DRAFT NOT FOR QUOTATION

PAPER PRESENTED AT THE

MISSOURI VALLEY ECONOMIC ASSOCIATION MEETING

ST. LOUIS, MO.

FEBRUARY 24-26, 2000

THE POLITICAL ECONOMY OF ETHANOL

BY

RALPH J. BROWN
PROFESSOR OF ECONOMICS
UNIVERSITY OF SOUTH DAKOTA
VERMILLION, SD 57069
RBROWN@USD.EDU

THE POLITICAL ECONOMY OF ETHANOL

By

Ralph J. Brown*

1. INTRODUCTION

A debate over ethanol subsidies has raged since the subsidy program began in the late 1970s. Both federal and state governments have designed programs to encourage the use of ethanol in gasoline. These incentives have included motor fuel tax exemptions as well as direct subsidies to the producers of ethanol. In 1998, the Federal government the gasoline tax exemption subsidies were almost one billion dollars. State government ethanol subsidies are in the hundreds of million dollars. The question remains: Why should the taxpayer subsidize the production and consumption of ethanol? This is a legitimate question. Are ethanol subsidies just another example of special-interest pleading or is there an overwhelming public interest served by these subsidies?

A variety of arguments have been offered to justify the subsidy. In the late 1970s, the energy crisis and the call for "energy independence" formed the basis for the development of a renewable energy source. The "farm crisis" provided arguments for the use of corn-based ethanol since it would provide a new market for corn. A corollary of the farm economy argument is that ethanol plants would provide a source of new jobs in rural areas. Environmental concerns, particularly concerning clean air, have also been used as arguments for ethanol development. The continuing trade deficit and the net importation of oil from politically volatile areas such as the Mideast have been also used as arguments for the development of our own renewal energy source.

* Professor of Economics, University of South Dakota, Vermillion, SD 57069.

Corn-based ethanol is produced by milling corn either by a dry-milling or wet-milling process. Wet mills account for about 60 percent of all ethanol production in the U.S. Dry mills produce approximately 2.6 gallons of ethanol per bushel of corn and coproducts of distillers' dried grains. Wet mills produce approximately 2.5 gallons of ethanol per bushel of corn and coproducts of corn oil, corn gluten products, and carbon dioxide. The energy value of one gallon of ethanol is 76,000 Btu (British thermal units). Ethanol is typically used as a gasoline extender by blending one part ethanol with nine parts gasoline to produce gasohol. It has also played a minor role as an octane-enhancer. Ethanol contains about two-thirds of the energy of gasoline resulting in about a 3.3 percent reduction fuel economy for the 10/90 percent blend.[1]

Since the 1990 Clean Air Act Amendments (CAAA), it has also taken on a role as a clean-air additive. In certain metropolitan areas, the CAAA mandated oxygenated gasoline to lower carbon monoxide emission levels during the winter months. In addition, the CAAA implemented in 1995 requires the use of oxygenated fuels as part of the reformulated gasoline program to control ground level ozone formation in the 9 worst ground-level ozone areas. Oxygenated gasoline can be produced using methyl tertiary butyl ether (MTBE) which is a methanol derivative supplied primarily from natural gas. In this process 15 percent MTBE is mixed with gasoline to produce gasoline with a 2.7 percent oxygen level. Recently, the use of MTBE has come under attack because of ground water contamination concerns. The states of California and Maine have both banned the use of MTBE by the year 2002 and other states are studying the issue. The only other alternative to the use of MTBE as an oxygenate is ethanol. Ethanol based oxygenated gasoline is produced by

[1] Office of Energy, "Fuel Ethanol and Agriculture: An Economic Assessment," U.S. Department of Agriculture, *Agricultural Economic Report* No. 562, August 1986, p. 4.

splash blending 7.7 percent ethanol with gasoline to produce the 2.7 percent oxygenated gasoline. One logistical hurdle with the widespread use of ethanol as an oxygenating agent is that most of the production of corn and ethanol takes place in the Midwest and the greatest use of oxygenated fuels is in the large metropolitan areas on the east and west coasts. Because ethanol is susceptible to water contamination it can not be blended at the refinery and shipped by pipeline. This requires shipment by truck or rail and then blending at the location of use. More recently, California has asked the Environmental Protection Agency for an exemption from federal laws requiring the use of oxygenates to meet clean air standards.[2]

With these recent changes in the CAAA the primary role of ethanol is changing from that of a gasoline substitute and octane-enhancer to that of a clean-air additive. Currently, ethanol-blended fuels account for about 12 percent of fuel sales in the U.S. In 1998, ethanol production was approximately 1.774 billion gallons and accounted for 0.011 percent of total energy use in 1998.

It is the purpose of this article to review the history of the ethanol debate and evaluate some of the economic arguments for and against the subsidy. This paper is organized as follows: Part 2 provides a short history of ethanol subsidy programs; Parts 3 and 4 examine the arguments for and against the ethanol subsidy; Part 5 presents an economic analysis of the subsidy; and Part 6 summarizes and concludes the paper.

