The Effects of Expanding Ethanol Markets On Ethanol Production, Feed Markets, And the Iowa Economy

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The Iowa Department of Agriculture and Land Stewardship
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By Professor Daniel Otto and Associate Professor Paul Gallagher
Department of Economics
Iowa State University
Ames, Iowa

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Introduction: Demand Growth in the U.S. ethanol industry

Nationally, ethanol has had a growth market over the last two decades. It has grown from negligible levels to the point where it now accounts for about 5% of U.S. corn production (Figure 1 and Figure 2).

Ethanol is a gasoline additive. Increasing quality demands of modern gasoline engines and government regulations on health and clean air have shaped the gasoline additives market. So far, two regulatory changes stand out. First, a lead-based additive, the octane-increasing choice during the 50s and 60s, was banned during the 70s because it causes cancer. Second, the U.S. EPA required that the largest U.S. cities use reformulated gasoline with fuel quality restrictions that reduce smog (ground level ozone) and improve other dimensions of air quality in the most densely populated areas of the U.S. An oxygen standard was included in the fuel quality restrictions on reformulated fuel, on the grounds that oxygen facilitates complete combustion and improves air quality. Ethanol demand received a major boost from both the lead ban and reformulated fuel. Ethanol has the highest octane and oxygen content in the fuel additives market.

Now, a third regulation carries the prospect for a doubling of ethanol demand during the current decade. Methyl tertiary butyl ether (MTBE), the oxygenated chemical of the petroleum industry, has appeared in the drinking water in California and other states that use reformulated fuel. The U.S. EPA has issued a health advisory against drinking water that contains MTBE, because it is a suspected carcinogen (EPA, 1997). California went a step further. It banned MTBE from gasoline, effective at the end of 2002. The California Governor also requested a waiver from the federal oxygen requirement for reformulated fuel to avoid reliance on ethanol. However, the U.S. EPA has now denied the waiver. Ethanol has an assured share of the California reformulated gas market now, since it is the remaining additive that contains oxygen. Other urban states on the East Coast, including New York, Connecticut, New Jersey, and Maine, also an MTBE ban. (Reuters). It is doubtful now that the East Coast states will get an oxygen waiver and they will also require ethanol. Close monitoring of developments in state-level bans could be fruitful for stakeholders in the ethanol industry now. A de facto national ban is a strong possibility if the ban stands and extends to most other urban States.

Estimates of new ethanol demand associated with the bans are calculated from the consumption of reformulated gasoline and the ethanol proportion needed to meet the oxygen requirement. The California ethanol demand expansion was calculated using West Coast (PADD V) data on reformulated fuel. PADD V includes Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington. Only California and Arizona have reformulated fuel, so the West Coast fuel consumption estimate also includes minor amounts of Arizona reformulated gasoline. California data on reformulated fuel is not reported. The demand expansion associated with the California MTBE ban is 985.0 million gallons of ethanol.

Data and support for was provided by Hosein Shapouri, Jeff Price, Guenter Schamel, Mark Dikeman, and Heather Brubacker.

The national (or extended) ban estimate uses the assumption that the ban includes all of the states on the East Coast of the United States. The Energy Department's PADD I includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, Florida, Georgia, North Carolina, South Carolina, Virginia, and West Virginia. The national demand expansion that includes East Coast and West Coast MTBE bans is 1852.0 million gallons of ethanol.

The Potential for Demand Instability

The new reformulated fuel market for ethanol should be very stable because oxygen content is required in reformulated fuel and ethanol is the only remaining additive that contains oxygen. Nationally, reformulated fuel accounts for about one-third of gasoline consumption.

Outside the densely populated urban areas, ethanol is used in conventional gasoline as an octane enhancer. In fact, about one-half of the (pre-ban) ethanol consumption is used in conventional gasoline(EPA, 1999, p. 79). Ethanol must still compete with several octane-increasing additives (alkylates, polymers and iso-octane) in the conventional gasoline market. The competitive additives are made from by-products of petroleum production and natural gas. Consequently, the cost and price of competitive additives fluctuates with the petroleum and natural gas prices.

The variability of the world petroleum market is well known. Current high petroleum prices on the world market occurred because fuel demands grow rapidly with income growth in the world's wealthy countries. The price increases, such as $30/bbl oil are likely aggravated by monopoly pricing in the OPEC cartel during periods of strong growth in the wealthy countries. In contrast, the oil price can fall to $12/bbl during moderate or weak growth in importing countries. The large price declines occur because of the strong income-oil connection, and because OPEC's effectiveness diminishes in weak markets. Typically, Saudi Arabia, who has production costs of $6/bbl, will not reduce production enough to maintain high prices in weak petroleum markets.

Presently, ethanol can compete favorably with other additives and even as a commodity fuel. However, ethanol becomes a marginal additive on the low side of the price cycle in the petroleum market and the high side of the price cycle in the agricultural market. Hence, there is considerable potential for instability of demand for ethanol in the conventional gasoline market.

However, gasoline retailers who use 10% ethanol blends have an exemption from part of the federal excise tax on gasoline. This subsidy is likely sufficient to maintain ethanol demand during the periods of low oil prices.

Hence, the outlook for stable ethanol demand during low oil price periods reduces to the likelihood that the tax credit for blending is maintained. This outlook is good for the intermediate period and maybe the long run as well. For the intermediate term, the credit does not expire until 2007. For the longer term, the current administration has declared its intention to support renewal of the ethanol subsidy (National Energy Policy Development Group, p.6-9).

The ethanol subsidy represents an intersection of the interests of crop producers, environmentalists, and those concerned with national security and imported fuel. Hence, the ethanol tax credit/subsidy has, so far, survived an era of deregulation. Nonetheless, the political environment can change, especially the national security concern at $12/bbl oil.

Processing Margins

Processing margins are the sum of revenues on ethanol and byproducts less the expenditures on the corn input, all expressed in terms of one bushel of corn processed. Margins are useful for the ethanol industry, because they can be compared to processing costs (labor, utilities and capital) that are stable per unit of input processed.

The annual average margins for Iowa ethanol processors are shown in Figure 3. The wet-mill margin includes byproduct revenues from gluten feed, gluten meal, and corn oil. The dry-mill margin uses by product revenues from distiller's dry grains. Both margins use an ethanol price for Bettendorf, Iowa, and an average corn price for North Central Iowa. The by-product prices use price data for Illinois and Indiana locations.

Both margins exceeded $3/bu corn in the early 80s and then declined to the $1.5-$2 range by the mid-90s. In the most recent years the margin has returned to the $3/bu range. A typical range for the sum of operating and annual capital costs is $1.6/bu to $1.8/bu. The market is signaling for a capacity expansion.

