RISK FACTORS IN ETHANOL PRODUCTION

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INTRODUCTION

Investing in an ethanol processing facility involves many risks. The presence of risk means that more than one outcome is possible. Risk refers to the possibility of suffering loss or a profit in an inherently risky environment. For an event to be considered a risk there must be uncertainty about the likelihood of outcomes for the event. This publication discusses risk common to most ethanol facilities. There may be other unique risk factors not discussed since ethanol can be produced from many different types of feedstocks. Before investing in an ethanol facility, investors should consider additional risks that may be unique to a particular production facility.

A business entity that is seeking initial investment capital for ethanol production should provide interested individuals with a document called a prospectus, which explains the various risks involved in that particular project. If a business must provide a prospectus describing the risk factors, we recommend you review the Securities and Exchange Commission (SEC) investment risk information. It can be accessed through the SEC website at www.sec.gov.

ETHANOL PRODUCTION RISKS

Investors in an ethanol processing facility face risk in three major risk factor categories: (1) processing technology risks, (2) marketing and operation risks, and (3) government and regulatory risks. We describe the three types of risks and their relationship to ethanol production.

Processing Technology Risks

Processing technology risk refers to the risks involved in the physical processing facility used in the production of ethanol. Some examples include plant engineering, plant construction, feedstock storage, and the movement of product within a plant. Evaluating processing technology risk in a proposed plant is difficult because there is little historical data to study. The two phases of processing technology risk are (1) plant engineering and construction and (2) plant operation. Unique risks occur during each phase. You need to understand the nature of these risks and how you can manage them to your advantage.

Engineering and Construction Phase

In 2004 there are nearly seventy-five ethanol facilities in operation with about another dozen under construction. Two methods are currently used to produce ethanol from grain, wet milling and dry milling. Wet mills produce ethanol, but can also produce corn syrup, high fructose corn syrup, corn starch and corn oil as well as other products. The markets determine which product will be produced. Almost all dry mills produce only ethanol or fuel alcohol, distillers grain and carbon dioxide. A few dry mills also produce both fuel alcohol and industrial or beverage alcohol that is used in beverages like vodka. The advantage of dry mills over wet mills is that they are significantly less expensive to build. Nearly all of the ethanol plants constructed in the past 10 years use the dry mill technology. Dry mill ethanol plants will be the focus for the rest of this publication.

An inherent risk for ethanol production starts with the engineering firm hired to design the ethanol facility. A few engineering firms dominate the ethanol engineering industry. These firms produce nearly “boiler-plate” facilities that continue to produce ethanol more efficiently. Other engineering firms could try to enter the industry with new technology, but risk is involved in unproven technologies.

Most of the construction of dry mill technology has taken place in the last 10 years and almost all have been overseen or performed by a small number of firms. This has helped to reduce the level of risk involved in building a new facility. Construction companies have past projects to learn from previous mistakes and allow for contingencies, which enables ethanol production to occur without as many costly overruns or delays. However, construction risk does still exist and is outlined below.

If the company hired to construct the facility is new to ethanol production or if a new feedstock is used for conversion to ethanol, construction risk is higher than if the most common procedure is used. Higher risk also exists if the traditional feedstock used has different properties than the more common feedstocks used for ethanol production. For example, if the corn projected to be used is of a different quality or moisture level than what is usually processed.

In general, you can minimize construction and technology risk by using proven technology provided by engineering and construction companies with a proven track record. Ideally, these are also companies that continue to improve their technology and can assist you in modernizing your existing plant when it is economically feasible. Some companies offer to share the risk by becoming investors in the project.

Environmental issues could arise that were not found during previous inspections of the construction area. For example, if hazardous materials are found during ground breaking then construction must be stopped until the material is removed and properly disposed of, leading to a costly delay and additional expenses. Also, depending on the plant location, it may be difficult to obtain all the necessary environmental permits required for construction, which could lead to additional costs or delays as well.

Operational Phase

Just as experience exists in the engineering and construction of ethanol facilities, experience is also available in the operational phase. Some companies offer to participate in the initial start-up of a plant to facilitate a smooth transition from the construction phase to the operational phase. Some companies offer to operate the plant indefinitely under a management contract. This management bridge helps to alleviate operational problems due to lack of experience. However, operational risks still exist.

Problems rooted in the construction phase impact the operational phase if the ethanol facility was poorly constructed. Poor construction may lead to excessive wear and breakdowns, higher than expected maintenance and repair costs, and higher costs of production.

Environmental regulations could adversely impact an ethanol facility during operation. Previously untracked emissions could present a problem with ethanol production as seen by 12 Minnesota ethanol plants in 2002 (Shaw 2002). Unforeseen events such as this result in possible fines and additional emissions regulating equipment.

The dry milling technology currently used to produce much of the nation's ethanol may not compete in the future with ethanol produced from cellulose-based biomass. In other words, superior or more cost efficient technology may become available making the dry mill technology less cost competitive. The Biomass Research and Development Act of 2000 calls for continued research into cellulosic feedstocks for production of fuels and chemicals (2000). The probability that future research will progress to a point where ethanol is produced more efficiently from less expensive feedstock is relatively high. However, the rate at which that technology will become viable is not known. The Department of Energy set a goal of reducing production costs through cellulosic conversion technology by 60 cents per gallon by 2015 (DePardo 2002).

Marketing and Operation Risks

Downside marketing and operation risks refer to the likelihood of negative profitability due to unfavorable input prices (grain, natural gas) and output prices (ethanol, distillers grains). Of course there is also the possibility of upside risk and profitability outcomes due to favorable prices. Each input or output for an ethanol facility has varying degrees of risk depending on price volatility, the relative amount of the input/output used/produced in the plant, and the risk management tools available for a specific input or output. Ethanol production facilities may choose to hire a company that performs some or all of the marketing tasks required by an ethanol facility. Procuring inputs, finding new markets for DDGS, and placing hedges are some examples of marketing tasks that a marketing company may execute that help to lower the risks in ethanol production. Some companies offer to provide (1) engineering and construction services, (2) operational management services and (3) marketing services in procuring inputs and selling outputs. In addition they may offer or even prefer to be investors, thereby, managing and even sharing the risk.

The four major market risk factors for an ethanol plant are the prices of ethanol, distillers grains, grain feedstock (corn or sorghum) and natural gas. There are other products that an ethanol plant uses (water, electricity, chemicals, enzymes) or produces (carbon dioxide). However, these products have relatively low risk impacts on profitability either due to the low price volatility exhibited in the past for the product or the relatively small quantity value used or produced. Carbon dioxide is produced in large quantities, but the value is low enough that many plants do not capture or market it.

