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Fuel Ethanol Subsidies: An Economic Perspective

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Fuel Ethanol Subsidies: An Economic Perspective

Executive Summary:

When Congress enacted in 1978 the first federal subsidies for use of ethanol blended with gasoline the program contained a fixed $0.40 per gallon payment to the blender for every gallon of ethanol added to gasoline, as long as the blend contained at least 10% ethanol[1]. Current Federal law has raised the subsidy to $0.51 per gallon and also mandated 7.5 million gallons of renewable fuel use by 2012. In addition, there are also additional Federal subsidies for smaller ethanol producers and state and local subsidy programs for both fuel ethanol production and use. This paper will focus on the effects of the $0.51 per gallon Federal subsidy program.

The stated intentions of the ethanol subsidy program were to diversify our sources of energy and to reduce motor vehicle emissions. For a number of years the ethanol program produced relatively small amounts of fuel, and did not have a major impact on crop economics or fuel prices. However, in the last two years the situation has changed dramatically. The root cause of the changing influence of fuel ethanol is the fixed nature of the Federal subsidy program in the face of a very dynamic energy market.

Due to changing economic forces the U.S. ethanol subsidy is also now having major effects on crop plantings, global crop prices, global food costs and the availability of major grain and oilseed crops for food use and export. The reasons for the sudden upsurge in fuel ethanol production are rooted in major changes that have occurred in the petroleum market since the current ethanol subsidy program was enacted.

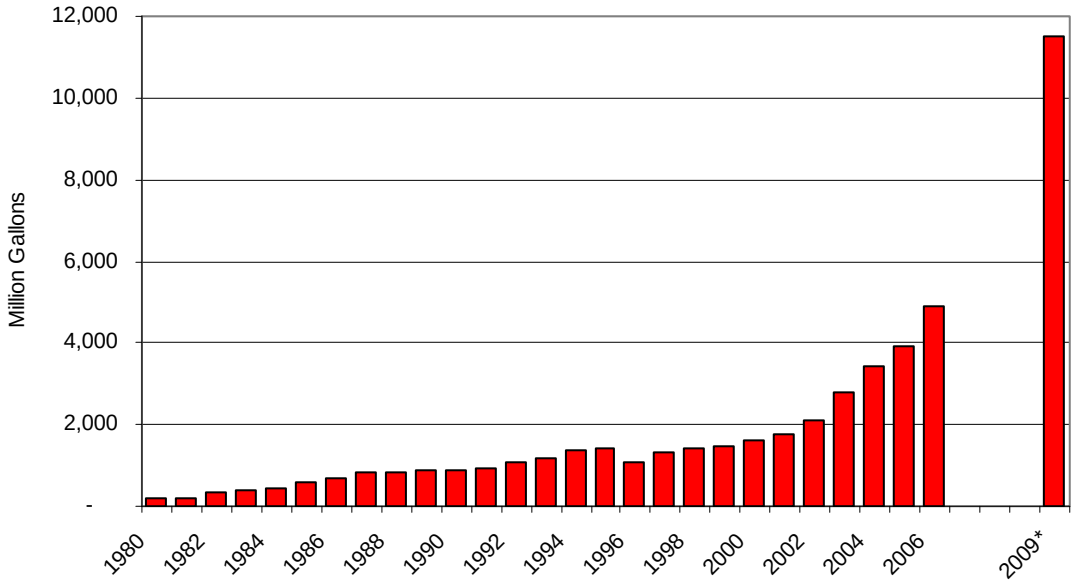
The Federal subsidy program does not require that corn or other grains be used to produce ethanol. However, given current ethanol technology, grain is the only cost effective raw material for ethanol production. The fact that the only economically viable feedstock for ethanol production in the U.S. is grain, mainly corn, has focused the economic effects of the subsidy program on the U.S. farm economy.

The total current and planned U.S. corn-based ethanol production capacity is 11.5 billion gallons per year by 2009 compared to 4.9 billion gallons in 2006 and 1.6 billion in 2000[2] (Figure 1). The upsurge in ethanol production is due to the effects of gasoline prices relative to the cost of producing ethanol from grain. When gasoline was less expensive than today ethanol economics were not as attractive, even with subsidies. As energy prices have risen, ethanol produced from grain has become a viable source of motor fuels, even without subsidies.

The ethanol subsidy program is now increasing the cost of food production though side effects on major crop prices and plantings. The cost increases are already starting to show up in the prices of meat, poultry, dairy, bread, cereals and many other products made from grains and soybeans.

[1] Energy Tax Act of 1978
[2] http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2007.pdf

Figure 1: U.S. Fuel Ethanol Production
(1980 to 2006, 2009 Projected)[3]



* Projected Production Capacity

Fuel ethanol has economic value based on the price of the gasoline that it replaces in motor fuels. Since ethanol has only about 66%[4] of the net energy of gasoline it has an economic value that is inherently 34% less than that of the gasoline it replaces. Put another way, it takes 1.52 gallons of ethanol to replace 1 gallon of gasoline. If wholesale[5] gasoline is priced at $2.00 per gallon, ethanol is worth only $1.32 per gallon based on its energy content.

When gasoline is relatively inexpensive (certainly not in recent times) the value of ethanol is also low. At $1.00 per gallon for wholesale gasoline ethanol is worth only about $0.66 per gallon. At that value it would be difficult, if not impossible, to produce fuel ethanol with no subsidies due to the economics of that value in relation to the price of raw materials (mainly grain) and the cost of converting grain into ethanol.

In light of current gasoline prices the Federal subsidy program is no longer needed to promote ethanol production. The existence of the subsidy is, today, severely distorting crop prices while adding little, if anything, to the stated goals of the renewable energy program. The ethanol program is also increasing the Federal

[3] http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2007.pdf
[4] http://bioenergy.ornl.gov/papers/misc/energy_conv.html
[5] Wholesale prices are used for this analysis to eliminate the effects of taxes and retail margins that vary widely across the U.S.

outlays and has very little impact on U.S. dependence on foreign oil. China, having also seen these effects, recently banned further expansion of grain-based ethanol.[6]

Origins of the U.S. Federal Fuel Ethanol Subsidy Program

The beginnings of the Federal ethanol subsidy program can be traced back to the Energy Tax Act of 1978[7]. At that time the U.S. had experienced two episodes of crude oil supply interruption. In addition, there was a desire to find an oxygenator for gasoline to reduce emissions, particularly in winter fuels and a replacement for lead as an octane enhancer. With the relatively low gasoline prices of that era coupled with the cost of producing ethanol from corn, subsidies were required for any production to take place.

