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Ethanol in an Era of High Energy Prices

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Introduction

As one of the oldest and most valuable crops grown in American history, the value of corn has been evident for centuries. The only crop grown in every state, corn is the United States' number one agricultural commodity. The research to find new and innovative ways to use corn is ongoing. One such use that has reached the headlines recently is ethanol production. While not a new technology, the value of ethanol is responsible for keeping it at the front of researchers' minds.

This study analyzes the effectiveness of the current United States ethanol production, specifically the effect of ethanol plants on corn markets; a comparison of the prices of U.S. produced ethanol with prices of ethanol imports; and profitability of ethanol production under alternative gasoline and corn price scenarios.

The use of ethanol as a fuel in the United States dates back to at least 1908. In an attempt to increase the use of homegrown renewable fuels, Henry Ford designed his Model Ts to run on either gasoline or pure ethanol. Ethanol again gained much attention in the 1970s when the Middle East limited the United States' oil supply (DiPardo). In recent years, ethanol has once again become a popular issue due to the Clean Air Act and high gasoline prices.

Energy is a hot topic at the front of Americans' minds these days due to the high fuel prices of the past year. Oil prices have reached $70/barrel in the past year and show little sign of declining. One of the causes of this oil price spike is the pace of economic development of China and India and the accompanying increase in energy demand. Americans now face global competition for the oil they have taken for granted for so long. Also, recent media attention has focused on the diminishing oil supply in the world. Alternative fuels, including ethanol, continue to gain political and media attention as oil prices climb (Rask).

Ethanol's environmentally friendly characteristics have opened up markets for ethanol use. Using an ethanol/ gasoline mix (gasohol) has significant environmental benefits. Studies show that use of a 10% ethanol/ 90% gasoline mix will reduce carbon monoxide emission by 30% and net carbon dioxide emissions by 10% (Environmental Benefits). The percentage of ethanol in this mix could be raised to 20%, creating a nearly limitless market for ethanol. Currently, of the more than 137 million gallons of motor fuel used per month in the United States, only 15 % is gasohol (Highway Statistics). There is also a very large market for ethanol as an octane booster, as ethanol is replacing methyl tertiary butyl ether (MTBE). The use of MTBE is being phased out in several states, because of its negative effects on the environment. In a society that is increasingly conscience of the environment, a product with clean air qualities will continue to be very marketable in the coming years.

Research similar to this study was completed in past decades. In 1985, a study titled, "The Impacts of Fuel Alcohol Production on Ohio's Agricultural Sector" was conducted at The Ohio State University. The study analyzed the increased demand for corn with ethanol production, the ethanol co-product, and the price fluctuations due to both (Rask, et. al.). In 1993, Dr. Norman Rask of The Ohio State University and Dr. Kevin Rask of Colgate University conducted a study on the supply and demand of ethanol in the Western Hemisphere. The study explored the trade possibilities between the United States and Brazil and suggested policy changes (Rask and Rask). Since both of these studies were completed over ten years ago when oil prices where much lower, this study looks at the current market situation with today's higher energy prices.

The United States must take a look at the current ethanol policy to keep up with the ever changing energy market. What kind of effects does increased ethanol production have on local cash grain markets? Can the current transportation system handle an increased supply of ethanol? This study takes a closer look at these questions to provide a clear picture of both the future of ethanol use in the United States and a path for ethanol policy.

Objective 1 Introduction

Using cash grain prices, the first objective of this study analyzes the impact of the opening of an ethanol plant on local cash grain markets. With increased demand for corn, it is logical that the corn basis would strengthen. Over time, farmers may increase their corn acreage at the expense of soybean acreage to take advantage of the higher corn prices. This higher supply of corn will meet the increased demand for corn. Therefore, the author's hypothesis is that the corn basis will not reflect significant change, because of the increased corn acreage.

The impact of three different ethanol plants was measured: Tall Corn Ethanol, LLC, Lincolnland Agri-Energy, LLC, and VeraSun Energy Corporation. The plants were chosen based on availability of grain bids at local elevators, location, size, and opening date. These plants are outlined in Table1.