Price Series Information

The price series information provided in Table 1 shows the average, minimum and maximum prices for important economic factors that are a risk for ethanol production. These factors relate to prices that are typical for ethanol production in Kansas. The information for the various series came from the following sources. The ethanol and unleaded gasoline are FOB price series at Omaha, Nebraska. These prices were provided by the Nebraska Ethanol Board and represent approximate prices that Kansas ethanol producers could expect to receive. The DDGS series is based on the Chicago DDGS price series from *Feedstuffs* magazine. The value used for Kansas DDGS is adjusted to 80% of the Chicago price, which is a more realistic amount for DDGS produced in Kansas from what we have learned in our research. The corn and sorghum series are the average Kansas monthly prices from the USDA Kansas Agricultural Statistical Service. Kansas monthly industrial price series for natural gas and electricity were sourced from The Energy Information Administration in the U.S. Department of Energy.

Table 1. Summary Statistics of Selected Factor Monthly Prices for 1992-2003

	unit	**average**	**minimum**	**maximum**
ethanol	$/gallon	1.22	0.90	1.77
unleaded	$/gallon	0.69	0.36	1.24
DDGS	$/ton	108.14	72.00	183.00
corn	$/bushel	2.42	1.68	4.84
sorghum	$/bushel	2.11	1.33	4.31
natural gas	$/mcf.	3.65	1.96	10.38
electricity	cents/kwh	4.67	4.20	5.40

Sources: USDA, EIA, Feedstuffs and Nebraska Ethanol Board

Factor Relationships, Correlation Coefficient and Risk

The relationship between prices of inputs and outputs is important in determining the nature of the risk. The correlation coefficient of input prices and output prices can be used to compare factor relationships.

The correlation coefficient is a statistical tool to compare price series to each other to see how closely related they are. If the correlation between two price series is equal to one, then the two price series are said to be perfectly positively correlated, which means the two prices rise together and fall together. If the correlation between two price series is equal to negative one, the two price series are said to be perfectly negatively correlated, which means that as the price of one rises the other falls. If the correlation is zero, the two are said to have no relationship with each other. The highest risk for two or more outputs would be associated with the perfectly positive correlation of one and the lowest risk would be perfectly negatively correlated of negative one. The highest risk for an input and an output combination would be a negative correlation of one and the lowest risk would be a positive correlation of one. A correlation of zero signifies that the compared factors have no relationship. Table 2 shows the correlation of prices for the economically significant outputs and inputs in ethanol production.

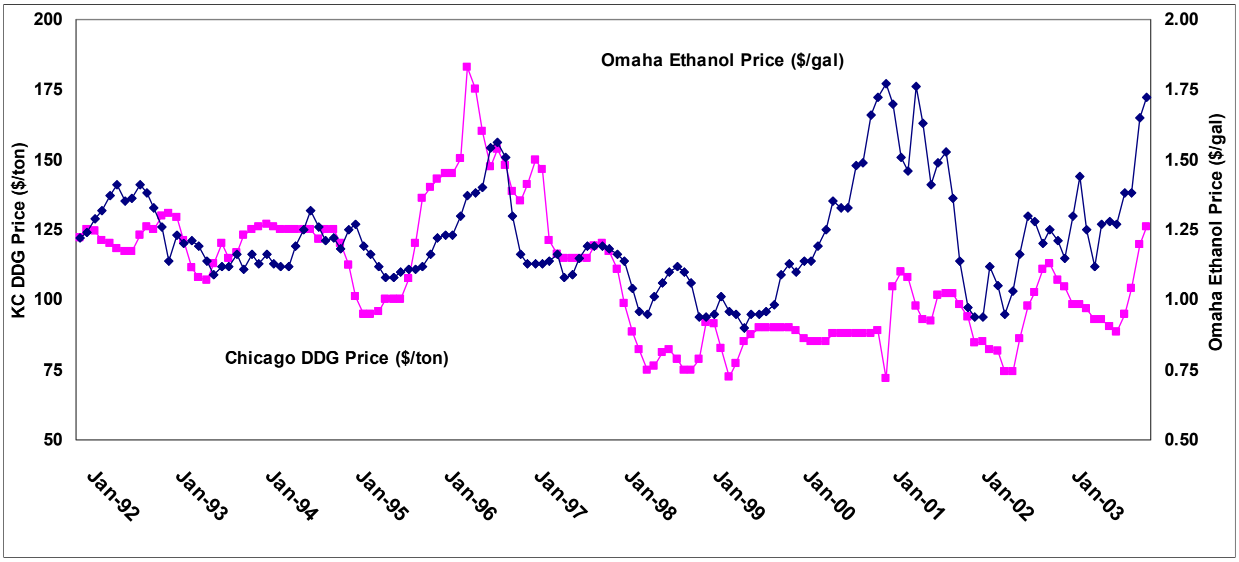
Table 2. Correlation Between Selected Monthly Price Series for the Period of 1992-2003

	Unleaded Gasoline	**DDGS**	**Corn**	**Grain Sorghum**	**Natural Gas**	**Electricity**
Ethanol	0.58	0.26	0.14	0.17	0.49	0.09
Unleaded		-0.15	-0.11	-0.05	0.64	-0.11
DDGS			0.77	0.74	-0.25	0.35
Corn				0.97	-0.21	0.19
Sorghum					-0.17	0.17
Natural Gas						-0.26

Sources: USDA, EIA, Feedstuffs and Nebraska Ethanol Board

Figure 1 shows the price patterns of the two major outputs of an ethanol plant, ethanol and dried distillers grain, for 1992-2001.

Figure 1: Chicago Dried Distiller Grains Price and Omaha Ethanol Price for 1992-2003