Furthermore, the difference between the wet-mill margin and the dry margin, or the wet-dry differential, indicates the market benefit of a wet-mill expansion instead of a dry-mill expansion. Wet mill expansions will probably occur when the return difference exceeds the corresponding cost difference. Otherwise, the market favors a dry-mill expansion. Using industry average data from a recent survey, the processing and capital costs are about $0.18/bu corn higher for the wet mill. The return difference clearly exceeded the annual cost difference during the eighties and early 90s (Figure 4). But in recent years, costs and returns are just about in balance, suggesting little incentive for a wet-mill. Finally, costs for the newest dry mills have fallen, due to lower wages and improved energy efficiency. Thus, dry mills may dominate the present expansion.

The Price and Margin Impacts of an ethanol capacity expansion

Processing margins and profits that exceed operating and annual capital cost are an incentive for the ethanol industry to expand capacity. In a competitive market, the margin gradually falls as capacity and output expand and the ethanol price declines. The process of expanding capacity and declining ethanol prices stops when the processing margin exactly covers the operating and capital costs in a competitive industry. At this point, investors can earn equal or greater returns in other investments.

Related price adjustments in the input (corn) and byproduct (distiller's dried grain, or gluten feed, meal and corn oil) also contribute margin declines when ethanol output expands. First, increasing corn input demand will increase corn price, to attract corn away from alternative uses like exports and feed demand and to provide an incentive for farmers to produce more. Second, increasing byproduct output will require more generous incentives and lower prices to encourage increased consumption.

Calculations of adjustments reduce the ethanol demand expansion for corn by 200 million bushels because likely expansions in Montana and Kansas are wheat using. The estimates are based on national adjustments and elasticities for corn, gluten feed, gluten meal, and corn oil. The corn market response to the demand increase consists of a price increase, which encourages increased production and reduced domestic and export sales. The corn production response accounts for acreage and productivity response to price changes (Houck and Gallagher). Also, the byproduct price declines are limited by nutrient content equivalence with corn and gluten feed; by protein content equivalence with soy meal and gluten meal; and by soy oil prices with corn oil. Changes in the distillers' dried grain price are calculated with a yield-weighted average of gluten feed, meal, and corn oil price changes.

Estimates of the market quantity and price effects of the MTBE Ban are shown on the right hand side of table 1, which shows the changes associated with the California ban and the extended ban, respectively. For comparison, baseline levels from the 2000/2001 crop-year are included in the left column.

To illustrate the effects, consider the extended ban. First, U.S. ethanol output from corn increases by 1620 million gallons and doubles production. The ethanol expansion causes a national expansion in corn demand of 660.8 million bushel. The price increases by $.15/bu to $1.88/bu on a north central Iowa basis.

The supply increases for byproducts are also large, nearly 50% of existing supplies with the extended ban. So all byproduct prices decline. But estimated byproduct price declines are all limited; by the nutrient content, protein and oil price in corn and soy-product markets because byproduct demands are inelastic. The gluten feed price decline is negligible because the baseline price is already near the nutrient value of corn. Similarly, the corn oil price change is negligible. The gluten meal price declines by about 35% before falling to the protein value of soy-meal. The DDG price falls by about 15%.

We believe that the co-product supply increases will have limited effects in the soybean meal market because there are offsetting forces affecting soymeal prices. For illustration consider the extended ban and suppose all of the gluten meal supply increase competes directly in the soymeal market; this is a 0.76% increase in high protein supplies on the world soymeal market. Next consider that the corn price has increased by 8.4%, which in turn, shifts the demand for soymeal up. Using some estimates from Gallagher (1998), we calculate the net demand shift at 0.47% of world soymeal utilization. So the net protein supply increase is only 0.29% (.76-.47). Again using standard elasticity estimates, the implied reduction is 1.6% in soymeal prices. This is an upper limit estimate, using the larger ethanol market expansion from table 1, and assuming that all of the high protein meal displaces soymeal, instead of being spread around in fishmeal, rapseed meal, and meatmeal.

For an estimate of the eventual ethanol price change, we calculate the ethanol price that is consistent with long-run competitive equilibrium (10 % return on investment), processing costs and processing margins at the new input and byproduct prices (Table 2). The reported ethanol prices, $1.05/gal for a wet mill and $1.08/gal for a dry mill are the prices that balance processing margins and processing costs. The ethanol market price will return to these levels when processing capacity is sufficient to cover the demand expansion associated with the MTBE ban. How long it takes to return to the normal ethanol price level depends on plant construction lags, and the implementation schedules for East Coast MTBE bans.

Iowa's Growing Ethanol Industry

The present level of ethanol consumption in Iowa is well within the state's working production capacity of 405 million gallons. The local ethanol industry involves the production, distribution, and sale of ethanol-blended fuels in Iowa. The sales volume and market share of ethanol blended fuels in Iowa continues to increase steadily. Currently, about 835 million gallons of 10 % ethanol blended fuels are sold and used in Iowa, representing about 54% of the 1,550 million gallons of gasoline motor fuels sold in Iowa annually. Thus, 84 million gallons of ethanol is used within the state. Iowa already exports most of its ethanol to other states. Interstate trade in ethanol will likely expand now with a larger west-coast market.

We estimate the Iowa production increase associated with the MTBE ban with a model of the ethanol market (Gallagher, Otto, and Dikeman). This model accounts for many sources of inter-state cost variation: local corn costs, plant size, and transport costs that increase less than proportionately with distance.

The regional and Iowa production estimates are calculated from ethanol demand expansions on the West Coast in the case of the California ban. Next, West Coast ethanol demands are reduced by wheat-using ethanol capacity additions in Montana and Kansas, which have a location advantage over

Iowa. Our estimate of the Iowa ethanol production increase is 193 million gallons with the California ban, which would be shipped to California.

In the case of the extended ban, all of the reformulated fuel on the East Coast and West Coast will require ethanol blends Then the Iowa production increase is estimated at 506 million gallons of ethanol. Our estimates suggest that Iowa still sends most of its ethanol to California with the extended ban, while other States (Illinois, Indiana, Minnesota, and Nebraska) supply the East Coast market.

Currently, 15 new facilities, mostly smaller scale dry milling operations, are under some stage of development in Iowa (Table 3). These dry mills will have about 325 million gallons of working capacity. Iowa's actual plans fill more than the estimated new demand of the West Coast ban. About two-thirds of the demand increase associated with an extended ban is also filled. Concerns about the sufficient ethanol supplies should be allayed. In fact, further expansion in Iowa may warrant caution until there is confirmation of MTBE bans and implementation schedules in eastern states, and moderate capacity adjustments in other Midwest states.