Table 1. Ethanol Plants Analyzed in this Study

Plant Name	Owner	Capacity (MMGal/Yr)	Production Start	Location
Aurora Plant	VeraSun Energy Corporation	120	March, 2004	Aurora, SD
Lincolnland Agri-Energy, LLC	Farmer Coop	48	July, 2004	Palestine, IL
Tall Corn Ethanol, LLC	Farmer Coop	49	August, 2002	Coon Rapids, IA

Data

Since increased demand for corn from ethanol production would only affect local prices and not national prices, the difference between the local cash price and the Chicago Board of

Trade futures price, or the basis, was used to measure the impact of ethanol production. Local cash data was gathered for elevators near each ethanol plant from June, 1998 to July, 2005. For each plant, five nearby elevators were selected based on location and availability of bids.

To analyze the impact of Tall Corn Ethanol, located in Coon Rapids, Iowa, bids were gathered from: West Central Coop, Halbur, IA; West Central Coop, Scranton, IA; West Central Coop, Templeton, IA; Farmers Coop, Bayard, IA; and Farmers Coop, Glidden, IA.

To analyze the impact of VeraSun Energy Corp located in Aurora, South Dakota, bids were gathered from: AgFirst Farmers Coop, Aurora, SD; Bruce Farmers, Bruce, SD; AgFirst Farmers Coop, Brookings, SD; AgFirst Farmers Coop, White, SD; and AgFirst Farmers Coop, Toronto, SD.

For Lincolnland Agri-Energy, in Palestine, Illinois, bids were gathered from: Bridgeport Grain, Bridgeport, IL; ConAgra, Carlisle, IN; LittleJohn Grain, Martinsville, IL; ConAgra-Peavey, Shelburn, IN; and ADM, Sullivan, IN.

Model and Estimation Results

An ordinary least squares model has been used to estimate the impact of an ethanol plant on local cash grain prices. The model estimated was:

$$y_t = \alpha + \beta I_t$$

where y_t is the basis at time t and I_t is an indicator variable. $I_t = 0$ before the ethanol plant opened and $I_t = 1$ after the ethanol plant opened.

The regression analysis was first run with just the corn basis. Then, recognizing that the corn basis and the soybean basis tend to move together, a corn basis regression that included a soybean basis variable was run.

In the following charts, a summary of the regression model is given. The coefficient for each variable is given. The first column is the α coefficient, which is before the ethanol plant opened. The second column, β, is the effect on local cash prices when the ethanol plant began production. The third column, SB, gives the effect of the ethanol plant on local cash prices after the soybean basis variable has been added. The t-statistic, which measures significance of the coefficient, is in parenthesis below the coefficient. Asterisks denote the p-value, another measure of coefficient significance. A p-value of 10% or less is denoted by one asterisk. A p-value of 5% or less, meaning more significance, is denoted by two asterisks. The last column of the chart gives the R^2, which is a measure of the model's significance. The higher the percentage, the more strength the correlation between the opening of an ethanol plant and changes in cash grain prices.

Table 2. Tall Corn Ethanol Regression Summary

Tall Corn corn regression							
	α		β		SB		R^2
Without the soybean variable							
West Central Coop, Halbur, IA	-40.05		10.67				0.3370
	(-71.06)	**	(13.05)	**			
West Central Coop, Scranton, IA	-39.54		9.99				0.3200
	(-70.42)	**	(12.39)	**			
West Central Coop, Templeton, IA	-38.09		9.77				0.3264
	(-70.98)	**	(12.66)	**			
Farmer's Coop, Glidden, IA	-38.81		10.55				0.3330
	(-73.45)	**	(12.76)	**			
Farmer's Coop, Bayard, IA	-36.18		10.001				0.2805
	(-62.76)	**	(10.92)	**			
With the soybean variable							
West Central Coop, Halbur, IA	-37.11		8.922		0.0854		0.3952
	(-49.59)	**	(10.61)	**	(5.671)	**	
West Central Coop, Scranton, IA	-36.69		8.249		0.0836		0.3829
	(-50.28)	**	(9.978)	**	(5.755)	**	

West Central Coop, Templeton, IA	-35.22		8.065		0.0825		0.3896
	(-49.67)	**	(10.19)	**	(5.846)	**	
Farmer's Coop, Glidden, IA	-36.50		9.061		0.0678		0.3732
	(-50.69)	**	(10.46)	**	(4.565)	**	
Farmer's Coop, Bayard, IA	-32.84		8.027		0.0997		0.3593
	(-42.59)	**	(8.692)	**	(6.126)	**	

For Tall Corn Ethanol, the five plants monitored all show a positive impact on corn basis with the start of ethanol production. The model fits all five price series well. Without the soybean basis variable, the R^2 is at least 28% for all five elevators. West Central Coop in Halbur, IA, and Farmer's Coop in Glidden, IA, have the best fit with 33%. When the soybean basis variable is added, the model fits even better, with all elevators showing an R^2 of at least 35%.