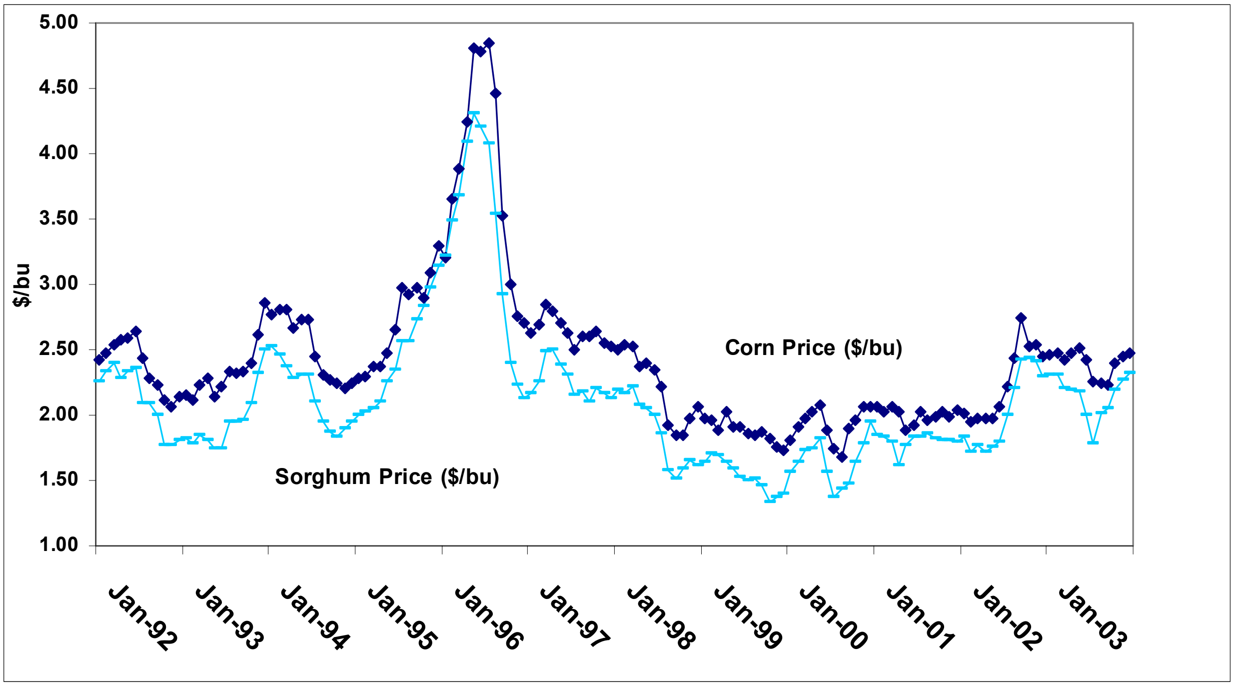


Source: Feedstuffs and Nebraska Ethanol Board

The two price series may appear to move together much of the time. However, the correlation between the two is only 0.26 as noted in Table 1, suggesting the correlation is less than it appears. The implication of this is that an ethanol plant's output does not have the highest marketing risk or the lowest marketing risk possible between its two major outputs.

Figure 2 compares the two most common feedstocks, corn and sorghum, used to produce ethanol in the Great Plains region.

Figure 2: Kansas Corn and Sorghum Price for 1992-2003

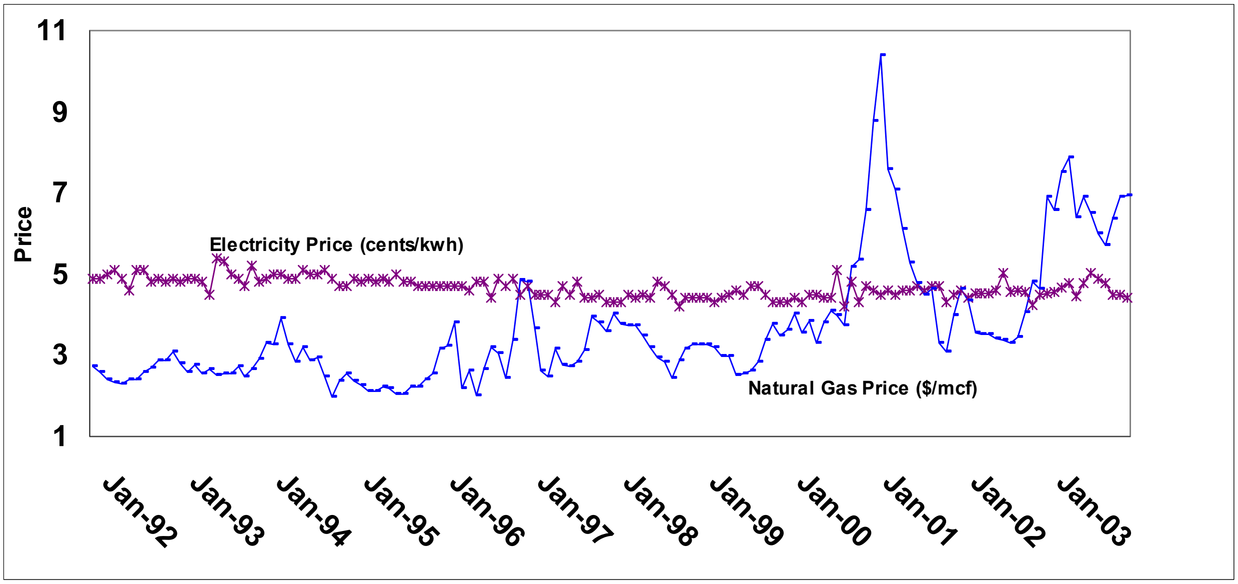


Source: USDA Kansas Agricultural Statistics Service

The two prices were in near perfect relation to each other over the 12 year time period from 1992-2003 as indicated by a 0.97 correlation displayed in Table 1.

Figure 3 shows the prices of electricity and natural gas from 1992-2003.

Figure 3: Kansas Industrial Electricity Price and Natural Gas Price for 1992-2003