The initial subsidy had a value of $0.40 cents per gallon, but at prevailing energy prices did little to promote ethanol plant construction. In 1980 the Surface Transportation Assistance Act increased the ethanol subsidy to $0.50 per gallon. Coupled with rising gasoline prices this was enough to make production marginally profitable. By 1984 the number of ethanol plants in the United States rose to 163 from only 10 in 1980. The Tax Reform Act of 1984 further increased the ethanol subsidy to $0.60 per gallon. However, falling petroleum prices reduced the profitability of ethanol production, and by the end of 1985 only 70 ethanol plants were still operating despite the higher subsidies.

The current subsidy (in the form of an excise tax rebate) level is $0.51 per gallon, lower than the peak of 1984, but ethanol production is increasing at a rate of well over 25% per year.

Why the Upsurge in Fuel Ethanol Production in 2004-2007?

In 2004-2007 there has been a major increase in ethanol production and construction of new ethanol production plants. Fundamentally, the reason is the increase in the value of the energy content of corn due to energy price increases. To fully understand the reasons for the sudden ethanol expansion and the role of the Federal ethanol subsidy the relationships of these five key economic forces must be understood:

1. The source and size of the underlying demand for fuel ethanol;
2. Wholesale gasoline prices;
3. Corn and ethanol byproduct prices;
4. The cost of producing ethanol from grain; and
5. The economic effect of the federal ethanol subsidy program

[6] http://www.chinadaily.com.cn/china/2007-06/22/content_899837.htm
[7] http://americanfarmer.blogspot.com/2007/05/key-dates-in-ethanol-development.html

Source and size of underlying demand:

The theoretical potential exists for fuel ethanol from corn to replace all of the current 140 billion gallons[8] of annual U.S. gasoline use. However, to do so would require 212 billion gallons per year of ethanol production[9] and that would in turn require 76 billion bushels[10] (1.93 billion metric tons) of corn per year. In perspective, the total world grain crop of 2007 is currently estimated to be 2.1 billion tons[11]. **In other words, nearly all of the world's current grain supply would be needed to fuel the U.S. gasoline powered vehicle fleet, leaving almost nothing for world food needs. Put another way, each 1% of the U.S. gasoline supply that is replaced by ethanol uses almost 1% of our current global grain production.**

Clearly, the global demand for food places a severe limit on the feasibility of using grain supplies for producing a large percentage of U.S. motor fuels.

More realistically, replacement of 10% of the U.S. gasoline supply by ethanol would require the gasoline equivalent of 21.3 billion gallons of ethanol per year. Ethanol production in 2006 totaled 4.855 billion gallons[12], or enough for a 20% of the amount required. Clearly, the market is far from saturated if ethanol is priced correctly in terms of its energy value relative to gasoline. There is plenty of room for increased ethanol use, even if E10 is the highest blend rate used and no E85 (85% ethanol, 15% gasoline) is ever sold.

To achieve a 10% reduction in U.S. gasoline use with ethanol will take about 7.7 billion bushels of corn, or over 60% of the estimated 2007 corn crop. To reach the required 21.3 billion gallons of ethanol per year and not reduce other uses of corn will require more than 30 million acres of additional corn plantings on top of the near-record 92.2 million planted in 2007. Most of those acres would come from other crops.

Demand for ethanol is not limited by demand for the product as a replacement for gasoline as long as ethanol is priced competitively. The limit to ethanol production is not the 140 billion gallon U.S. gasoline market, but rather how much ethanol production can expand before corn prices are bid up to the point where corn costs choke off further expansion.

Wholesale gasoline prices

The value of ethanol to the end customer, the motorist, is based on the energy that ethanol contains relative to gasoline. E10 (10 % ethanol) contains about 96.6% of the energy of regular gasoline. A car that gets 30 miles per gallon on gasoline will get about 29 miles per gallon on E10. While this is a relatively small difference, for

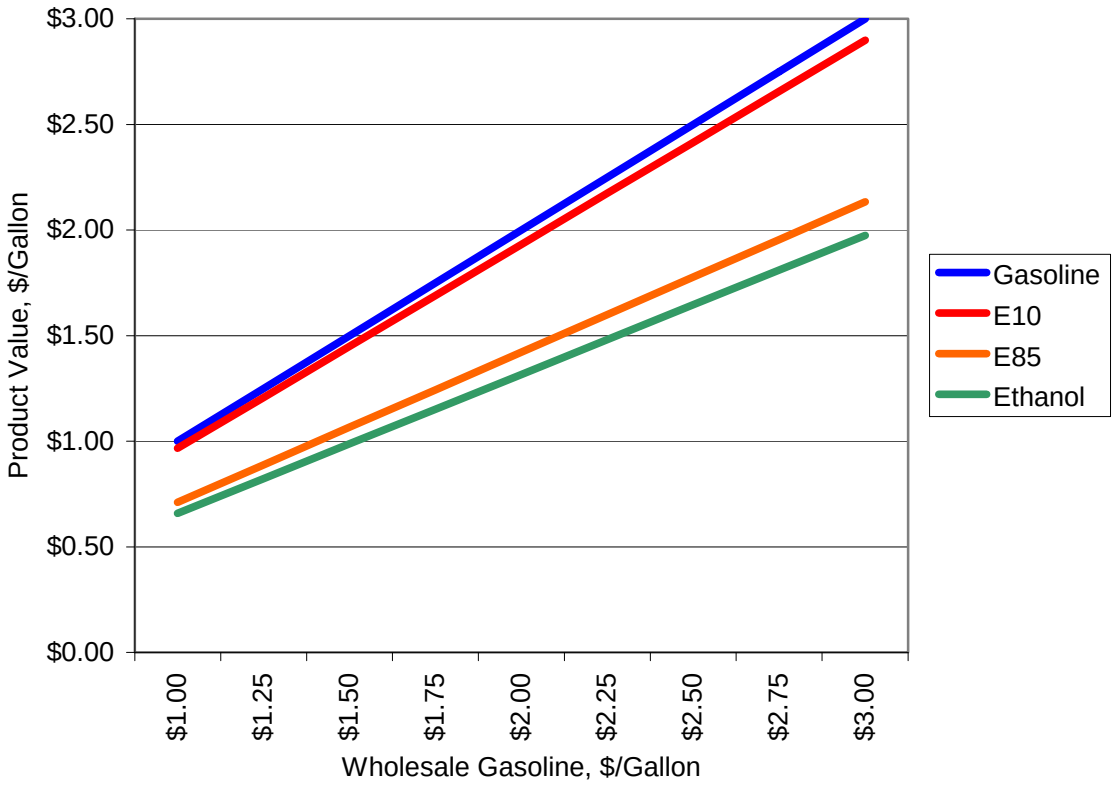
[8] http://www.eia.doe.gov/neic/quickfacts/quickoil.html
[9] The net energy of ethanol is 66% that of gasoline
[10] Assumes 1 bushel of corn yields 2.8 gallons of ethanol
[11] http://usda.mannlib.cornell.edu/usda/current/wasde/wasde-06-11-2007.txt
[12] http://www.ethanolrfa.org/industry/statistics/

the same fuel cost per mile E10 needs to be priced at about 3.4% under of the price of gasoline. If wholesale gasoline prices are $2.00 per gallon, wholesale E10 should be priced at $1.93 per gallon for the same fuel cost per mile.