In the model with the soybean basis variable included, the local corn prices around the Tall Corn Ethanol plant are significantly lower than Chicago prices; B_o ranges from -32 to -37. With the opening of the ethanol plant, the corn basis strengthened by eight to nine cents in each location and is also highly significant according to the p-values. A one cent change in the soybean basis is associated with a .06 to .10 cent change in the corn basis, indicating that some external factors are affecting both the corn basis and the soybean basis, such as transportation or fertilizer costs.

Table 3. VeraSun Energy Corp. Regression Summary

VeraSun corn regression

	α		β		SB		R^2
Without the soybean variable							
AgFirst Farmer's Coop, Aurora, SD	-48.15		20.67				0.3159
	(-52.85)	**	(12.84)	**			
AgFirst Farmer's Coop, Brookings, SD	-49.02		21.46				0.3369
	(-56.6785)	**	(13.60031)	**			
AgFirst Farmer's Coop, Toronto, SD	-50.07		21.08				0.3150
	(-49.18)	**	(11.92)	**			
AgFirst Farmer's Coop, White, SD	-50.52		21.60				0.3314

	(-53.47)	**	(12.94)	**			
Bruce Farmer's, Bruce, SD	-51.24		17.97				0.2074
	(-51.19)	**	(8.905)	**			
With the soybean variable							
AgFirst Farmer's Coop, Aurora, SD	-36.05		12.20		0.2678		0.5160
	(-28.06)	**	(7.751)	**	(11.76)	**	
AgFirst Farmer's Coop, Brookings, SD	-36.60		12.04		0.2717		0.5305
	(-29.31)	**	(7.833)	**	(12.24)	**	
AgFirst Farmer's Coop, Toronto, SD	-36.33		10.85		0.2766		0.5116
	(-24.49)	**	(6.226)	**	(11.32)	**	
AgFirst Farmer's Coop, White, SD	-36.95		12.06		0.2780		0.5254
	(-26.43)	**	(7.401)	**	(11.78)	**	
Bruce Farmer's, Bruce, SD	-33.12		5.455		0.3992		0.4851
	(-20.28)	**	(2.868)	**	(12.76)	**	

In the case of VeraSun Energy Corp., the model shows significant fit. Without the soybean basis variable, the R^2 is 20% at Bruce Farmer's in Bruce, SD, and at least 30% at the other four elevators. With the soybean basis variable, the R^2 ranges from 49% at Bruce Farmer's and 53% at AgFirst Farmer's Coop in Brookings, SD.

In the VeraSun Energy Corp area, cash grain prices were also much lower than Chicago prices with B_o ranging from -33 to -36 in the model with the soybean basis variable included. The corn basis strengthened by five to twelve cents with the beginning of ethanol production, and this is highly significant as indicted by the p-values. A one cent change in soybean basis is associated with a 0.26 to 0.39 cent change in the corn basis, indicating that an external factor is affecting both.

Table 4. Lincolnland Agri-Energy Regression Summary

Lincolnland corn regression					
	α		β	SB	R^2
Without the soybean variable					
Bridgeport Grain, Bridgeport	-11.32		1.44		0.0028
	(-20.95)	**	(0.9709)		

LittleJohn Grain, Martinsville	-15.77		-0.8882				0.0010
	(-26.01)	**	(-0.5616)				
ConAgra, Carlisle	-15.77		-0.8882				0.001037
	(-17.35)	**	(-1.467)				
ConAgra-Peavey, Shelburn	-11.08		-2.028				0.0029
	(-19.18)	**	(-0.9175)				
ADM, Sullivan	-11.03		0.4521				0.0002
	(-20.33)	**	(0.3086)				
With the soybean variable							
Bridgeport Grain, Bridgeport	-10.35		0.4739		0.1674		0.1997
	(-20.84)	**	(0.3550)		(9.093)	**	
LittleJohn Grain, Martinsville	-11.92		0.2302		0.3492		0.3256
	(-20.12)	**	(0.1764)		(12.08)	**	
ConAgra, Carlisle	-9.356		-3.314		0.2042		0.2647
	(-16.94)	**	(2.499)	**	(10.54)	**	
ConAgra, Shelburn	-8.814		0.3474		0.3388		0.3092
	(-16.91)	**	(0.1873)		(11.34)	**	
ADM, Sullivan	-9.940		-0.2173		0.2044		0.2496
	(-20.81)	**	(-0.1665)		(11.35)	**	