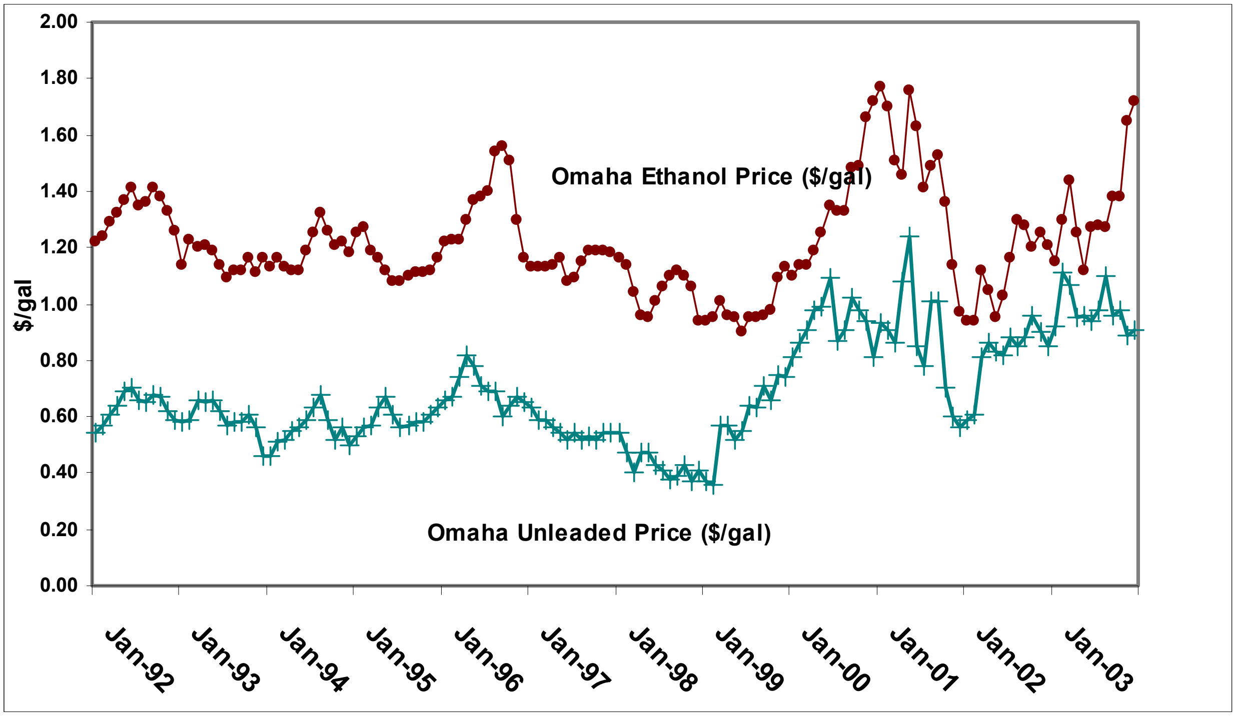


Source: U.S. Department of Energy, Energy Information Administration

Notice how electricity moves little during the period while natural gas is relatively volatile. Their correlation is -0.26, which surprisingly shows a fairly significant negative correlation. The price of electricity has been about the same while the price of natural gas has trended upward.

A chart comparing rack ethanol and unleaded gasoline prices for 1992-2003 is displayed in Figure 4.

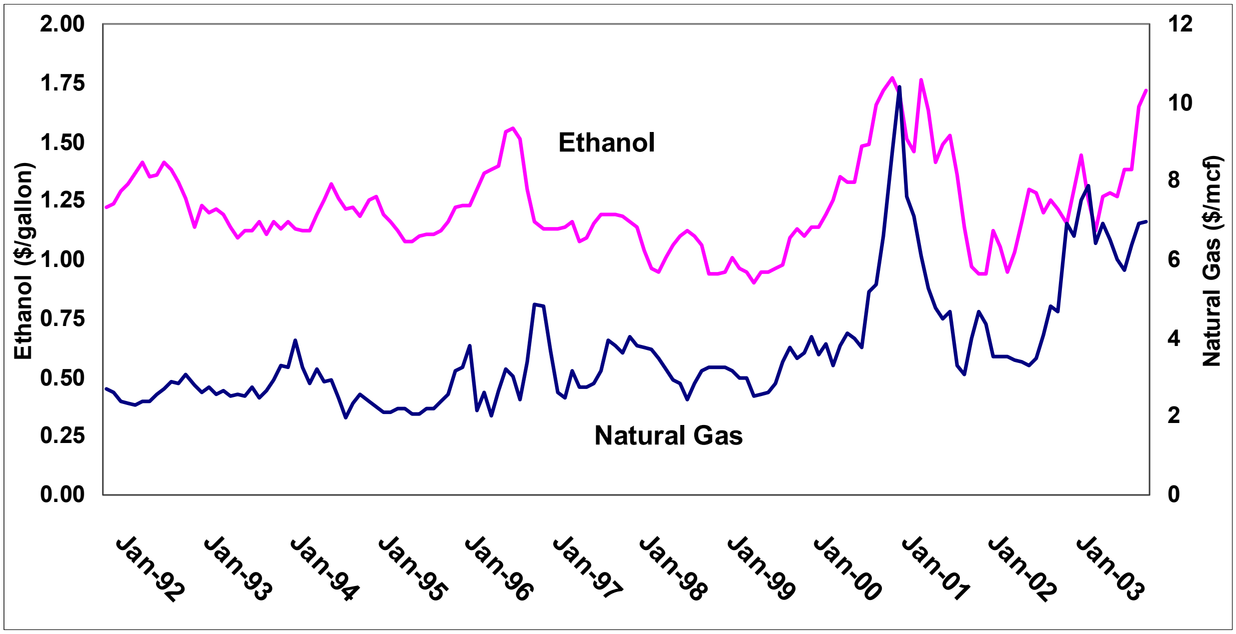
Figure 4: Omaha Ethanol and Unleaded Price for 1992-2003



Source: Nebraska Ethanol Board

Note how the two price series move fairly close together over the time period. The correlation of 0.58 from Table 1 shows that the prices of ethanol and unleaded gasoline are relatively highly correlated, but not perfectly so, as some people believe. Some believe the price of ethanol is always about $0.50 per gallon higher than unleaded gas because of federal subsidies. In reality the relative supply and demand for each are also big drivers in the price pattern. Also note how the two price series, ethanol and natural gas, move closely together as shown in Figure 5. Their correlation is 0.49.

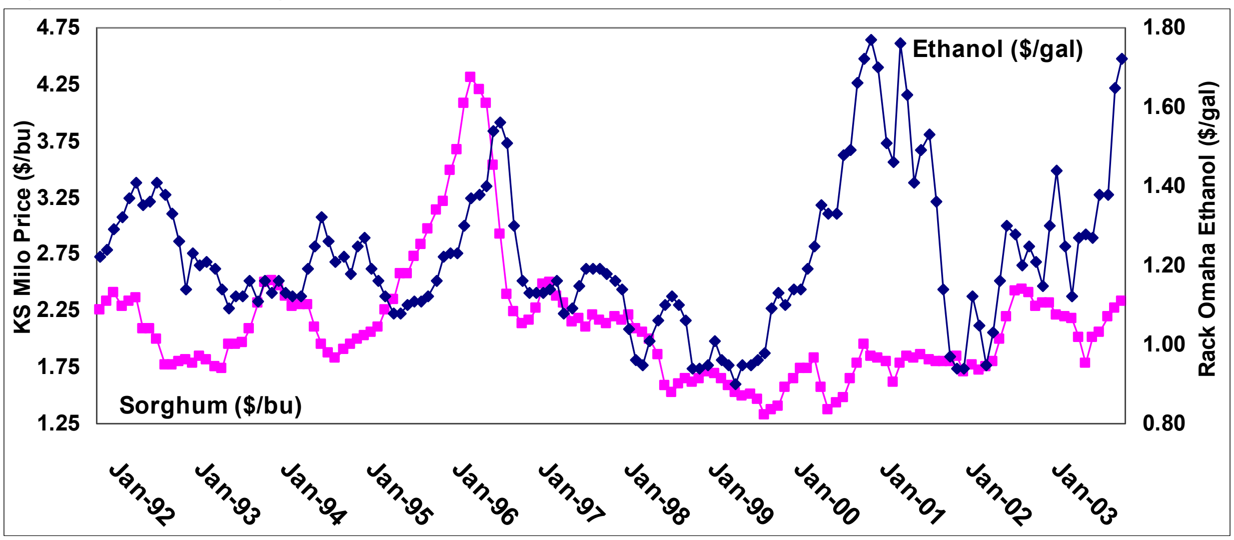
Figure 5: Omaha Ethanol Price and Kansas Industrial Natural Gas Price for 1992-2003



Sources: Nebraska Ethanol board and DOE Energy Information Administration

Then compare Figures 4 and 5 to Figure 6 which displays the price series of sorghum and ethanol.