Livestock and Poultry Feeding in Iowa

The potential for a livestock industry expansion arises with more by-product supplies. Wet mills separate the starch for ethanol production and then remove the fat for corn oil, the high-protein for corn gluten meal (CGM) with 60% protein, and corn gluten feed (CGF) with about 18 % protein. The Distillers Dried Grains (DDG) produced in dry mill is a composite byproduct that still includes the fat and all protein components. In comparison to CGF, DDG has higher protein, fat and methionine (Weigel, et all, 1997a). DDG gets about a 10% premium over CGF in the marketplace, likely because some users value DDG characteristics.

Grain prices in Iowa tend to be lower than in other locations that export similar products. The corn price differential between the gulf and Iowa versus the gulf and Illinois for corn (Figure 5) illustrates this point. The Iowa price is the export price less the Iowa-Gulf transport cost. Further, the export-Iowa price difference equals the transport cost ina competitive market. Similarly, the Central Illinois price is the export price less the Illinois-Gulf transport cost, and the price difference. s because the export market looks at the Iowa-Gulf transport cost is higher than the Illinois-Gulf transport cost. The corn price differentials suggest that a feeding corn in Iowa will cost about $6/ton less in Iowa than in central Illinois. The feed cost of ethanol co-products in Iowa will also be lower than central Illinois prices by about the same amount, since gluten feed and gluten meal and distillers dried grains also have export markets at the gulf port. That is, prices for gluten feed, gluten meal and distiller's dried grains will likely be about 10% less in Iowa than in Central Illinois.

Moreover, the feed cost advantage is a strong incentive for the location of livestock in Iowa. To see this, note that it takes about 5 tons of feed to produce 1 ton of meat. Suppose the livestock is located

in Iowa and a profit calculation is made on a per cow basis. Then no transport cost is paid on 5 tons of feed, but transport charges are paid on the corresponding 1 ton of meat to a final product market, such as Europe. The Alternative is to put the cow in Europe; then the transport cost is paid on 5 tons of feed but the cost of shipping the livestock product is avoided. The Iowa location has lower net transport costs than the Europe location, unless the meat transport rate is more than 5 times the grain transport rate. Central Illinois is not competitive for cattle location, since higher feed costs and meat transport are both required.

However, the required feed ration must fit the price changes implied by the ethanol expansion and the particular byproduct feeds must be available locally. Generally speaking, the feed cost with ethanol byproducts in Iowa must be lower than it is in the dominant feeding area with a standard ration.

A comparison of beef cattle rations in Iowa and Kansas before and after the (extended) MTBE ban illustrates some of the limitations and possibilities (table 4a). Initially, a conventional corn-soybean-hay-silage ration is about $1.74/ton cheaper in Iowa, mainly because corn prices are lower. After the ban, the feed cost at both locations increase because the corn price increases. But Iowa's advantage would widen to $3.64 ton if it used gluten feed after the price changes. In contrast, Iowa's cost advantage would erode (to $1.31/ton) with distillers dried grain; DDG is a more expensive way to displace corn in the ration. The problem is that DDG is the feed that will likely be available. Rations that replace more than corn with byproducts may give larger cost advantages.

There are feeding activities that are good candidates for DDG utilization. First, the demand for dairy replacement cows has been expanding because the length of a cow's production period has declined. Further, the ration for a dairy replacement cow removes some corn and some soy-meal when DDG is introduced in the diet. In table 4b, some approximate dairy cow replacement rations use 31%corn and 13% soy-meal in the conventional ration, and then substitute 13% corn and 23% CGF or DDG in the post-ban ration. Iowa's competitive feeding position does improve when the protein substitution is included.

Second, the poultry ration appears best suited to DDG introduction. Poultry diets typically add all of the components that are present in DDG. These factors are protein, methionine, and fat. So cost-reducing possibilities are likely when DDG prices fall closer to the value or its protein component. In fact, the premium for DDG over gluten feed may arise from the fact that it is well suited to poultry and poultry is a growth industry.

To illustrate the potential for livestock and poultry expansion, we took the previous estimates of expansion for Iowa's ethanol industry, calculated the DDG supply increase, and arbitrarily assumed that the export industry, dairy replacement, and poultry feeding all get one-third of the increase in DDG supplies. Next, the maximum feed ration fraction was used to compute a total feed expansion and an implied animal population adjustment. For cows, the baseline is 3.9 million head; the expansion was 7.2% with the California ban and 18.8% for the extended ban. For poultry, the baseline is 33.2 million

birds; the expansion was 100% for the California ban and 200% for the extended ban. For poultry, the percent changes are large because the industry is small. Also, the DDG fraction in the ration is small, and so may exaggerate the size of population adjustments.

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Alternative Plant Configurations and Economic Impact in Iowa

Presently, Iowa has an extensive wet-milling industry. Iowa Department of Workforce Development data indicated there were seven wet milling plants in Iowa in 2000. These wet mills employ 2,200 workers at an average annual wage of about $50,000. High Fructose Corn Sweetener is a major product at these large facilities. Three of these wet-mills produce both fuel ethanol and corn sweetener; corn syrup helps meat peak summer demands in Chicago's soft drink industry while fuel ethanol production takes advantage of seasonal low corn prices in the late fall. Most of Iowa's ethanol supply is produced in these three wet-mills. The lack of opportunities for joint exploitation of sweetener and fuel markets may explain why plans for new wet mills are not emerging.

The Iowa dry-milling industry currently includes flour and cereal milling operations at 10 facilities that employed 468 workers at an average annual wage that ranged from $25,000 to $30,000 per year in 2000. Several dry milling ethanol facilities are under construction and will be part of this dry milling industry. This wage scale is comparable to salaries being proposed as part of the prospectus for new dry mill ethanol processing facilities.

The technology and economics of ethanol production has changed rapidly in the past decade. A recent survey on cost of production by wet milling and dry milling facilities indicates that while wet milling still has lower per gallon production and labor costs, the gap has narrowed considerably (Shapouri, et al). Information on production costs from this survey are used in this study to simulate the labor and resource use by different size ethanol processing facilities and to estimate the overall economic impacts associated with new facilities producing 10, 18, 40, and 80 million gallons of ethanol annually. These impact results for different scales can also be used to estimate the aggregate statewide impacts associated with different growth scenarios for the Iowa ethanol industry following recent developments.