In the Lincolnland Agri-Energy case, the model does not show as much significance as the previous two cases. Without the soybean variable, the R^2 is less than 1% at all five locations. When the soybean basis variable is added, the model fits much better. The lowest R^2 is 20% at Bridgeport Grain in Bridgeport, IL, and the highest R^2 is 32% at LittleJohn Grain in Martinsville, IL.

The local cash grain prices around the Lincolnland Agri-Energy are eight to eleven cents lower than the Chicago prices in the model that includes the soybean basis variable. No significant change is seen, though, when ethanol production begins. The B_o ranges from -3 to 0.4 cents and the p-value indicates the numbers are not significant. A one cent change in the soybean basis is associated with a 0.16 to 0.35 cent change in the corn basis, indicating that some external factor is affecting both the corn basis and the soybean basis.

Acreage Effects

A least-squares regression model was run on the corn and soybean acreage in the counties that the ethanol plants and surrounding grain elevators are located. The results of this model show that increased demand for corn due to ethanol production has not changed the amount of acres being planted to corn versus soybeans. Corn and soybean acreage was obtained from the USDA National Agricultural Statistics Service. Table 5 shows the amount of corn and soybean acres harvested in the time period that grain bids were analyzed. The numbers in red indicate the year ethanol production began at each plant. The acreage is a combination of the counties in which the evaluated ethanol plant and local grain elevators are located.

Table 5. Corn and Soybean Acres Harvested near Analyzed Ethanol Plants

	Acres Harvested						
	1998	1999	2000	2001	2002	2003	2004
Corn							
Lincolnland	301,198	326,100	338,900	337,200	313,800	325,600	**338,400**
VeraSun	313,000	266,000	330,000	283,000	300,800	332,500	**362,300**
Tall Corn	404,600	410,800	416,500	408,500	**413,500**	409,500	426,500
Soybeans							
Lincolnland	354,900	345,800	339,500	354,700	364,900	337,600	**344,500**
VeraSun	351,300	401,700	379,200	394,500	334,100	359,900	**323,000**
Tall Corn	386,700	392,200	391,200	399,200	**380,800**	389,000	373,400

Objective 1 Conclusions

With the opening of Tall Corn Ethanol and VeraSun Energy, Corp, the local cash corn basis strengthened by at least eight cents. The model does not fit Lincolnland Agri-Energy as well. This may be due to the fact that Palestine, Illinois has close access to water transportation, allowing access to markets not accessible to the land-locked plants. Additionally, this river access could open markets to Lincolnland Agri-Energy that are not available to the other two ethanol plants, which are not located near a river. Also, due to the river, a large amount of grain moves through the Palestine area, so the increased corn demand due to ethanol production is not significant enough to make a difference in the local corn basis.

A significant change has not been seen in the corn/soybean acreage ratio, causing a rejection of the author's hypothesis. This could be due to the short time span being analyzed. It is difficult to make a conclusion based on the Lincolnland and VeraSun cases, because the data does not extend beyond the year ethanol production began. There is data two years beyond the opening of Tall Corn Ethanol. As years pass, more acres could be dedicated to corn production to match the demand from the ethanol plant. Another factor that could contribute to this lack of acreage change could be farmers' dedication to crop rotation. Farmers tend to be very committed to rotation and may not be willing to change for increased demand due to the ethanol plant. The weather also has a large impact on the corn and soybean acres planted. If there was a large amount of rain in the spring, more soybean acres may be planted, regardless of the corn demand.

Objective 2 Introduction

The second objective of this study was to analyze the United States' current transportation system and trade situation as they relate to the country's ability to supply growing ethanol markets. To analyze the current trade situation, production and transportation costs were gathered for both the United States and Brazil. A similar study, "Ethanol Policy in the Clean Air-Free Trade Era," was conducted thirteen years ago. Since that study is over a decade old, the data will be reevaluated with the current high oil prices. It is hypothesized that lower production costs in Brazil will allow that country to produce and ship ethanol to the major U.S. markets cheaper than production and transportation can occur within the U.S. Only the current tariff is keeping Brazil from importing large quantities.

