.40 per bushel of added value in terms of product revenues of corn processed during the last five years. Further operating and capital costs are only $1.4/bu., which leaves a profit margin of about $1.0/bushel.

But ethanol returns are highly variable. Last month, value added was $4/bu and the profit margin was $2.6/bu. However, the monthly profit margin has also been zero in the last five years. Put another way, the 5-year average after tax return on investment for a typical dry mill is 25.5%. But the average return combines periods of 40% or greater with an equal number of periods at less than 5%.

Further, the industry went through a 5-year period in the mid-90s when the typical dry mill
could not cover operating expenses. This period of low returns for ethanol coincided with a price-discounting and market share fight in the world petroleum market that typically produced $14/bbl petroleum prices.

Nonetheless, an ethanol investment can reduce overall portfolio risk if it is a modest share of an investor's portfolio. The negative relation between ethanol returns and agricultural returns occur because agriculture's outputs are ethanol's inputs. Ethanol returns and returns for an S&P 500 portfolio are negatively correlated because ethanol's output, energy, is an input to the rest of the economy. Given the occasional periods of very high profits and episodes of pricing at cost, a long-term view is likely necessary to capture the true average return on an ethanol investment.

Further expansion in ethanol industry capacity may still turn out to be profitable over the next few years. But the industry may have nearly filled the ethanol market that will develop with more normal petroleum prices by the end of the decade. So increasingly, capacity expansion is a bet that unusually high petroleum prices will extend for the next two or three years, or beyond. The risk of over-expansion is possible ethanol plant closure or steep price discounts under future surpluses in the world petroleum market.

References


Ethanol Industry Outlook

Outline

History of Market
Baseline Outlook
Key Variables Affecting Industry Outlook
Return Variability

History of ethanol market

First presidential pardon
1935 Congressional hearings
Clean Air Acts of 1970/1990--regulations/ standards that created the modern market for gasoline additives:
  All fuel: Lead ban
  Reformulated fuel:
    benzene (max)
    oxygen (min)
  EPA's pollution aggregates reduced:
    VOCX(-), NOX(+),TOX(+),SOX(+)

California/ 18 State MTBE ban

Baseline Outlook - 2015 Baseline

Key Assumptions
1. Continue provisions of Clean Air Act
2. Petroleum price slowly declining to $22/bbl

Petroleum and gasoline assumptions come from recent Energy Department 'middle baseline' projection for gasoline and petroleum markets.

Our simulation model:
*looked at how refiners would use petroleum and additives for gasoline production when they seek profits but must also follow the Clean Air Acts.
*accounted for price and quantity adjustments in the input (petroleum and corn), output (gasoline), and additives (ethanol and MTBE) markets.
Some long-run effects of growing markets and renewable fuel standards on additives markets and the US ethanol industry

Paul W. Gallagher, Hosein Shapouri, Jeffrey Price, Guenter Schumel, Heather Rubaker

1. National MTBE Ban

(a) Expansion, 2000 to 2015

- All refinery gasolines increase
- Additives increase

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<td>Total</td>
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(b) Relative prices indicate quality of gasoline grades, ranked as follows:
- MTBE
- Ethanol (less subsidy)
- Other additives (alkylates, polymer)
- Refinery gasoline (coker, butane, hydrocracate, cat. cracker)

2. Renewables Fuel Standard

(a) describe
- 2.9% of consumption or 5 mil gal of ethanol used in any grade of gasoline

(b) motivate
- EPA has done similar things in other markets (e.g., fuel economy standard on cars)
- A policy change that the corn lobby is likely to accept.

(c) modeling
- Remove oxygen constraint.
- Add constraint: 5 mil gal = Sum of ethanol in all gas grades.

Verbal Summary of Table 5 Market Simulation Results

1. National MTBE Ban

Implications
(a) Expansion, 2000 to 2015
- All refinery gasolines increase
- Additives increase

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SIMULATION RESULTS, QUALITATIVE

(1) MTBE Ban: For summer reformulated gas, a large price increase.