While the E10 mileage difference is small, for E85 (85% ethanol) fuel mileage drops significantly. The energy content of E85 is about 71% that of gasoline. A car that get 30 miles per gallon gasoline will get about 21 miles per gallon on E85[13]. That means that if wholesale gas is priced at $2.00 per gallon a breakeven wholesale price for E85 would be $1.42.

Regardless of the current level of gasoline prices, the economic value of both ethanol blends, E10 and E85, are in direct proportion to the price of gasoline. Figure 2 shows the wholesale value of E10, E85 and regular gasoline as the wholesale price of gasoline varies from $1.00 to $3.00 per gallon.

Figure 2: Energy Value of Ethanol, E85 and E10 Relative to Gasoline



As gasoline prices rise, ethanol becomes more valuable, and so does the major raw material used to make ethanol, corn. However, only if the price of corn is low enough to make producing fuel ethanol a viable business will any be produced.

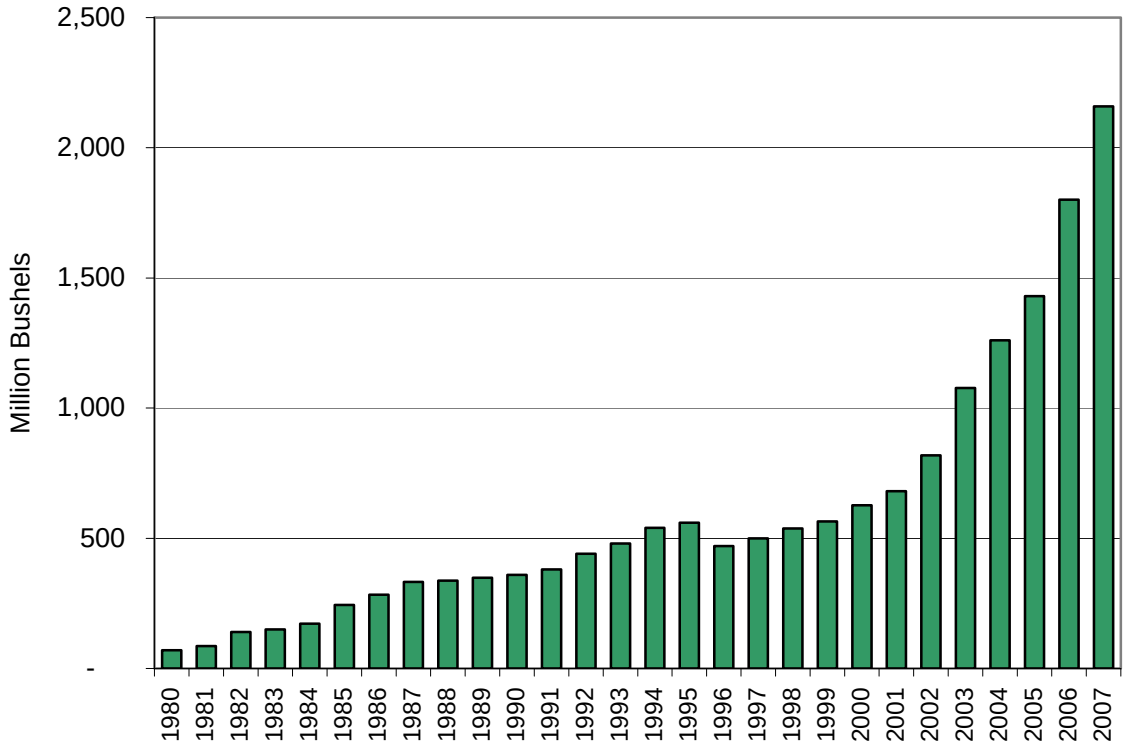
[13] http://www.greenenergynetwork.com/media/research/ffvs-e85-Extended-Summary.pdf

Corn and ethanol byproduct prices

Corn is by far the leading grain used to produce fuel ethanol in the U.S. (Figure 3). Essentially all current and planned U.S. ethanol plants use corn as their primary feedstock[14]. The reason is simple. Corn is historically the most widely produced grain in the U.S., and the least expensive source of the starch, converted to sugar by fermentation, that is needed as the starting material for ethanol production. Use of cellulose as a feedstock is a long term hope, but still only a theoretical possibility.

Ethanol production yields 17-18 pounds of valuable feeding byproducts from each every bushel of corn processed. The byproduct has significant value, and its sales help offset the cost of ethanol production.

Figure 3: Corn Used for Fuel Ethanol Production



The use of corn for ethanol production goes back for centuries, but only in very recent years have we seriously attempted to make a significant contribution to overall energy production with ethanol. Fundamentally, the reason is for first time in history corn and gasoline have been priced such that it is profitable to use the energy in corn for auto fuel. As will be shown later, even without Federal subsidies, ethanol production, and corn use for ethanol, would be increasing at this time.

[14] http://www.ethanolrfa.org/industry/locations/

The relationships among gasoline prices, ethanol prices, corn prices and ethanol byproduct prices are complex and will be discussed later. However, it is obvious that if everything else is held equal, at some corn price it is no longer profitable to use corn to produce a gasoline substitute.

The cost of producing ethanol from grain

Ethanol production costs are another key factor in determining how attractive it is to transform grain into fuel alcohol. The less it costs to produce ethanol, the more an ethanol producer can pay for corn, all else being equal. A recent USDA study[15] on ethanol production costs was based on survey of actual ethanol plants. The study showed an average of 41.24 cents per gallon of variable production costs net of the cost of the corn feedstock. In addition, there is approximately another 20 cents per gallon that is required for returns on investment, returns to management, and profits. Excluding the cost of corn, the total cost of transforming corn to ethanol is thus estimated at slightly over 61 cents per gallon of ethanol produced.