The two largest ethanol markets in the U.S. are New York and California. In 2002, California used over 15 billion gallons of gasoline. 8.45% of the gasoline use was gasohol, a 90% gasoline/10% ethanol blend. New York used over 5 billion gallons of gasoline in 2002, and only less than a percent was gasohol (Highway Statistics). Since then, both states have banned the use of MTBE as an octane booster and ethanol is used as a replacement (F.O. Licht and Agra CEAS Consulting 21).

Due to the Renewable Fuels Standard passed in 2002, renewable fuel usage is projected to increase to five billion gallons per year by 2012. Assuming that most of this demand will be met by ethanol, use of ethanol will be more than doubled in the next six years (Review of Transportation). To transport the ethanol from the Midwest, where the majority of ethanol is produced in the US, to the markets on the coasts, barges and railways will be used. Pipelines and trucks can also be used, but they are rarely used to transport ethanol long distances because of special handling requirements. Therefore, they will not be considered in this study.

The majority of ethanol in the US is transported by rail. The current railway system will not need to make many changes to handle an increased supply of ethanol. Bottlenecks could occur with yard space, switch capacity, and at terminals. However, these problems are not impossible to overcome; they just require some special attention as the supply of ethanol moving across the US increases. Railway infrastructure can be improved much quicker than ethanol production can be increased in the Midwest (Review of Transportation).

The other way ethanol is moved in the US is by water. The ethanol is loaded onto barges in the Midwest, where it is produced, shipped down the Mississippi River to the Gulf, and finally moved around the coasts of the US. One advantage for shipping ethanol by water is that there are at least twice as many terminals to receive products by water than terminals to receive products by rail on both the east and west coasts. Increasing the supply of ethanol moved by waterways will be difficult for several reasons. First, the Mississippi River is already a very busy river, with projections of 1.3% growth annually. While the amount of ethanol moving down the river is a very small percentage of the total river traffic, increased ethanol shipments cause a few bottlenecks. The northern Mississippi River also freezes in the wintertime, slowing down barge traffic considerably. Once the ethanol reaches the gulf ports, it must be loaded onto ocean vessels. Some problems can also occur here with an increased supply of ethanol. The Merchant Maritime Act of 1920, commonly known as the Jones Act, and the Oil Pollution Act of 1990 limit the number of vessels that can be used for ethanol shipment. Under the Jones Act, vessels moving products from one US port to another must be American made, American owned, and American manned. The Oil Pollution Act requires that double hulled vessels must be used to move petroleum products. As a result of these two acts, a limited number of vessels are available to transport ethanol. Next, it takes an ocean vessel more than a month to get from the Gulf ports, through the Panama Canal, and up to California and further delays are common. This makes the ethanol supply in California, the largest ethanol user, very costly and difficult to manage (Review of Transportation).

The trade of ethanol has been a popular topic in the media in recent years. Using sugarcane instead of corn, Brazil has cheaper ethanol production costs than the United States. Brazil also has a large supply and massive production capacity that far exceeds the country's demand for ethanol. Seeing a large demand for ethanol in the U.S., Brazilian producers are looking for a way to tap into this potential market. Import duty taxes are making this very difficult, but Brazilian producers have found a loophole to get ethanol into the U.S. Through the Caribbean Basin Initiative, El Salvador and other Caribbean countries can export several products to the United States, exempt from tariffs. Ethanol is one of these products, allowing up to a cap of 7% of the U.S. production or about 190 million gallons per year to be exported to into the U.S. Currently, about 45 million gallons of ethanol annually enter the country duty free through this initiative. Brazilian ethanol producers can ship ethanol to these countries and then into the U.S. to avoid the tariffs and take advantage of subsidies. Cargill, a large American agribusiness, has plans to take advantage of this loophole. Cargill has announced a plan to build a 63 million gallon capacity ethanol plant in El Salvador that will import ethanol directly from Brazil, complete one small production step, and send into the United States, duty-free (Diaz).

Currently the United States has a tariff of $0.54 per gallon on imported ethanol. In November 2005, according to the Renewable Fuels Association, ethanol demand in the US was 297,000 barrels per day, while production was only 275,000 barrels per day. As a result, some ethanol must be imported into the U.S., despite the large tariff. In 2003, 176 million gallons of ethanol were imported. This is a 10.5% increase over the imports in 1998. The majority of these imports came from Saudi Arabia, with 40.1% of the U.S. imports. Other large shares come from Jamaica and Costa Rica, which both fall under the Caribbean Basin Initiative, so those imports do not have the tariff applied to them. Only ten million gallons of Brazilian ethanol were imported into the U.S. in 2003 (F.O. Licht and Agra CEAS Consulting 98).