Implications
(a) reduced gasoline consumption
- [refinery gas \uparrow, ethanol \uparrow, additives \downarrow, alkylates \downarrow]

(b) production:
- [refinery gas \uparrow, but additives \downarrow, alkylates \downarrow]

(c) widening price spread between ethanol and other additives.
Why? MTBE is 1/5 of current octane supply...It's gone.

(2) MTBE Ban, remove oxygen standard, add renewable fuel standard:
- The large price increase for reformulated fuel disappears because the oxygen standard is gone.
- Total gasoline consumption increases.
- Ethanol demand and price are 10% higher than in (1).
Table 6. Ethanol utilization, by fuel type and policy

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Actual 2000</th>
<th>Baseline 2015</th>
<th>Ban with oxygen std.</th>
<th>Ban with averaging</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>in bil. gallons</td>
<td>in bil. gallons</td>
<td>in bil. gallons</td>
<td>in bil. gallons</td>
</tr>
<tr>
<td>Conventional</td>
<td>1.222</td>
<td>3.150</td>
<td>1.636</td>
<td>4.956</td>
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<tr>
<td>Reformulated</td>
<td>0.403</td>
<td>1.050</td>
<td>2.730</td>
<td>0.0</td>
</tr>
<tr>
<td>Oxygenated</td>
<td>0.026</td>
<td>0.169</td>
<td>0.168</td>
<td>0.084</td>
</tr>
<tr>
<td>Total</td>
<td>1.651</td>
<td>4.368</td>
<td>4.536</td>
<td>5.04</td>
</tr>
</tbody>
</table>

National and Iowa Capacity Adjustment

- National Demand & Supply:
- Demand (RFS/2015): 5,000 mill gal
- Baseline Supply (2000): -1,651 mill gal
- Expansion, 2015/2000: 3,349 mill gal

- National Demand Expansion:
- Iowa expansion share: 3,349 mill gal
- Iowa Demand Expansion: 1,005 mill gal

- Iowa Capacity:
- In 2004:
  - Operating: 864
  - Under construction: 276
  - Planned: 98
- Total: 1,236 mill gal
- In 1998: -505 mill gal

- Iowa Capacity still required, through 2015:
  - 1,005-731 = 274 mill gal.
Key Drivers of Ethanol Industry in Next Decade:

1. Corn Exports. Two possibilities:
   - continue historical stagnation
   - get a lot better soon (China)

2. Corn Yield. Two possibilities:
   - continue 70 year growth trend
   - yield increases stop (limits of response to fertilizer)

3. Petroleum Price
   - $20/bbl baseline for 2014
   - Low of $14/bbl
   - Current high of $54/bbl
   - $6/bbl Saudi cost

4. MTBE Bans
   - 21 states' bans extend to national ban
   - States tire of high fuel prices and reverse existing ban

5. Ethanol Subsidy?

6. Ethanol Trade?
U.S. IMPORT POLICY

I. U.S. Imports for 2002 were very modest, at 0.11 billion gallons or 3% of domestic production. But California began importing (0.04 billion gallons) in 2003, after their MTBE ban went into effect.

II. There is a $0.57 per gallon import duty on fuel-grade ethanol for the United States (U.S. International Trade Commission).

III. There is also a tariff-rate quota up to 7% of U.S. domestic consumption or about 200 million gallons in 2003.

A. Below quota imports from Canada, Israel, Caribbean Basin Economic Recovery Act countries, and countries covered under the African Growth and Opportunity Act are excluded from the import duty on fuel ethanol.

B. Further, ethanol produced in Brazil and dried in a Caribbean Basin Country, such as Panama, can qualify for the under quota tariff exemption (IPV Staff). The quota for Caribbean Basin Countries and Brazil trans-shipments is not yet binding.

Return Variability

Dry Mills: Corn-Ethanol Processing Margin and Costs, with actual prices and current technology
Jan 1990 thru Oct 2004
Prepared by: Paul Gallagher (Iowa State University) & Hosein Shapouri (USDA)
Monthly Return on Investment (ROI) after taxes, dry mills

5-year average ROI: 25.5%