The Federal subsidy is $0.51 cents per gallon. Thus, the net cost of transforming corn into ethanol is only $0.10 per gallon. **The subsidy essentially pays for the cost of running an ethanol plant.**

The Federal ethanol subsidy level

While ethanol production would be a viable business today even without federal subsidies, the presence of the $0.51 per gallon subsidy is a major driver in the rapid increase in corn use for ethanol. At $0.51 per gallon, the subsidy enables ethanol producers with a 2.8 gallon per bushel ethanol yield to pay $1.43 per bushel ($0.51 X 2.8) more for corn that they would if they did not receive the subsidy. State and local subsidies further increase this corn value premium.

The Federal subsidy has the effect of enabling the ethanol industry to bid corn away from other users. When gasoline prices were lower than current levels this premium merely made ethanol producers more competitive with other users. In fact, in the mid 1990s Federal subsidies were not enough to keep many ethanol producers in business due to an unfavorable relationship between low gasoline prices and high corn prices (Figures 2 and 3, 1996-1998). At today's gasoline prices the Federal subsidy gives ethanol producers a huge premium in the value of corn relative to historical corn price levels and corn's value in other uses.

[15] Hosein Shapouri and Paul Gallagher. USDA's 2002 Ethanol Cost-of-Production Survey. USDA, AER 841. Office of the Chief Economist, Office of Energy Policy and New Uses. July, 2005. P. 8.

Putting it All Together

To see the relationship of ethanol costs, returns and subsidies on corn prices we can look at a few simple equations. First, Net Returns (Revenue – Costs) for ethanol production can be expressed as:

1. $R_{I,M,P} = TR – VC - C_c$

Where: $R_{I,M,P}$ = Returns to investment, management and profits, $/gallon
TR = total revenue of the ethanol plant, $/gallon
VC = variable costs of ethanol production, excluding corn, $/gallon
C_c = Cost of corn, $/gallon of ethanol produced

Expanding Total Revenue, this variable consists of three major revenue streams; ethanol sales, byproduct sales, and the Federal subsidies received (indirectly) by ethanol plants[16].

2. $TR = P_e + Q_{dg}*P_{dg} + R_{fs}$

Where: TR = Total Revenue per gallon of ethanol produced
P_e = Price of ethanol, $/gallon
Q_{dg} = Quantity of distillers grains produced per gallon of ethanol (6.1 pounds)
P_{dg} = Price of distillers grains, $/pound
R_{fs} = Revenue from the Federal subsidy, $/gallon ($0.51)

For each gallon of ethanol produced about 0.357 bushels[17], or 20 pounds, of corn is used. However, for each gallon of ethanol production about 6.1 pounds of distiller's grains are also produced and sold for feed. Some of the corn that is used is thus still available for livestock and poultry use, but for every gallon of ethanol production there is a substantial net loss of feed and food availability.

The breakeven cost of corn for a gallon of ethanol, $C_{be,c}$ is equal to:

3. $C_{be,c} = P_{be,c}*Q_c$

Where: $P_{be,c}$ = Breakeven price of corn per bushel
Q_c = quantity of corn, in bushels needed to produce 1 gallon of ethanol (0.357 bushels)

For purposes of this analysis the variable costs of production are assumed to be the $0.414 per gallon found in the USDA study and the required returns are assumed to be $0.20 cents per gallon. For this analysis only the $0.51 cent per gallon Federal subsidy will be considered in the overall revenue stream. However, this is the minimum subsidy, state and local subsidies could increase this amount.

[16] There are also minor contributions from carbon dioxide production that are ignored in this analysis.
[17] 1 divided by the average yield of 2.8 gallons of ethanol per bushel of corn

If we expand Equation 1, using equations 2 and 3, we get:

4. $R_{I,M,P} = P_e + Q_{dg}*P_{dg} + R_{fs} - VC - P_{be,c}*Q_c$

If we rearrange equation 4 slightly we get:

5. $P_{be,c}*Q_c = P_e + Q_{dg}*P_{dg} + R_{fs} - VC - R_{I,M,P}$

That is, the breakeven cost of corn to produce a gallon of ethanol is equal to the price of ethanol per gallon plus the revenue from byproducts, plus the Federal subsidy, minus variable costs and minus the returns for investment, management and profit. That is, the breakeven value of corn is the residual of all revenue minus all other costs and returns.

Dividing both sides by Q_c, we get the breakeven price that ethanol producers can afford to pay for a bushel of corn and still earn their returns to investment, management and profit:

6. $P_{be,c} = (P_e + Q_{dg}*P_{dg} + R_{fs} - VC - R_{I,M,P}) \div Q_c$

From this equation the relationships among the key variables and the value of corn to the ethanol producer are clear. As ethanol or distillers grains prices increase so does the value of corn. As the Federal subsidy increases, so does the value of corn. As either variable costs or required returns increase the value of corn will decline. Finally, as ethanol plants become more efficient, and Q_c decreases, corn becomes more valuable (all other factors unchanged).

Finally, if we substitute current values estimated for the cost, returns and efficiency variables we get:

7. $P_{be,c} = (P_e + 6.1*P_{dg} + \$0.51 - \$0.4124 - \$0.20) \div 0.357$

Equation 7 shows some interesting relationships between the breakeven value for corn and the economic variables on the right hand side.

1. Each 1 cent increase in the price of ethanol (P_e) increases the corn breakeven by 2.8 cents per bushel
2. Each 1 cent increase in the Federal subsidy (R_{fs}) also increases the corn breakeven by 2.8 cents per bushel
3. Each 1 cent increase in the variable cost of ethanol production (VC) or required returns ($R_{I,M,P}$) reduces the corn breakeven by 2.8 cents per bushel
4. A \$20 increase in the price per ton (\$0.01 per pound) of DDGS (P_{dg}) increases the corn breakeven by only \$0.17 cents per bushel

Thus, in the short run, the primary drivers of breakeven corn value to the ethanol producer are the price of ethanol, the level of the Federal subsidy, and the cost of

producing ethanol. The price of DDGS has relatively little impact on the value of corn to ethanol producers.