Based on these previous studies, the assumptions on labor and feed grain inputs required for these different scale facilities are detailed in Table 5. The technology and efficiencies are intended to reflect emerging technology of newly designed facilities rather than industry averages over older facilities. Most of the labor and all of the feed grain input will be locally supplied. As discussed previously, a favorable local price impact for producers is expected with higher prices paid for local corn supplies. Shipping costs may also decline with a nearby sales point.

An Input-Output model for Iowa based on the IMPLAN system was used to estimate these impacts on the Iowa economy. The primary impacts are the labor and feed grain income. The secondary impacts include transportation, handling, energy purchases, and other inputs and services used to produce and

distribute ethanol. The total impacts also include the consumer-related expenditures by people employed in these sectors.

The detailed results of the Input-Output analysis for these four different sized ethanol-processing facilities are presented in Appendix Tables A1-A4. Although all the facilities are relatively capital intensive, the employment and economic impacts are fairly robust. For instance, the smallest facility examined produces 10 million gallons of ethanol annually and employs 13 workers. After incorporating linkages for input purchases by the ethanol industry and consumer-related expenditures by workers, the estimated total employment impacts are 49 jobs. Other economic effects associated with a 10 million-gallon dry milling facility include $1.44 million of additional labor income and $4.25 million additional value added or net economic value to the region.

Similarly, the largest of the facilities examined was an 80 million-gallon wet milling ethanol-processing facility. Direct employment at a new facility of this size was estimated as 90 workers. Total impacts throughout the economy associated with an 80 million gallon facility include 414 jobs, $14.5 million of labor income, and $34.6 million of new value added. As with the smaller facilities, these economic effects are concentrated in the manufacturing, agricultural and transportation sectors, but also widely distributed across services and trade sectors.

Ethanol Expansion Impacts on Iowa's Economy

The state analysis considers two expansion scenarios for the ethanol industry for Iowa in particular. The first case considers the expansion potential and implications of a West Coast ban on MTBE. In the second case, an extended MTBE ban is considered. Assumptions and results from the simulations of these two scenarios are presented in Table 6. From earlier analysis, the Iowa share is 193 million gallons for the West Coast ban, and 506 gallons of ethanol for a generalized ban.

For the West Coast ban scenario, we assume the ethanol processing capacity in Iowa will expand to meet the new 193 million gallon requirement via a combination of one 80-million gallon facility, one 40-million gallon, two 18-million gallon, and four 10-million gallon plants. Then estimated economic impact results for four different size facilities presented in Tables A1-A4 are added to arrive at an overall estimate of economic impacts from a 193 million gallon ethanol demand change. A slightly different plant configuration would not alter the impact numbers significantly.

For the general economy, the sum of direct employment at the new ethanol facilities is estimated as 231 additional workers with economy-wide effects estimated as 976 workers. Labor income at the new ethanol facilities is estimated as $9.21 million with total indirect and consumer-related spending impacts of over $30.93 million. Total value added to the state is $81.0 million. Based on average revenue yields from income changes, general state revenues are expected to increase by $8.47 million.

For crop agriculture, 77.2 million bushels of corn and generate additional statewide price increases for corn of about $.043 per bushel. The additional corn value applied to 1,740 million bushel corn production implies a $74.8 million income gain to corn farmers. This price benefit on corn production is expected to be concentrated in the 50-mile radius surrounding a new ethanol facility. Producers near the facility could expect a 20 cents per bushel premium that diminishes as distance and transportation costs to the facility increase.

For livestock agriculture, new feeding opportunities associated with DDG could generate $26.9 million in the West coast ban scenario. The calculation is based on an equal three-way split of available DDG supplies for dairy replacement, poultry and exporting. Also, a livestock profit margin of $.025/lb meat output was used.

The second scenario involves an extended MTBE ban, with Iowa's share of that expansion is expected to be 505.9 million gallons of ethanol and 202.4 million bushels of corn processed. We assume a configuration of ethanol plants involving three 80-million gallons, three 40-million gallons, five 18-million gallons and six 10 million-gallon facilities around the state. The direct and total economic impacts associated with this expansion are also presented in Table 6.

Direct employment at all the new facilities is estimated at 593 new workers with 2,550 total jobs supported throughout the economy. Direct labor income from the new facilities is an estimated $24.13 million with $81.74 million of income supported throughout the state. Value added is $244.7 million. Crop income increases by $189.7 million with increased revenues on the State's corn production. Livestock income increases by $70.6 million with expanded feeding. General State tax revenues increase by $17.2 million.

Conclusions and Limitations

-Since California's waiver on the oxygen standard has been denied, it is unlikely that other states with an MTBE ban will get a waiver either. Hence, the prospective demand expansion now extends beyond the California market, and includes several states on the East Coast.

-Recent price signals for ethanol capacity expansion have been very strong. At average margins and costs for the 2000/2001 agricultural marketing year, the payback period for an ethanol plant investment is easily less than two years. Investors should bear in mind, however, that the processing margin in a competitive market returns to the level that can be secured in investments elsewhere in the economy. Five-year, ten-year, and fifteen-year payback periods will return when the market catches up to the new ethanol demand.

-Iowa's Capacity expansion plans for ethanol fill new estimated Iowa demands associated with the California's MTBE ban easily. In fact, the capacity plans already fill much of Iowa's estimated ethanol

demand with an extended MTBE ban on the East Coast. Confirmation of implementation schedules for other bans and ethanol capacity plans in other Mid-western states should precede further expansion plans in Iowa. If possible, it would be useful to monitor the financing of capacity expansion plans for potential overestimates; banker's equity requirements for ethanol exceed those for many other industries.

-Regarding ethanol's byproduct feeds, Iowa is well-positioned to feed ethanol's byproduct feeds instead of exporting them. However, the feed-using industry must match the qualities of the increasing supplies from the dry mill industry. Distiller's Dried Grains (DDG) contain more protein, fat, and certain valuable amino acids than Corn Gluten Feed from the Wet Mill Industry. Hence, dairy and poultry feeding may make most efficient use of supplies of distillers dried grains. However, there may be some handling problems and industry resistance to using DDG . Also, some segments of the livestock industry that cannot exploit reduced DDG prices may offset the gains discussed in this report because corn prices will increase.

-Regarding local economy benefits of expanding ethanol production in Iowa, the income improvement to corn producers is important for agriculture, while the employment, income and value added is important for the rest of the state. While both effects are important, the agriculture income benefit is becoming relatively more important. The jobs benefit of a given level of ethanol processing has declined during the last decade because ethanol plants are using less labor in an effort to get processing costs down. While the size of the facilities do not appear to affect the economic impact, the ownership structure may be important. A cooperatively-owned facility may keep more of the value-added (profit) effects in the regional economy, compared to an outside firm.