Data

Production costs for the United States were collected from F.O. Licht and Agra CEAS Consulting's "Ethanol Production Costs: A Worldwide Study." Production costs for one gallon of ethanol are $0.94 at a dry mill ethanol plant with a 40 million gallon per year production capacity. At a Brazilian port, the price of ethanol (FOB) is $0.86. This price, which is the production cost plus the transportation cost from the plant to the port, was found in the 2005 U.S. Trade Statistics.

Transportation costs were gathered from Brazil and the Midwest, where most US ethanol is produced, to New York and California, the largest ethanol markets. Midwest transportation costs were calculated from Chicago, Illinois, to New York Harbor and San Francisco, California. These costs were calculated by first obtaining rail costs for shipping ethanol. The rail costs were found at the CSX railway website and the Burlington Northern Santa Fe railway website. The barge costs were then calculated using relative prices from a previous study by Downstream Alternatives. The transport costs from Brazil to the US ports were calculated as follows: According to the US Trade Statistics, the average CIF price of Brazilian ethanol at US ports is $0.98. The FOB price of ethanol at Brazilian ports is $0.86. The difference between the two, $0.12, is the transport cost. The costs are summarized in Table 6 with the origins in the left column and the destinations in the top row:

Table 6. Ethanol Transportation Costs

Transportation Costs		
	New York	California
Brazil	$0.12	$0.12
Chicago by rail	$0.11	$0.14
Chicago by water	$0.10e	$0.145-0.155e

Shipping cost estimates are denoted by an e following the cost.

Objective 2 Conclusions

To meet the rapidly growing demand for ethanol due to the Renewable Fuels Standard, the US will have to make some changes to its transportation infrastructure, especially in the shipping industry. Even with those changes, ethanol imports will still occur. Since US ethanol consumption is currently exceeding production, there will be ethanol imports from Brazil as well as other countries, despite the current tariff. With or without a tariff, Brazilian ethanol is competitive in the United States markets. Brazilian ethanol is $0.98 at US ports plus the $0.54 tariff. This equals a price of $1.52; an extremely competitive price with ethanol currently selling for about $2.45 in Illinois (Ethanol Market Price). However, the U.S. markets are not flooded with Brazilian ethanol, because Brazil is using most of its ethanol domestically. Decreasing the U.S. import tariff will not significantly increase Brazilian ethanol imports as the author hypothesized.

Objective 3 Introduction

When analyzing the United States ethanol policy, the topic of subsidies will invariably be at the center of the debate. Currently, ethanol receives a blanket subsidy of $0.52 per gallon. This subsidy comes in the form of a tax break at the fuel pumps. Additionally, there are also three types of income tax credits for alcohol fuels: the alcohol blender's tax credit, the straight alcohol credit for blends of 85% ethanol or larger, and the small ethanol producer's credit for producers with a production capacity of 30 million gallons per year or smaller. The subsidy focused on in this study is the tax break at the pumps. The current subsidy was originally created in the 1970s to support a new and growing industry. It does not take current oil or corn prices into consideration. This subsidy only applies up to a 10% blend of ethanol, so higher blends of ethanol cannot receive a higher subsidy (F.O. Licht and Agra CEAS Consulting 23). A conventional car engine can handle a higher blend of ethanol, such as 20% ethanol and 80% gasoline, but blenders will not make this blend because the subsidy would be no more than that of a 10% ethanol blend. Therefore, by subsidizing only a 10% blend, the current policy is limiting ethanol consumption. Now that the ethanol industry has developed and grown substantially in an era of high oil prices, it is less necessary to receive this support and protection from imports (Rask). This study proposes a new subsidy policy that takes current corn and gasoline prices into consideration.