There is one additional factor that needs to be considered. Ethanol producers do not receive the Federal subsidy directly. The subsidy is actually paid to the blenders (in the form of a tax rebate) who add ethanol to gasoline. This explains why the reported wholesale market price of ethanol is always well above that of wholesale gasoline on an energy basis when it should be 66% of the gasoline price. The blender can, and does, pass the subsidy back to the ethanol producer in the form of a higher ethanol market price than is justified based on the energy value of ethanol to the end consumer. To get the net price that the blender pays we need to subtract the $0.51 cent Federal subsidy (and state and local subsidies too) from the raw price of ethanol. As of June 27, 2007 this relationship was:

1. Gasoline: Regular, NY, gallon: $2.177[18]
2. Cash Ethanol, U.S. Average: $2.133[19]

Based on the energy value of ethanol the ethanol price should be about 66% of the gasoline price, or $1.44 per gallon. Subtracting the $0.51 Federal subsidy from the cash ethanol price, the net price to the gasoline blender was $1.62 per gallon, or $0.18 above the energy value. All of the Federal subsidy was being passed back to ethanol producers on this date, and they were receiving a price premium of $0.18 per gallon on top of the Federal subsidy. To a great extent the additional premium likely reflects state and local subsidies that are given in addition to the base Federal subsidy that all ethanol blenders receive.

What was the Ethanol Value of Corn on June 27, 2007?

On June 27, 2007 the following prices of gasoline, ethanol and dried grains with solubles (DDGS) were reported:

1. Ethanol - $2.133 per gallon[20]
2. Wholesale gasoline, regular grade. NY – $2.177 per gallon[21]
3. DDGS – $111 per ton, or $0.0555 per pound[22]

As mentioned above, given the price of gasoline, the energy value of ethanol was $1.43 per gallon. Adding the full $0.51 Federal subsidy to the energy value gives $1.94, the value that a blender could afford to pay for ethanol based on its energy content. Based on its energy value, ethanol was priced at a $0.18 per gallon premium to gasoline on this date.

[18] Wall Street Journal, 6/22/07
[19] http://www.dtnethanolcenter.com/index.cfm?show=10&mid=32
[20] http://www.dtnethanolcenter.com/index.cfm?show=10&mid=32
[21] Wall Street Journal, 6/27/07
[22] DDGS price of $111 per ton, $0.0555 per pound, is from: USDA. Livestock, Hay, & Grain Market News. 6-22-07. p. 12.

If we substitute the actual DDGS and ethanol prices into Equation 7 (the Federal subsidy is already reflected in the price of ethanol and therefore is not included to avoid double counting):

$P_{be,c}$ = ($2.133 +6.1*$0.0555 - $0.4124 - $0.20) ÷ 0.357

$P_{be,c}$ = $5.21 per bushel

That is, on June 27, 2007 ethanol producers could afford to pay up to $5.21 per bushel for corn and still earn a return on their production.

What if there were no subsidies and ethanol is priced at its energy value? In that case the price of ethanol would have been $1.43 per gallon and the value of DDGS would have also been lower due to the boosting effects of the subsidy on corn prices. Assuming that DDGS prices would fall in proportion to corn, without the subsidies the value of corn to the ethanol producer would have been:

$P_{be,c}$ = ($1.43 +6.1*$0.04 - $0.4124 - $0.20) ÷ 0.357

$P_{be,c}$ = $2.95 per bushel

Given that the average price of corn from 2003 to 2005 was about $2.33 per bushel it is clear that corn-based ethanol would be a quite viable business today even with no subsidies. With the subsidies, and their distorting effect on ethanol profitability, the construction of new ethanol capacity is incredibly profitable, and plant construction is proceeding a very high rate.

As of the latest data from the Renewable Fuels Association there are 85 ethanol plants either under construction or in the process of being expanded, and these projects will about double U.S. ethanol production capacity. **The extremely high value of corn to ethanol producers relative historical averages explains the rush to build ethanol capacity over the past year.** This is true especially in light of the fact that in June, 2006, when many of the projects were in the planning stage, corn was selling for about $2.15 per bushel and had an ethanol value of about $5.00 per bushel.

Ethanol is one of the most profitable enterprises in the United States today, but the profits are driven by subsidies that allow ethanol producers to bid more for corn than other potential corn users, not by market forces. In a sense, ethanol is profitable in spite of subsidies, not because of subsidies. If the ethanol subsidies were to disappear, corn prices would drop, ethanol would still be profitable, and we would all benefit from lower costs of food and ethanol production.

In summary, the value of corn, inflated by subsidies, relative to other uses is the driving force behind ethanol plant construction and corn demand. The Federal subsidy has the effect of raising the value of corn to the ethanol plant by over $1.40 per bushel. The increase in ethanol production is itself driving up the price of corn,

and will continue to do so as long as the value of corn to an ethanol producer exceeds the market price of corn.

Federal Ethanol Subsidies are Not Needed for a Viable Ethanol Fuels Industry

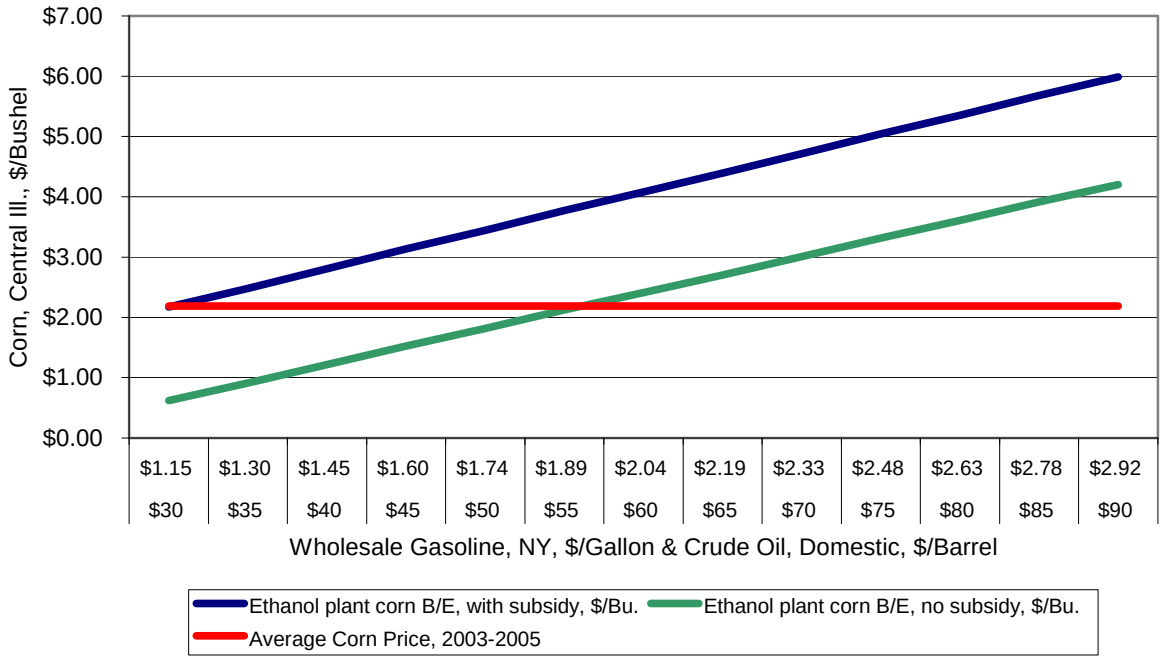
The ethanol industry of the 1990s needed subsidies to even exist. Wholesale gasoline prices of well under $1.00 per gallon, and ethanol plants that were not as efficient as those of today, made it impossible to make money producing fuel ethanol without subsidies. The dip in ethanol production in the mid 1990s was in spite of higher subsidies than there are today. But $75+ per barrel oil and $2.00+ per gallon wholesale gasoline have fundamentally changed the need for subsidies.