Figure 6: Kansas Sorghum Price and Rack Omaha Ethanol Price from 1992-2003

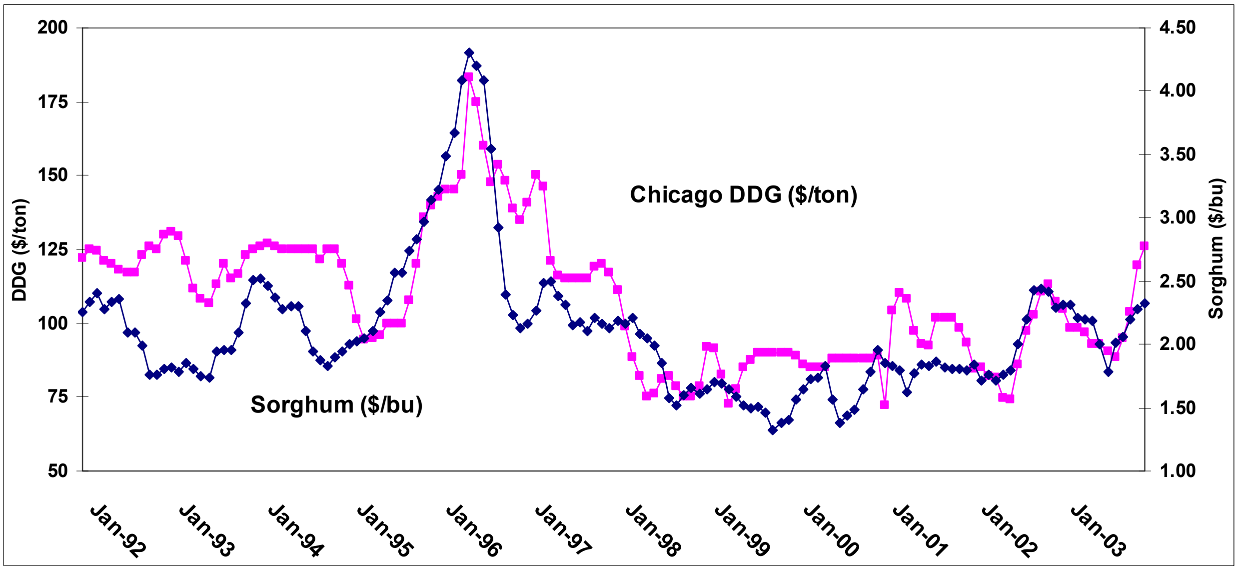


Sources: USDA National Agricultural Statistics Service and Nebraska Ethanol Board

The correlation between sorghum and ethanol is 0.17 as displayed in Table 1, which indicates that there is little relationship in price between the feedstock (i.e., sorghum) and its derived product (i.e., ethanol). The close price relationships shown in Figures 4 and 5 show that the price of ethanol is driven more by the energy market (i.e., unleaded gasoline, natural gas) than the agricultural commodity market (i.e., sorghum, corn) as indicated by the significantly uncorrelated relationship shown in Figure 6.

An ethanol facility's co-product, distillers grains, however, is very closely related to the agricultural feedstock commodity market as shown by Figure 7, which compares the prices of sorghum and DDG to each other.

Figure 7: Kansas Sorghum Price and Chicago Dried Distillers Grains Price from 1992-2003



Sources: USDA National Agricultural Statistics Service and Feedstuffs

The correlation between sorghum and DDGS is 0.74, which shows the two price series are highly correlated. Since DDGS is an output and sorghum is an input this positive correlation implies that as the price increases for sorghum, the price for DDGS produced will also increase. This relationship lowers risk in ethanol production. However, the total proportion of income derived from DDGS is small compared to ethanol income. In fact the value magnitude is normally about six times for ethanol compared to DDGS.

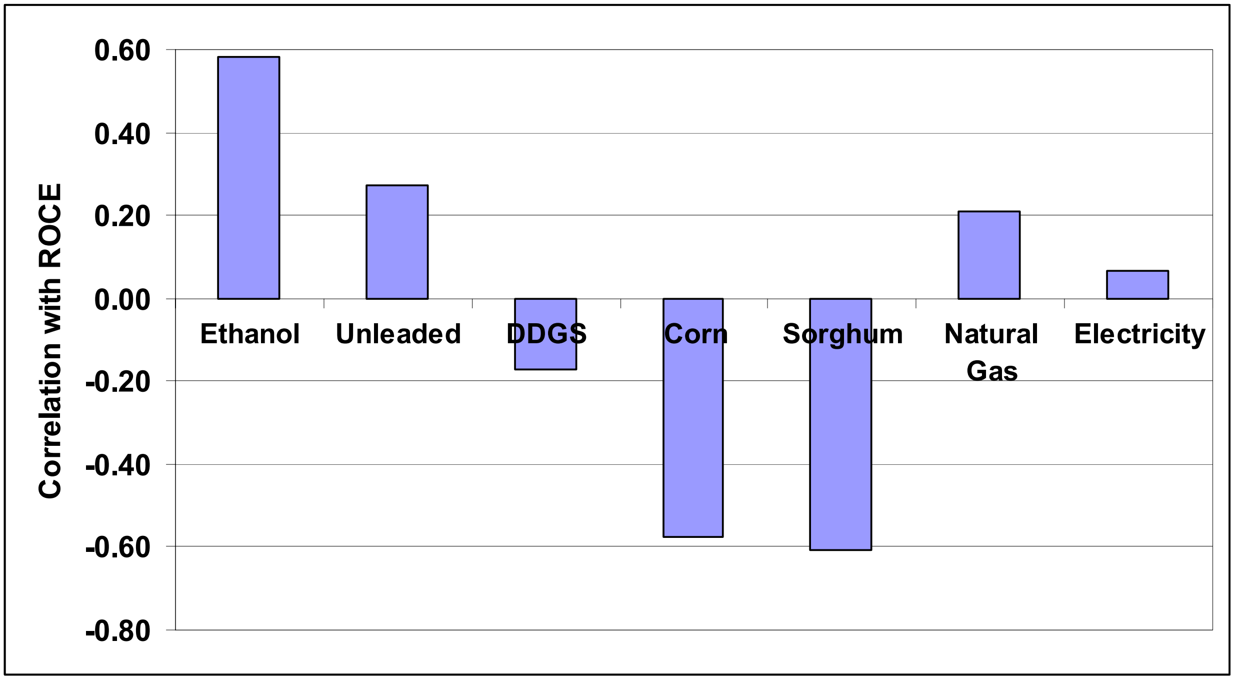
Correlation of Return on Common Equity (ROCE) with Market Factors