Model

The proposed subsidy policy is based on a breakeven point for ethanol plants, as well as the current corn and gasoline prices. The profitability of ethanol plants was calculated based on the following assumptions. Ethanol currently receives a $0.52 tax break at the pump. The point in which ethanol plants will breakeven on their investment and expenses will be different for plants with different production capacities. For this study, a plant with a 40 million gallon per year capacity, a typical size plant located in the Midwest, was used. However, a different capacity could easily be put into the equation. Fixed costs are based on plant and equipment investment of $2.50/ gallon of ethanol, depreciation over a 10-year period, a salvage value of zero, and an interest rate on investment of 10%. This results in $0.375/gal of fixed costs. Variable costs include feedstock (corn) costs, a credit for ethanol byproducts (distilled dried grains and carbon dioxide) revenues, and cash operating expenses. These costs were all obtained from the "USDA's 2002 Ethanol Cost of Production Survey." One bushel of corn will make 2.66 gallons of ethanol. This results in the following equation:

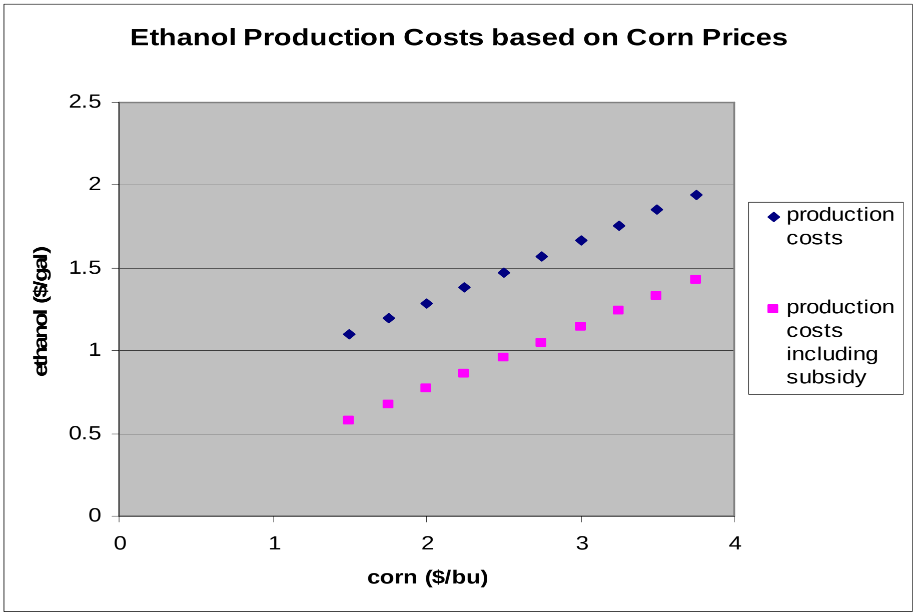
$$\text{Total Cost} = [FC + VC + (1/2.66 * Pc) - \text{feedstock credits}] * Qe,$$

where Qe is the quantity of ethanol, Fc is fixed costs per ethanol gallon, VC is variable costs per ethanol gallon, and Pc is the price of corn. Inserting the numbers results in the following equation:

$$\text{Cost per Gallon} = [0.375 + 0.41 + (1/2.66 * Pc) - 0.25]$$

This can then be plotted on a graph:

Graph 1.



The wholesale price of gasoline in 2005 and 2006 is plotted in graph 2.

Graph 2.

TFC Commodity Charts

Unleaded Gas (HU, NYMEX)