-The state of Iowa's recent ethanol legislation encourages ethanol consumption by giving a gasoline sales tax break when a retailer uses more than 60% ethanol blends. Other studies have shown that tax exemption incentives reduce the retailer's cost of fuel (Otto and Gallagher). Hence, the Iowa ethanol marketing incentive has the potential to reduce the retailer's costs and may stabilize the demand for Iowa's ethanol. If the Iowa program is highly successful over the 2002-2007 period, and all Iowa gasoline used 10% ethanol blends, annual ethanol consumption in Iowa would increase by an additional 70 million gallons, beyond the increases associated with regulation changes in California and Eastern States.

-Finally, the estimates of this report use the 2000 crop year agricultural market situation as a baseline, implying that the corn price will increase to encourage more production and less use in alternative demands such as feed and exports. Some in the industry are concerned about diversion, especially from export uses.
However, interpreting the corn market baseline must be done carefully. Nationally, corn yield has grown steadily during the last twenty years because of improving technology, while demand growth has lagged behind; corn feed demand has grown very slowly and exports have been virtually stagnant. Hence, there is a secular increase in net corn supply that must find a new use in order to avoid a real corn price

decline. The price adjustments discussed in this report are not strict increases--they are offsets to an annual trend of declining real prices. Further, diversion from feed or export use does not occur until after the technology-based supply growth component has been used.

Still, the demand adjustments discussed in this report are large. They have magnitudes that are comparable to the grain deals and export booms of the 70s. Hence, adjustment problems in the grain marketing system should not be unexpected.

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Figure 1. U.S. Ethanol Production, 1980-2000

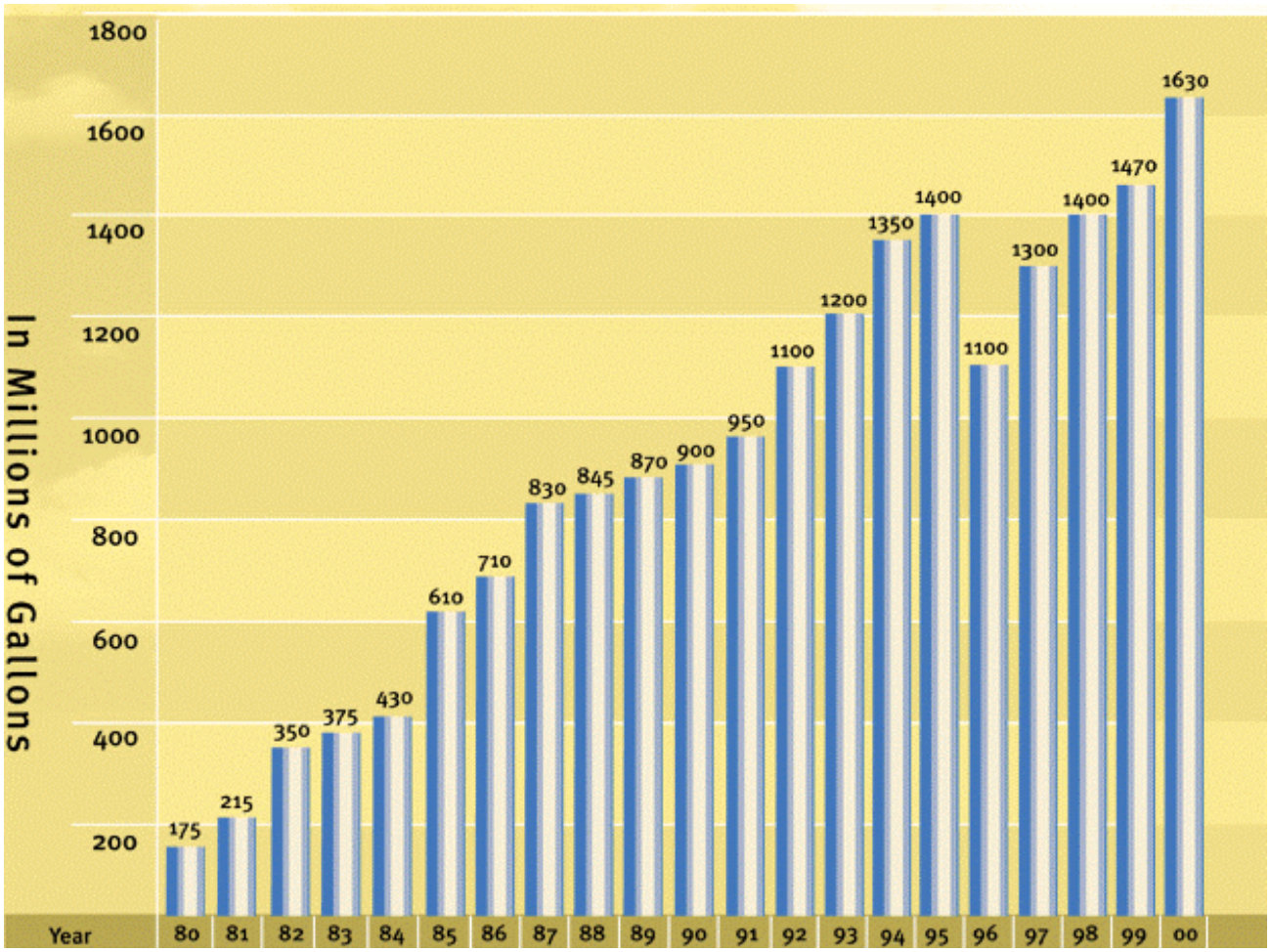
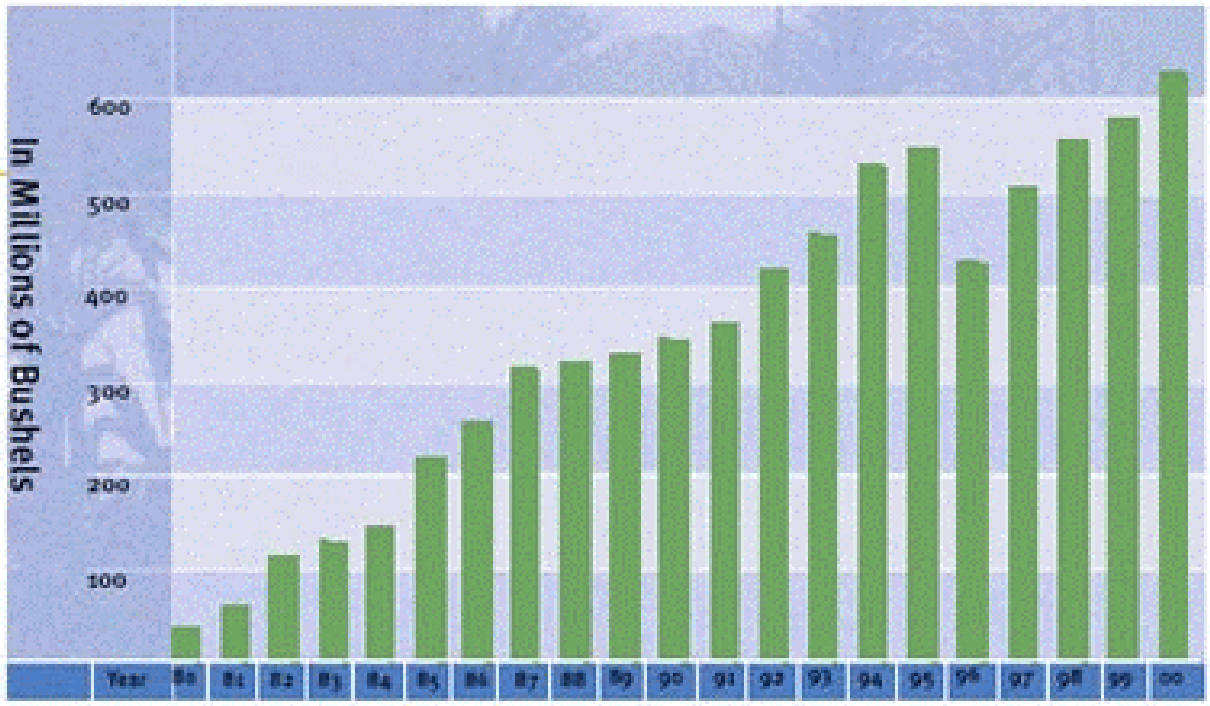