Given the price relationships that we have witnessed over time, the next logical question is: How do these price relationships affect the bottom line of a dry mill ethanol plant? One way to study the question is to set up a simple annualized spreadsheet for a 30 million gallon example ethanol plant and compare the Return on Common Equity (ROCE) when the monthly price series are used. ROCE refers to the return from the initial equity invested by the owners of the ethanol facility. For this analysis, it is assumed that each month has a specific ROCE that refers to the simulated 10 year average ROCE if all of the specific monthly price series existed for all ten years. The 10 year average ROCE is used to account for the negative ROCE experienced during the first year when construction of the ethanol facility is completed. The simulated ROCE is very volatile over the 1992-2003 period. The summary statistics show an average ROCE of 7.5% with a maximum of 73.8% and a minimum of negative 74.8%. This simulated analysis does not necessarily reflect actual performance for ethanol plants.

The monthly price factor series used for the analysis were ethanol, unleaded gasoline (used as the denaturant, which is mixed as 5% of the finished ethanol product), grain sorghum, DDGS, natural gas and electricity. The simulated *proforma* analysis used to derive the ROCE assumed a debt to equity ratio of 1.25 for the example ethanol facility. The following assumptions were also used in the analysis: 30 million gallons per year facility, capital cost $1.50, interest 8%, ethanol yield 2.7 gallons per bushel of grain, DDGS yield 17 pounds per bushel, DDGS all marketed as a dry product, chemicals and enzymes $0.08 per gallon, and 33 employees.

Figure 8 shows the correlation relationship between ROCE and the significant monthly market factors in ethanol production.

Figure 8: Correlation Between Return on Common Equity and Various Input and Output Factor Prices Associated with Ethanol Production: Example Plant



Sources: USDA National Agricultural Statistics Service, US DOE Energy Information Administration, Feedstuffs and Nebraska Ethanol Board

As expected, ROCE is highly correlated (0.58) with the price of ethanol for the example plant. In other words, high ethanol prices go with high plant profitability. The other main output, DDGS is negatively correlated (-0.17) since changes in its price follow the grain feedstock price. It is interesting to note that ROCE for ethanol profitability is not particularly correlated with unleaded gasoline prices (0.27). Grain feed stocks, which are an input cost for ethanol, show a negative correlation (corn, -0.58 and sorghum -0.61) to ROCE. This is expected, since feedstock expenses constitute 50-70 percent of the total production cost in ethanol production. Surprisingly, the data show that natural gas price has a positive correlation with ROCE (0.21). This can be explained from the fact that high natural gas prices experienced in 2001 and 2003 occurred when ethanol prices were also relatively high. Electricity price nearly has almost no correlation to ROCE (0.06).

Figures 9-12 show the volatility of ROCE in ethanol production.

Figure 9: Correlation Between ROCE and Ethanol

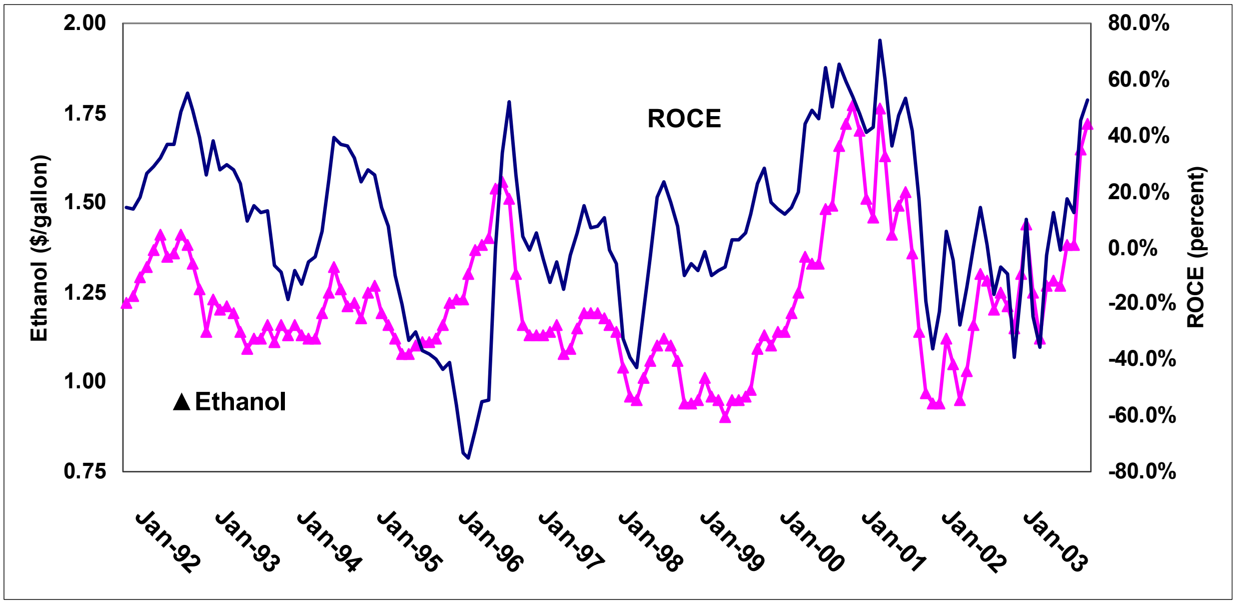


Figure 9 shows the close relationship of ethanol and ROCE with a correlation of 0.58. Sometimes ROCE and ethanol price appear to change together and other times there is a lag time of a few months.