The ethanol-based value of corn without subsidies is well above the $2.33 average of corn prices over the last four years. It should be apparent from the numbers above that given current ethanol prices (which are a direct result if historically high crude oil and gasoline prices) ethanol producers can easily afford to compete with U.S. livestock and poultry producers for corn. Even without subsidies, ethanol production would be expanding at a significant rate due to high gasoline prices and the improvements in ethanol production technology in recent years.

In the chart below (Figure 2) the breakeven ethanol value of corn is calculated based on the energy value of ethanol, current ethanol production costs, current ethanol yields and the current relationship between corn prices and DDGS prices. The chart uses the historic relationship between crude oil and U.S. wholesale gasoline prices to relate the value of gasoline to the value of crude oil. At current crude oil and gasoline price levels coupled with the Federal subsidy the ethanol industry can afford to pay about twice the 2003-2005 average price of corn. As long as oil remains above $55 per barrel, and more importantly wholesale gasoline above about $1.90 per gallon, ethanol producers can pay more than 2003-2005 corn prices. If crude oil were to go to $90 per barrel corn would be affordable to ethanol producers at up to $6.00 per bushel, including the Federal subsidy.

This figure shows clearly that the case can be made that the subsidy for ethanol, if there is to be one at all, should be based on gasoline prices, not a flat amount per gallon of ethanol used for fuel. In fact, if oil prices go high enough the government should consider taxing ethanol used for fuel to alleviate the effects of ethanol demand on food prices. At $80 per barrel the U.S. food sector will find itself paying over $5.00 per bushel for corn. China, having seen what ethanol is doing to food costs, has banned further development of grain-based ethanol production.

Figure 2: Estimated Corn Breakeven for Ethanol Producers
With and Without Federal Subsidy of $0.51/Gallon



What is the Effect of the Ethanol Subsidy on Crop Prices and Food Costs?

In 2007 we are seeing the beginnings of the impact of the ethanol subsidy program on food and feed costs. In spite of near-record corn plantings in 2007, corn prices are also near-record high. The effects of the subsidy are not limited to corn. All but 4.1 million acres of the increased corn plantings came from soybeans, cotton, rice and other minor crops (Table 1).

Prices of these crops are now starting to increase too (Table 2) as are prices of products made from grains and soybeans (Table 3)[23]. If the ethanol subsidy continues, corn acreage will continue to expand, taking more acres from other crops and causing their prices to further increase, further increasing the cost of food production.

As can be seen in Table 1, in 2007 corn acres have expanded dramatically, and soybean acres have shrunk by almost as much. After rising in 2007, prices for all major crops except sorghum are forecast to rise in 2007, and these cost increases are showing up in the form of substantial price increases in products produced using these commodities.

[23] Forecast prices for 2007 are mid-points of USDA forecast ranges of 6-11-07

Table 1: 2006-2007 U.S. Planted Acreage, Major Crops (million acres)[24]

Crop	*2006*	*2007*	***Change***
Corn	78.3	92.9	14.6
Sorghum	6.5	7.8	1.3
Barley	3.5	4.0	0.5
Oats	4.2	3.9	-0.3
Soybeans	75.5	64.1	-11.4
Cotton	15.3	11.1	-4.2
Rice	2.8	2.7	-0.1
Wheat	57.3	60.5	3.2
Total	243.4	247.0	3.6

Cost Increases are Not Limited to Corn

As has been shown the Federal ethanol subsidy raises the breakeven corn price for ethanol plants by about $1.42 per bushel. If ethanol producers expand production until they bid corn prices up to their breakeven corn price point at today's gasoline price level it will take corn prices to near $4.75 per bushel, about double the average price of corn before the increase in gasoline prices. At the current 12-13 billion bushels of annual corn production that amounts to an increased corn cost for all U.S. users and our corn export customers of $17 billion per year. These costs are going up even as corn production increases. Included in those paying higher corn costs are ethanol producers themselves! **That is, the Federal subsidy program has the indirect effect of increasing the cost of ethanol production and food as well!**

Table 2: USDA Crop Price Estimates 2005-2007[25],[26]

Crop	**Units**	*2005*	*2006*	*2007*	***%06/05***	***%07/06***
Corn	$/Bu.	$2.00	$3.05	$3.40	53%	11%
Sorghum	$/Bu.	$1.86	$3.30	$3.00	77%	-9%
Barley	$/Bu.	$2.53	$2.88	$3.15	14%	9%
Oats	$/Bu.	$1.63	$1.85	$2.20	13%	19%
Soybeans	$/Bu.	$5.66	$6.30	$7.15	11%	13%
Cotton	$/Lb.	$0.48	$0.48	na	0%	na
Rice	$/Bu.	$3.44	$4.39	$4.61	27%	5%
Wheat	$/Bu.	$3.42	$4.27	$4.80	25%	12%

[24] USDA. Acreage. 6-29-07
[25] Source for Tables 2-3: USDA. World Agricultural Supply and Demand Estimates. 9-12-07
[26] USDA does not forecast cotton prices

Table 3: USDA Livestock, Poultry and Milk Price Estimates 2005-2007

Item	**Units**	*2005*	*2006*	*2007*	***%06/05***	***%07/06***
Fed Steers	$/cwt	$87.28	$85.41	$91.00	-2%	7%
Hogs	$/cwt	$50.05	$47.26	$50.00	-6%	6%
Broilers	¢/lb	70.80¢	64.40¢	77.50¢	-9%	20%
Turkeys	¢/lb	73.40¢	71.80¢	78.50¢	-2%	9%
Eggs	$/doz	$0.66	$0.72	$0.94	10%	30%
Milk	$/cwt	$15.14	$12.90	$18.75	-15%	45%

But this is only the beginning of the effects. As increased corn acreage further reduces acreage of soybeans and other crops, their prices will also further increase, further raising costs throughout the food system. Table 4 below contains estimates of the long range impacts of the Federal ethanol subsidy on the costs of grains and cotton at today's gasoline prices and ethanol production costs[27].