Figure 2. Corn Utilized in Ethanol Production



Source: National Corn Growers Association

Figure 3. Ethanol Processing Margins

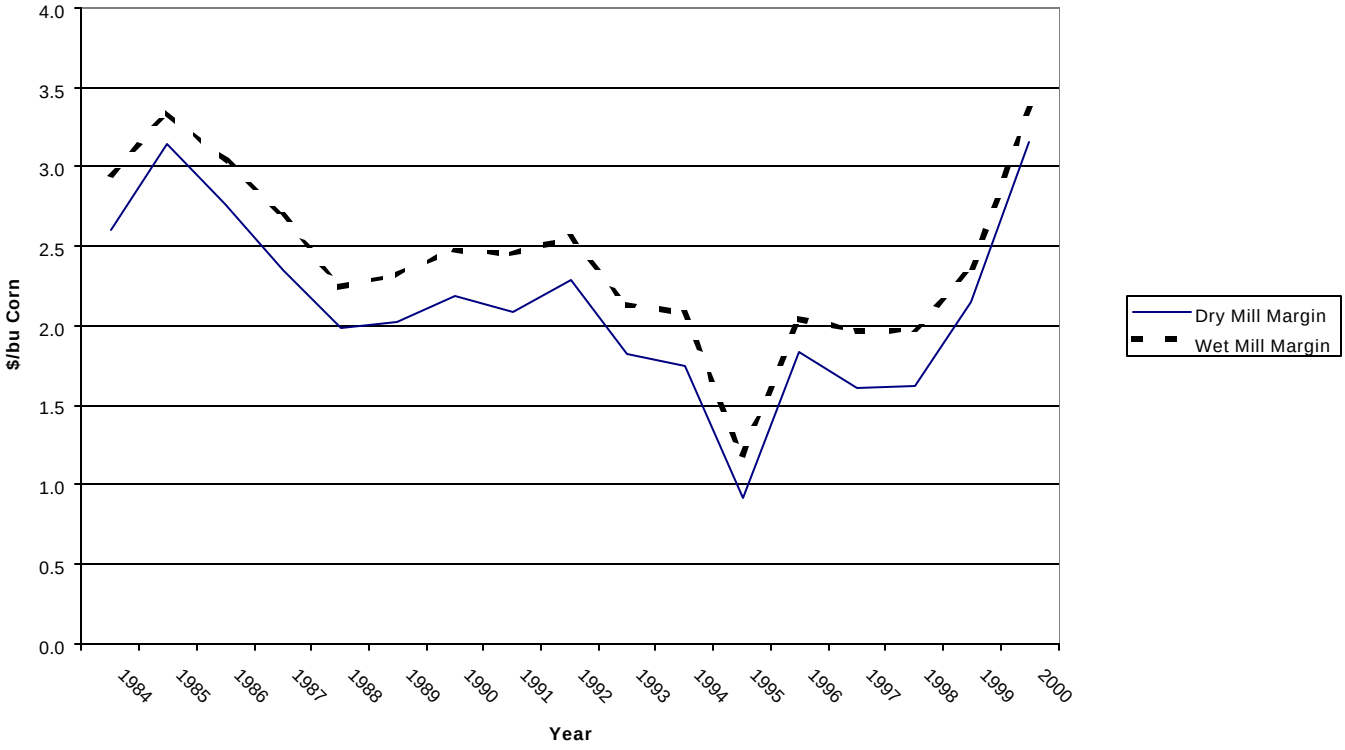


Figure 4. Wet-Dry Differential

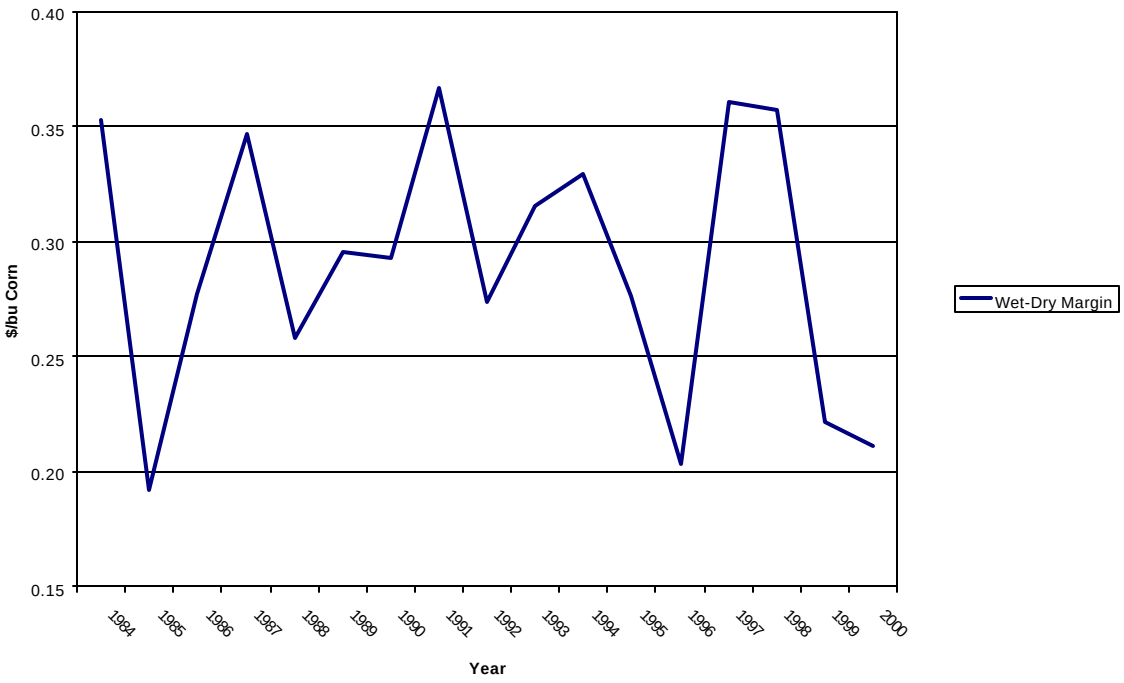


Figure 5. Corn Price Spreads for Gulf Port Shipment from Central Illinois and Central Iowa

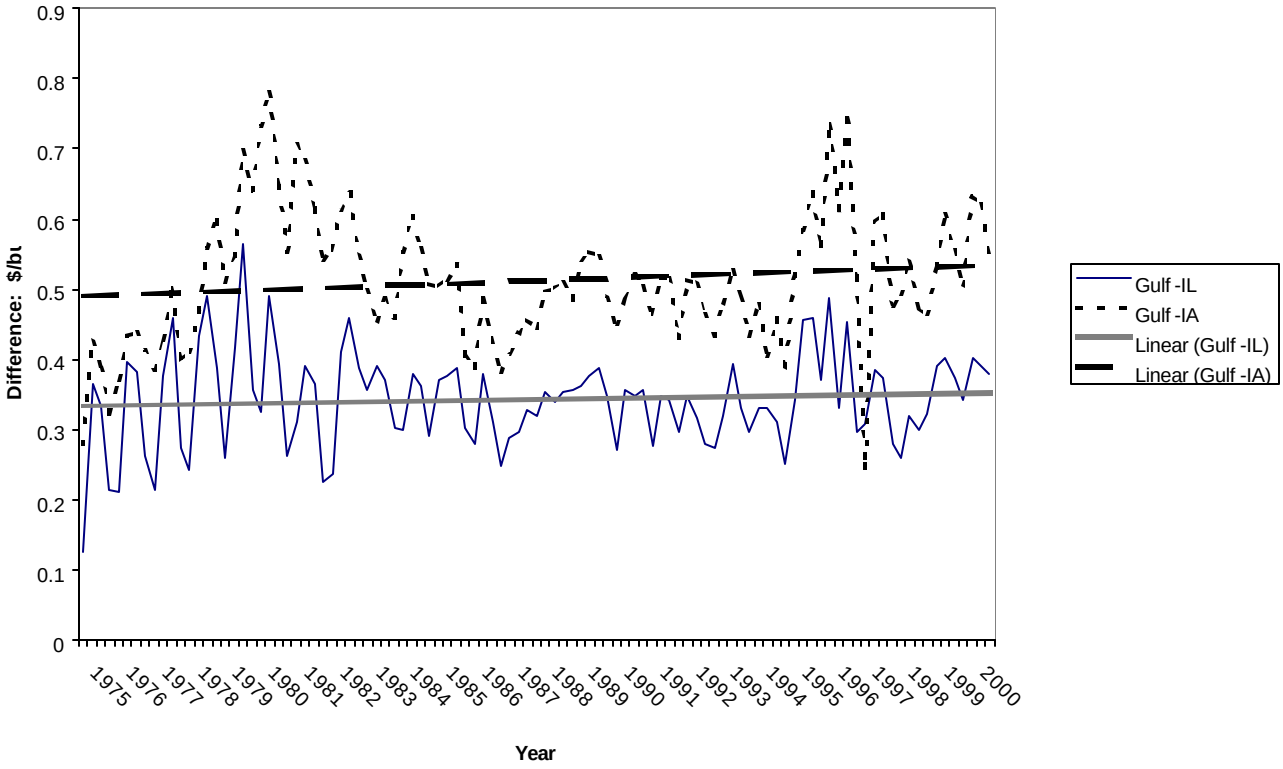


Table 1. Effects of An MTBE Ban In U.S. Ethanol and ByProduct Markets

	Variety	Baseline Level	Units	Change: California Ban	Change: Extended Ban
Corn	Processing	1395	mil.bu	249.2	660.8
	Price	1.738	$/bu	0.055	0.146
Gluten Feed	Output	9.417	mil.ton	1.682	4.461
	Price	65.76	$/ton	-3.37	-0.21
Gluten Meal	Output	1.849	mil.ton	0.330	0.876
	Price	277.35	$/ton	-35.76	-94.82
Corn Oil	Output	2162	mil.lb	386.3	1024.2
	Price	.117	$/lb	.003	.003
Distiller's Dried Grain	Price	89.2	$/ton	-7.33	-13.76
Ethanol	Output	1650	mil.gal	623	1652
	Price	1.58	$/gal	-0.55	-0.50

Table 2. Effects of an MTBE Ban on Corn Processing Costs and Returns,

	Baseline Level (200)	New Level
	in $/bu. corn processed	
Wet Mill:		
Margin	3.495	1.808
Processing Costs:		
Operating	1.233	
Capital (annual)	0.575	
Total	1.808	1.808
Dry Mill:		
Margin	3.211	1.637
Processing Costs:		
Operating	1.100	
Capital (annual)	0.537	
Total	1.637	1.637