Figure 10: Correlation Between ROCE and DDGS

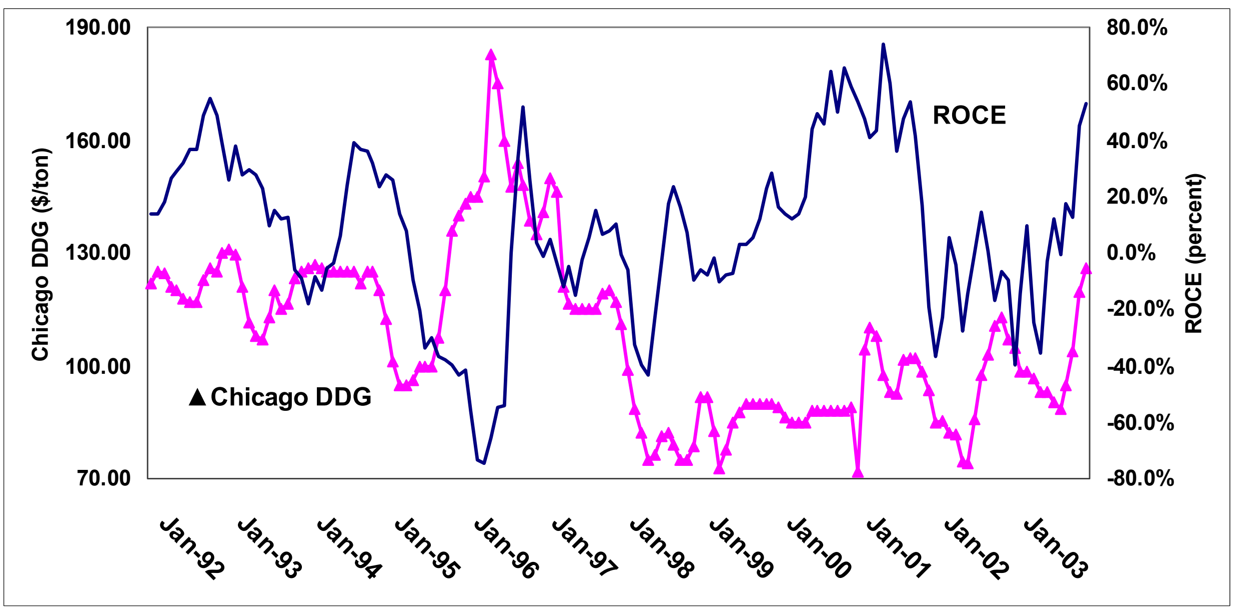


Figure 10 shows that the correlation between ROCE and DDGS are not very closely correlated (-0.17). The negative relationship can be explained since DDGS income is a small part of the total income in an ethanol plant and DDGS price is highly correlated with grain feed stocks that contribute such a high percentage of total production expenses.

Figure 11: Correlation Between ROCE and Sorghum

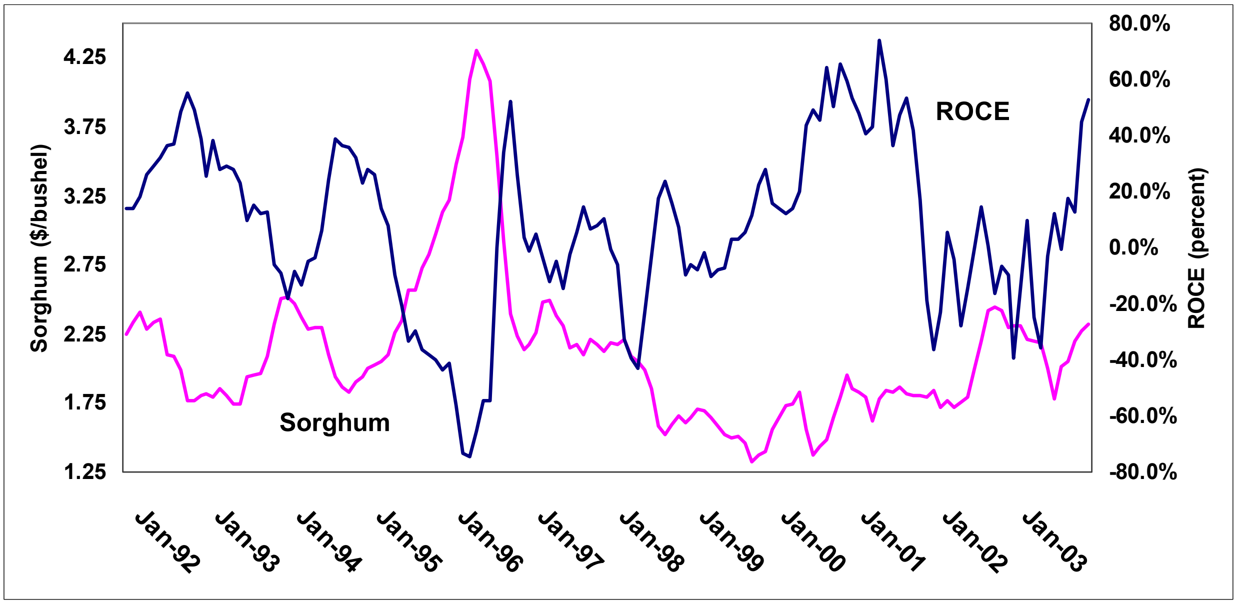


Figure 11 shows a highly significant negative correlation (-0.61) between ROCE and sorghum prices, which is to be expected from an input expense that is from 50-70% of total production expenses.