Table 4: Estimated Annual Impact of the Federal Ethanol Subsidy on Grain, Soybean and Cotton Costs, 100% E10 Market Share

Crop	Price Units	*Price Effect*	*Production Units*	*Production*	***Cost, $ Bill.***
Corn	$/Bu.	$1.42	Billion Bushels	17.0	$24.14
Sorghum	$/Bu.	$1.42	Billion Bushels	0.4	$0.57
Barley	$/Bu.	$1.00	Billion Bushels	0.2	$0.20
Oats	$/Bu.	$0.75	Billion Bushels	0.1	$0.08
Soybeans	$/Bu.	$2.50	Billion Bushels	1.8	$4.50
Cotton	$/Lb.	$0.15	Billion Lbs.	6.5	$0.98
Rice	$/Bu.	$0.75	Billion Bushels	0.3	$0.23
Wheat	$/Bu.	$1.50	Billion Bushels	2.2	$3.30
Total					$33.98

We are already seeing effects of the cost increases on consumer food prices outside of those caused by corn. On June 6, 2007 General Mills, citing higher grain prices, announced that they were raising prices of all boxed cereals by about 4%, and reducing box sizes[28]. Other cereal producers are also raising prices by the same amount. The effects of increased raw materials costs on food prices will be pervasive throughout the U.S. food system.

The total cost of just the grain price increases alone is about $115 per person per year, or $460 for a family of four.

Given that the ethanol industry will soon have the capacity to produce 12.5 billion gallons per year the annual corn requirement will increase to about 4.5 billion bushels per year. With the expansion the industry will be able to meet only 86% of potential

[27] Source: Estimates of FarmEcon.com based on historical price relationships with corn and acreage.
[28] Bloomberg News, 6-06-07

E10 demand and 0% of the potential E85 demand. To replace 10% of current gasoline use the ethanol industry will require over 50 million acres of corn every year and total corn acres will need to be over 120 million. Until 2007 total corn acres rarely exceeded 80 million acres. Clearly, corn could further displace other crops, reducing their supply and raising their prices.

Looked at from a different perspective, if the ethanol industry is successful in achieving only 10% replacement of gasoline it would take almost 200 millions tons of corn annually. ***This is equal to about a 9-10% reduction in the GLOBAL grain supply***. Such a reduction grain supply will have major impacts on global food costs and availability.

Who Benefits From the Federal Ethanol Subsidy?

The higher prices of corn and other crops that are the result of the Federal ethanol subsidy program obviously benefit the producers of those crops. In 2007 the cash receipts from corn production alone will increase by about $17 billion compared to 2005. However, the higher prices are leading to increasing costs of fertilizer, seed, land prices and rental rates for Midwestern farmland[29].

In the long run, farm inputs, agricultural land prices and rents will increase to the point where the cost of corn production will consume all of the increased revenues. The same goes for other crops. The only long run beneficiaries will be current land owners who will see the value of the subsidy capitalized into the value of their farmland.

Even ethanol producers will not benefit from the subsidy program in the long run. As long as ethanol production is profitable they will continue to build new production capacity. They will build new plants and expand existing ones until they bid up the corn price, or depress the ethanol price, by enough to make their excess profits disappear.

Who Pays for the Subsidy Program?

The simple answer is that we all pay. Food consumers and ethanol consumers all pay higher prices at the grocery store and the gas pump due to the effects of the subsidies on commodity prices. We will see more price increases in the years ahead as corn acres increase further and the ethanol industry uses up more and more of our limited farmland to produce energy.

How Much Does Ethanol Really Cost Us?

Ethanol prices at the pump do not reflect the total cost of production, including the side effects of Federal subsidies on food costs. In 2007 we will produce about 7 billion gallons of ethanol at an average cost, including the Federal subsidy, of about $2.00 per gallon, or $14 billion. In addition, the subsidy will raise the cost of corn to

[29] http://www.card.iastate.edu/iowa_ag_review/spring_07/article3.aspx

ethanol producers and the food system (ignoring price effects on other crops) by about $17 billion. **In total, the costs of ethanol paid by taxpayers, fuel purchasers and the food system is about $31 billion in 2007, or about $4.40 per gallon of ethanol produced. Corrected for the energy content of ethanol relative to gasoline, this is equivalent to a wholesale gasoline price of $6.67 per gallon. Ethanol is not a cheap source of energy, it is about 3 times as expensive as gasoline. Considering that the effects of the U.S. ethanol program on grain prices are global, this estimate is extremely conservative.**

How Much Does Ethanol Contribute to Net Energy Supplies?

This is a hotly debated question. Estimates of the energy gain from turning corn into ethanol range from a net loss to a 50% gain. The central issue is the question of how much fossil fuel energy is required to produce ethanol, and where does that energy originate.

Large amounts of fossil fuel energy are used to produce ethanol on the farm, in transportation, and in the ethanol plants themselves. According to a recent USDA study[30] each unit of fossil energy used to produce ethanol produces a net increase of 0.34 units of energy output. The net gain comes from solar energy used by the corn plant to produce the raw materials for ethanol production.

Using this ratio of output to input, it takes about 66% of the gross energy production of ethanol plants to produce and distribute the ethanol product. The 2007 production level of 7 billion gallons of ethanol costs the energy equivalent of 4.6 billion gallons of the ethanol produced, leaving a net gain of only 2.4 billion gallons. On a gasoline energy basis this is 1.6 billion gallons of regular gasoline, or about 1.1% of current U.S. gasoline consumption.

To replace 10% of U.S. gasoline about 21.3 billion gallons of ethanol are needed. The net energy gain would be about 7.2 billion gallons of ethanol, equal to the energy of 4.8 billion gallons of gasoline. At today's gasoline consumption level that is a net gain of 3.4% of net energy from gasoline. Converting the gasoline to crude oil, the net gain is about 115 million barrels of oil per year, or about 2.5% of our current crude oil imports, 1.5% of our current crude oil consumption, and about 0.4% of global crude oil consumption.