Table 3. Current Status of Proposed Iowa Ethanol Facilities

Iowa Ethanol Plants In Planning and/or Construction Phases				
	PROJECT AREA	**NAME**	**SIZE**	**STAGE OF DEVELOPMENT**
1	Lakota - Kossuth County.	Midwest Grain Processors Coop	45M gallon	Equity Drive - 95% Sold Site at Lakota
2	Delaware County	Northeast Iowa Grain Processors	15M gallon	Equity Drive - 20% Sold Option on Earlville Site
3	Site near Galva	Quad-County Corn Processors	18M gallon	Building Completion in Spring of 2002
4	Hardin County	Pine Lake Corn Processors, LLC	15M gallon	Started Equity Drive April 2001
5	O'Brien, Ida, Sac, Cherokee, Buena Vista, Plymouth, Woodbury	Little Sioux Corn Processors, LLC	40M gallon	Building at Cleghorn/Marcus Site
6	Sioux Farmers Coop	Siouxland Energy and Livestock Coop	14M gallon	Building at Sioux Center Site. Planned Completion Date, December 2001
7	Coon Rapids	Tall Corn Ethanol Cooperative, TCE, LLC	40M gallon	Broke Ground, June 2001 Building at Coon Rapids
8	Fort Dodge	A.E. Staley / Corn Investment Corporation	40-80M gallon	Evaluation Stage
9	Des Moines County	Big River Resources	40M ? gallon	Forming business structure
10	Harrison County, Woodbine, Denison	Amaizing Energy, LLC	20M gallon	Pre-Feasibility Study Completed. Doing Business Plan. Plan to Start Fund Raising, September 2001

Table 4a. Some Beef Cattle Ration Comparisons

Situation	Location		Kansas-Iowa Feed Cost difference
	Kansas	Iowa	
	----------in $/ton----------		
Baseline (ration type)	$56.81/ton (Conventional)	$55.07/ton (Conventional)	$1.74/ton
Post-ban (ration type)	$59.96/ton (Conventional)	$56.32/ton (CGF)	$3.64/ton
Post-ban (ration type)	$59.96/ton (Conventional)	$58.65/ton (DDG)	$1.31/ton

Table 4b. Some Dairy Cow Replacement Ration Comparisons

Situation	Location		Kansas-Iowa Feed Cost difference
	Kansas	Iowa	
	----------in $/ton----------		
Baseline (ration type)	$54.68/ton (Conventional)	$55.50/ton (Conventional)	-$0.82/ton
Post-ban (ration type)	$56.30/ton (Conventional)	$50.40/ton (CGF)	+$5.9/ton
Post-ban (ration type)	$56.30/ton (Conventional)	$52.72/ton (DDG)	+$3.58/ton

Table 5. Direct Effects Associated with Ethanol Processing Facilities of Different Sizes.

	10 mg dry	18 mg dry	40 mg dry	80 mg wet
Employment	13	22	45	90
Payroll ($1,000)	455	770	1,350	4,500
Corn used (mill. bu.)	4	7.2	16	32
Value of corn @ $2.00/bu. ($ mill.)	8	14.4	32	64

Table 6. Direct and Indirect Effects of an MTBE Ban on the Iowa Economy

	West Coast Ban	Extended Ban
IA Ethanol Demand Change (mil gal)	193	506
Corn Price Impacts, IA ($/bu)	.043	.109
Corn Producer Revenues ($ Mil)	74.8	189.7
Livestock and Poultry Revenues	26.9	70.6
Direct Employment in Plants	231	593
Total Employment in State	976	2,550
Direct Income in Plants ($ mil)	9.2	24.1
Total Income in State ($ mil)	30.9	81.7
Total Value Added in State ($mil)	81.0	244.7
General State Tax Revenues($mil)	8.5	17.2

Table a1 Economic Impacts Associated with an 10 Million Gallon Ethanol Plant

	Total Sales ($)	Labor Income ($)	Value Added ($)	Jobs
Agriculture	400,914	141,287	231,382	4.9
Mining	7,514	2,059	5,030	0.1
Construction	120,219	67,818	71,524	2
Manufacturing	18,350,420	460,315	2,565,878	14.2
Tran.Utilities	1,034,845	274,614	564,850	6
Trade	121,397	63,999	98,778	4.6
Fin.Ins.R.Estate	335,278	79,432	245,629	2.6
Services	680,735	313,175	398,740	13.3
Government	156,204	41,007	65,717	1.2
Other	1,794	1,794	1,794	0.2
Total	21,207,527	1,443,707	4,247,528	48.9

Source: IMPLAN Model for Iowa

Table a2 Economic Impacts Associated with an 18 Million Gallon Ethanol Plant

	Total Sales ($)	Labor Income ($)	Value Added ($)	Jobs
Agriculture	1,026,799	363,230	595,637	12.6
Mining	11,934	3,281	7,991	0.1
Construction	240,783	136,796	144,317	4.1
Manufacturing	33,501,508	713,779	3,957,950	22
Tran.Utilities	1,605,353	426,224	875,998	9.4
Trade	19,226	46,122	36,178	8
Fin.Ins.R.Estate	546,346	127,457	399,864	4.3
Services	1,062,275	490,278	622,618	20.8
Government	241,914	63,092	101,557	1.8
Total	38,256,138	2,370,257	6,742,110	83.1

Source: IMPLAN Model for Iowa

Table a3 Economic Impacts Associated with a 40 Million Gallon Ethanol Plant

	Total Sales ($)	Labor Income ($)	Value Added ($)	Jobs
Agriculture	2,376,076	842,171	1,379,922	29.4
Mining	26,997	7,423	18,079	0.2
Construction	537,294	304,776	321,507	9.1
Manufacturing	74,419,608	1,616,200	8,919,665	49.9
Tran.Utilities	3,656,097	970,012	1,997,412	21.3
Trade	882,811	389,538	633,191	24.4
Fin.Ins.R.Estate	1,302,669	301,325	953,182	10.2
Services	2,553,111	1,192,679	1,505,927	50.9
Government	557,655	148,862	235,982	4.3
Total	86,312,316	5,772,984	15,964,866	199.7

Source: IMPLAN Model for Iowa

Table a4 Economic Impacts Associated with an 80 Million Gallon Ethanol

	Total Sales ($)	Labor Income ($)	Value Added ($)	Jobs
Agriculture	3,630,813	1,260,061	2,074,924	41.1
Mining	67,427	18,450	45,124	0.6
Construction	431,116	228,467	240,225	6.9
Manufacturing	148,961,760	5,860,001	19,340,236	106.8
Tran.Utilities	8,109,380	2,091,075	4,630,198	41.2
Trade	2,038,682	942,529	1,535,853	53.5
Fin.Ins.R.Estate	3,199,908	739,562	2,341,267	24.5
Services	6,493,446	3,021,363	3,820,828	128.4
Government	1,450,409	383,788	611,988	11.2
Total	174,382,941	14,545,295	34,640,641	414.2

Source: IMPLAN Model for Iowa