Weekly Price Chart

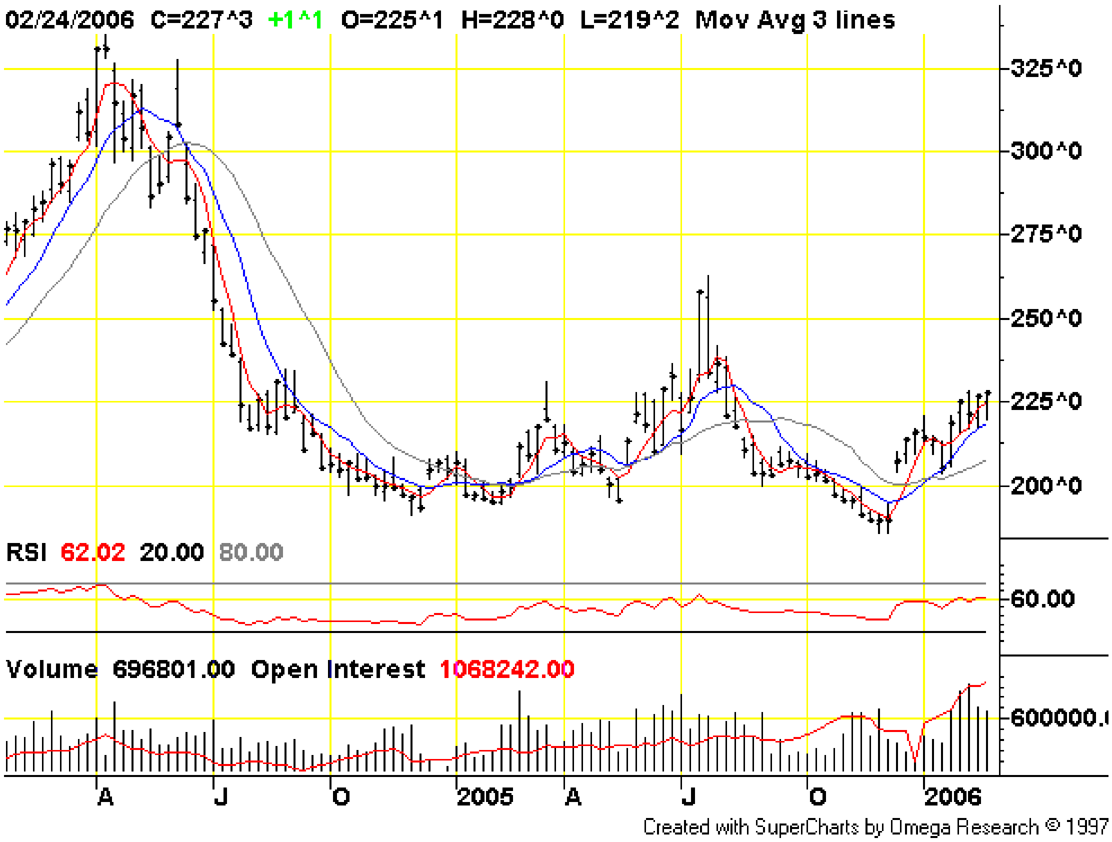
The Chicago Board of Trade futures price of corn in 2005 and 2006 is plotted on graph 3.

<u>Graph 3.</u>

TFC Commodity Charts

Corn (C, CBOT)

Weekly Price Chart



Currently, wholesale gasoline is selling for $1.55 per gallon (NYMEX). The corn futures price is $2.39 per bushel (CBOT). Plotting this point on graph 1 shows that ethanol is currently cheaper than gasoline, so no subsidy is needed. The profit graph for ethanol producers can be reevaluated on a monthly or quarterly basis to determine the subsidy needed to keep ethanol competitive with gasoline. For example: if the corn price moves to $2.75 per bushel and the gasoline price stays the same, ethanol will need a $0.04 subsidy to stay competitive with gasoline.

Objective 3 Conclusions

The current ethanol subsidy policy is inefficient. Producers are making large profits due to low corn prices and high gasoline prices. As a result, producers are likely to be unhappy about a change in ethanol policy. The three income tax credits will allow producers to continue to get some support from the government. Still, if the subsidy is changed to be coupled with profits, producers may see incentive to hide profits to get a higher subsidy. Therefore, this new subsidy policy must be accompanied by regulation of profits. Changing the subsidy policy will most likely not have an impact on the amount of ethanol being imported, since the proposed policy does not change the tariff and current imports get the same subsidy as domestically produced ethanol. By adopting a flexible subsidy model that changes as corn and gasoline prices fluctuate, the U.S. could still protect its ethanol industry as necessary, but not overcompensate ethanol producers.

Study Conclusions

With an increased demand for energy in the world and stagnant petroleum production, high energy costs are unlikely to abate. To respond, the U.S. ethanol industry has been expanding its current production, which has positive effects on the local cash grain markets. Another reason for this U.S. production, despite the ability to import ethanol cheaper from Brazil, is Americans' perception of homegrown fuels and an increased interest in less reliance in foreign sources of fuel. As long as consumption exceeds production, ethanol will also continue to be imported, despite the large tariff currently in place. The potential increased usage of ethanol as a replacement for MTBE and as an alternative fuel has the ability to use what the U.S. is producing domestically, as well as import some ethanol from Brazil. The largest change needed in the ethanol industry is a new subsidy policy. With a fixed subsidy, the government is wasting taxpayers' money by subsidizing large profits for ethanol producers. By implementing a flexible subsidy policy, producers would get help from the government only as needed when indicated by gasoline and corn prices. The U.S. ethanol industry is only going to continue growing in the coming years. To meet the needs of this industry, ethanol policy must also continue to evolve.

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