Figure 12: Correlation Between ROCE and Natural Gas

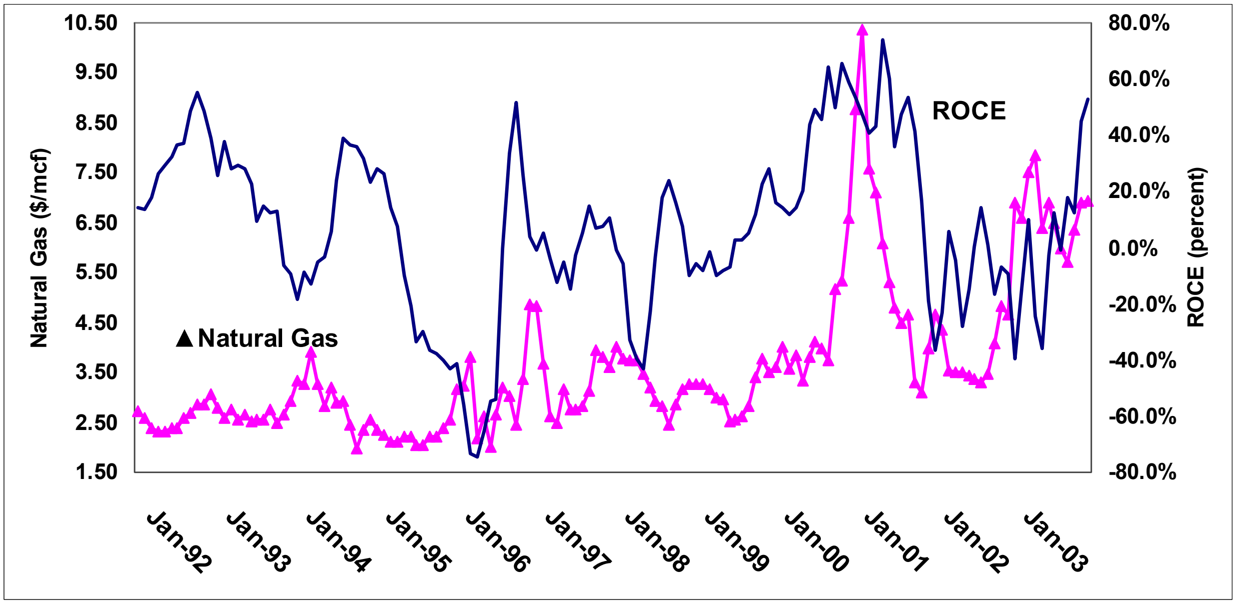


Figure 12 shows two price series that have little correlation (0.21), even though there does appear to be more correlation when observing the series.

Government and Regulatory Risks

The ethanol industry is a highly regulated industry that depends upon government policies. These policies contribute to the risks of ethanol production. Government support could change and adversely affect the profitability and viability of the ethanol industry. The proposed Energy Bill calls for a Renewable Fuels Standard that could increase the use of ethanol in the U.S to nearly five billion gallons per year from about 2.8 billion gallons used in 2003. The risk to ethanol producers involves how this regulation will play out in the next few years. Will the demand for ethanol meet the supply or will the supply get ahead of the demand? That is a risk confronting ethanol producers.

Changes in environmental regulations constitute a risk. More stringent federal or state regulations concerning ethanol production could be adopted and cause plant operating costs to increase. The emission of volatile organic compounds (VOCs) is a concern for ethanol plants if more stringent regulations are put in place that involve retrofitting existing plants to lower VOCs.

Changes in government environmental regulations could alter the amount of ethanol used. Depending on what changes are made, ethanol use could be encouraged and increase or even have the opposite effect. For example, ethanol consumption could decrease if changes are put into place that ignores the current required oxygen content of automobile emissions.

The ethanol industry has depended on government subsidies in the past to reach profitable levels. The current excise tax exemption for ethanol fuels that fuel blenders receive potentially increases the market price of ethanol nearly $0.50 per gallon. If this tax exemption is allowed to expire, the ethanol industry faces a great deal of risk to stay profitable. As an example, Minnesota ethanol payments were reduced from $0.20 to $0.13 in the 2003 Legislature because of concerns about large budget deficits. Many states have various subsidies for ethanol production. If state subsidies are discontinued or lowered, ethanol production and profitability could be at risk.

SUMMARY

Investors in an ethanol processing facility face risk in three major risk factor categories: (1) processing technology risks, (2) marketing and operation risks, and (3) government and regulatory risks.

Processing technology risk refers to the risks involved in the physical processing facility used in the production of ethanol. The two phases of processing technology risk are (1) plant engineering and construction and (2) plant operation.

In 2004 there are approximately seventy-five ethanol facilities in operation with about another dozen under construction. Nearly all of the ethanol plants constructed in the past 10 years use the dry mill technology, which is the focus of this publication.

An inherent risk for ethanol production starts with the engineering firm hired to design the ethanol facility. Engineering and construction risk may be minimized by using proven technology provided by engineering and construction companies with a proven track record. Experience in the operational phase is also available that can lower risks. Other risks to consider in plant operation include: (1) Environmental regulation changes could adversely impact an ethanol facility during operation. (2) Dry milling technology currently used to produce much of the nation’s ethanol may not compete in the future with ethanol produced from cellulose-based biomass.

Downside marketing and operation risks refer to the likelihood of negative profitability due to unfavorable input prices (grain, natural gas) and output prices (ethanol, distillers grains). Of course, upside marketing and operation risk with profitability outcomes are possible with favorable input and output prices.

Each input or output for an ethanol facility has varying degrees of risk depending on price volatility, the relative amount of the input/output used/produced in the plant, and the risk management tools available for a specific input or output. The four major market risk factors for an ethanol plant are the prices of ethanol, distillers grains, grain feedstock (corn or sorghum) and natural gas. The relationship between prices of inputs and outputs is important in determining the nature of the risk. To compare factor relationships, the correlation coefficient of input prices and output prices can be used. The correlation coefficient is a statistical tool that can be used to compare price series to each other to see how closely related they are. The highest risk for two or more outputs would be associated with the perfectly positive correlation of one and the lowest risk would be perfectly negatively correlated of negative one. The highest risk for an input and an output combination would be a negative correlation of one and the lowest risk would be a positive correlation of one. A correlation of zero signifies that the compared factors have no relationship.

The correlation of ethanol to unleaded gasoline is 0.58 signifying that their prices oftentimes move together, but still are a ways from being perfectly correlated. Ethanol and DDGS have a correlation of 0.26 showing they change in the same direction more often than not. Thus, comparing the two output products shows more profitability risk occurs than if they were negative. The correlation of ethanol and grain sorghum is 0.17, which is relatively close to zero showing their price series relationships have little significance. Ethanol and natural gas correlation of 0.49 is surprisingly high and does lower profitability risk.

The correlation between sorghum and DDGS is 0.74, which shows the two price series are highly correlated. This relationship lowers risk in ethanol production. However, the total proportion of income derived from DDGS is small compared to ethanol income. In fact the value magnitude is normally about six times for ethanol compared to DDGS.

How do these price relationships affect the bottom line of a dry mill ethanol plant? One way to study the question is to set up a simple annualized spreadsheet for a 30 million gallon example ethanol plant and compare the Return on Common Equity (ROCE) when the monthly price series are used. ROCE refers to the return from the initial equity invested by the owners of the ethanol facility. For this analysis, it is assumed that each month has a specific ROCE that refers to the simulated 10 year average ROCE if all of the specific monthly price series existed for all ten years.

The simulated ROCE is very volatile over the 1992-2003 period. The summary statistics show an average ROCE of 7.5% with a maximum of 73.8% and a minimum of negative 74.8%. ROCE is highly correlated (0.58) with the price of ethanol and shows a negative correlation with sorghum (-0.61).

Government policies and environmental regulations contribute to the risks of ethanol production. The ethanol industry has depended on federal and state government subsidies in the past to reach profitable levels. Ethanol production and profitability could be at risk if subsidies are discontinued or lowered, and if environmental regulations are put in place that are costly to achieve.

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