In other words, on a net energy basis ethanol will not make a significant contribution to overall energy production, even if we stretch U.S. agricultural resources and increase food costs significantly by replacing 10% of the U.S. gasoline supply with ethanol.

[30] Hosein Shapouri, James A. Duffield, and Michael Wang. The Energy Balance of Corn Ethanol: An Update. U.S. Department of Agriculture, Office of the Chief Economist, Office of Energy Policy and New Uses. Agricultural Economic Report No. 813.

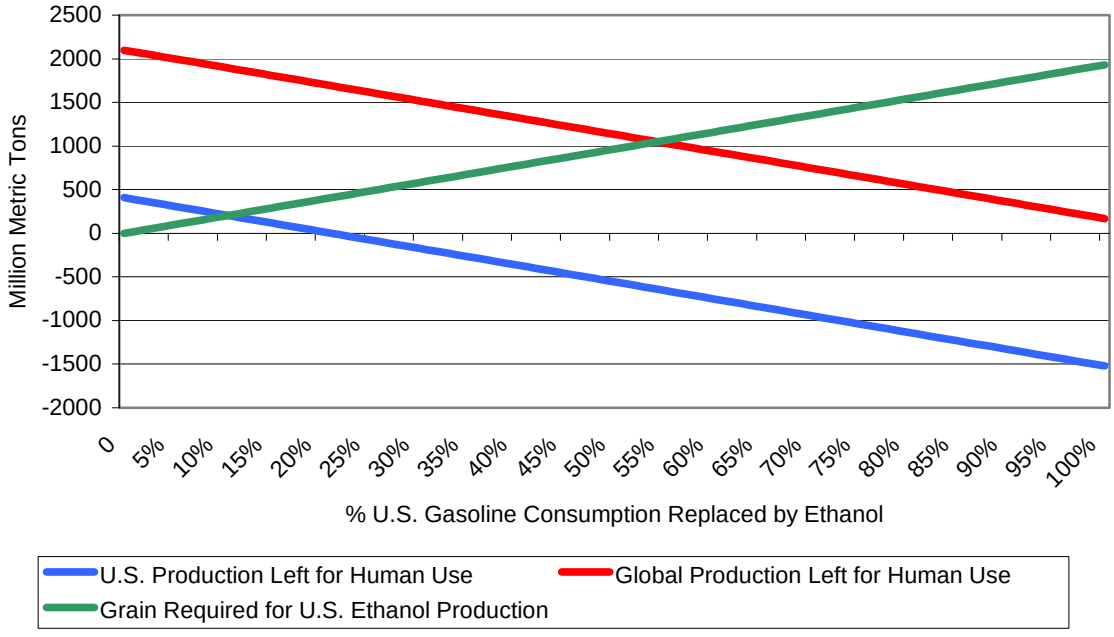
How Much of Our Food Does Ethanol Use

Given the small net amount of energy produced the effects of U.S. ethanol production on U.S. and global grain markets is incredibly large. If ethanol were to replace 21% of current U.S. gasoline use it would use 100% of the 2007 U.S. grain crop and 19% of the global grain crop.

The chart below shows how much of the 2007 global and U.S. grain crop would be left for food consumption as ethanol use in the U.S. expands from 0% to 100% of gasoline replacement.

Encouraged by high subsidies, the production of ethanol for U.S. fuel use is already having an influence on the amount of grain left for human food use in the U.S. and globally. Even at only 7 billion gallons per year in 2007 we have reduced global food availability enough to impact food prices around the world. If the 2009 ethanol production forecast of the Renewable Fuels Association comes to fruition we will reduce the amount of grain available on the global market by about 4% and on the U.S. market by about 19%. To replace 10% of the gasoline supply in the U.S. we would use 1 ton out of every 10 of the 2007 global grain supply and nearly 50% of the 2007 U.S. grain crop for ethanol production. Increased ethanol production in the U.S. will have negative effects on grain supplies available for food use, grain prices and global nutrition.

Figure 3: 2007 Grain Global Grain Production Available for Food Use as Ethanol Replaces U.S. Gasoline Consumption



Why is the effect so large? Grain is an incredibly efficient human food source, but very inefficient fuel source.

Do Ethanol Subsidies Insulate Us from the Global Oil Market?

To the extent that ethanol is produced in the U.S. and well over half of our oil is imported it could be argued that ethanol is a smart move that helps reduce the power of unfriendly foreign countries on the U.S. economy. In fact, nothing could be further from the truth.

The economics of corn-based ethanol may, in a very small way, reduce our demand for imported oil. However, the tradeoff is that in addition to influencing our transportation costs, we now see food costs heavily affected by those who can influence crude oil prices. If Mideast producers see fit to reduce oil production to drive oil prices higher, not only will our gasoline prices increase, but our food costs will soar as well.

The effect of ethanol subsidies is to substantially increase, not reduce, the exposure of the overall U.S. economy to oil market disruptions.

Summary

Created at a time when the ethanol industry was not profitable, changing circumstances have rendered the current fixed payment Federal ethanol subsidy program obsolete. Increased energy prices make it possible for the ethanol industry to thrive on its own, even without subsidies. The influence of the subsidy program has shifted from making ethanol feasible to causing significant increases in grain prices, distorting farmer planting incentives, and causing the cost of producing the U.S. food supply to increase.

The subsidy program is not only causing negative side effects on food costs, but also is not making a material contribution to U.S. net energy supplies or energy cost independence of the U.S. economy. The effects are not limited to the U.S. As ethanol production expands in the U.S. the industry here is beginning to have a significant effect on global grain prices and food costs. If the U.S. 10% gasoline replacement almost 10% of the **WORLD'S** current grain supply will be utilized to add (on a net energy basis) about 3.4% to **U.S.** gasoline output and offset 1.5% of our crude oil consumption.

The current Federal ethanol subsidy program does not reflect realities of current energy and food markets. China has seen this reality and taken action. Elimination of the Federal subsidy, or placing it on a sliding scale based on gasoline prices, would reduce the effects of ethanol on energy and food costs. However, even if the Federal subsidy were to be completely eliminated, current energy prices are high enough to link gasoline and food prices.

If wholesale gasoline prices increase significantly from today's levels U.S. food costs and food availability WILL be severely compromised by further increased use of grain for fuel production. This is true even if the Federal subsidy were to be scaled back or eliminated. In the future, even with today's gasoline prices, we, like China, may also find it advisable to tax or otherwise regulate the use of grain for ethanol production.