[2] Ellen Ferguson, "California Request Could Squelch Ethanol Need," *Argus Leader*, February 14, 2000. P. D1.
.

2. A SHORT HISTORY OF ETHANOL SUBSIDIES

Ethanol has been used as a vehicle fuel for more than 100 years. However, it did not receive attention from policymakers until after the first oil crisis of the mid-1970s. In 1978, Congress enacted a fuel excise tax exemption of 4 cents per gallon, which, at the time, was the full federal gasoline tax for gasohol (10 percent ethanol and 90 percent gasoline). As the federal gasoline has increased over time to 18.3 cents per gallon of gasoline the exemption was increased to 5.4 cents per gallon.[3] While the 5.4 cents per gallon applies to the ethanol/gasoline blends which are 10 percent ethanol; the lower ethanol blends such as the 7.7 percent and 5.7 percent blends receive a proportionately lower exemption. Since the 10 percent ethanol 90 percent gasoline blend receives a full 5.4 cents per gallon gasoline tax exemption the exemption per gallon of ethanol is 54 cents. In 1998, Congress voted to extend the federal fuel tax exemption until 2008. However, the tax incentive will be reduced to 5.3 cents in 2001, to 5.2 cents in 2004 and 5.1 cents in 2005.

At least 30 states have established some additional incentives to encourage the use or production of alcohol. State ethanol subsidies have taken two forms. One is an exemption from gasoline taxes when the product is an ethanol blend. The second form of subsidy is a direct subsidy to producer of ethanol. A number of Midwestern states have provided exemptions from the state gasoline tax for gasohol. South Dakota provides a 2 cents per gallon gasoline tax exemption for gasohol. The gasoline tax exemption for gasohol is 1 cent per gallon in Iowa and 5 cents per gallon in Minnesota. This exemption is often called a blender's credit in that it is administrated at the wholesale level where ethanol is splash blended with gasoline to produce gasohol. Thereby, the wholesale price with

[3] Actually the ethanol gasoline tax exemption was raised to 6 cents per gallon in 1987 and then lowered back to 5.4 cents per gallon in 1990.

taxes of gasohol is lower as a result of the blender's credit. As in the case of the federal exemption, the effective subsidy per gallon of ethanol is 20 cents per gallon for the 2 cents per gallon gasoline tax exemption and 50 cents per gallon for the 5 cents per gallon gasoline tax exemption.

In addition to the gasoline tax exemption, some states also provide subsidies to ethanol producers in the form of direct subsidies and low-interest loans. Minnesota, Nebraska, and South Dakota provides direct subsidies of 20 cents per gallon of ethanol to in-state producers.[4] North Dakota provides the most generous producer subsidy at 40 cents per gallon direct subsidy. In addition to direct subsidies, some state provide low-interest guaranteed loans and mandate the use of ethanol in government vehicles. Minnesota mandates the statewide use of the ethanol-based 2.7 percent oxygenated fuel (7.7 percent ethanol) year-round. Table 1 presents a summary of ethanol subsidies in Midwestern states.

Table 1: State Ethanol Programs

STATE	Federal Mandate	State Mandate	Producer Subsidy	Blender's Credit	Subsidized Loans
Minnesota	Ozone-No CO-Yes	OXY	$0.20/gal ethanol	$0.05/gal gasohol	Yes
Illinois	Ozone-Yes CO-No	Government Vehicles	No No	No No	No No
Indiana	Ozone-Yes CO-No	No	No	No	No
Iowa	Ozone-No CO-No	Government Vehicles	No No	$0.01/gal	Yes
Nebraska	Ozone-No CO-No	Government Vehicles	$0.20/gal ethanol	No No	No No
North Dakota	Ozone-No	No	$0.40/gal	No	No

[4] Some states have maximum producer subsidy and time period limitations. For instance, South Dakota limits the direct producer subsidy per producer to $1 million per year and for a maximum of ten years.

	CO-No		ethanol		
South Dakota	Ozone-No	Government	$0.20/gal	$0.20/gal	No
	CO-No	Vehicles	ethanol	gasohol	
Wisconsin	Ozone-Yes	Government	No	No	No
	CO-No	Vehicles			

As shown in Table 1, the magnitude of the ethanol subsidy varies from state to state. The most generous state in terms of ethanol subsidies is the state of Minnesota. In Minnesota, ethanol is subsidized at the rate of 20 cents per gallon (producer subsidy) and 50 cents per gallon (blender's credit) plus the value of low-interest loan and mandated use of the oxygenated gasoline statewide and year-round. If one includes the federal subsidy of 54 cents per gallon the total subsidy (not including the value of the subsidized loans and mandate) is $1.24 per gallon. The state subsidy in North Dakota and South Dakota amounts to 40 cents per gallon of ethanol and if the federal subsidy is included the per gallon subsidy is 94 cents per gallon. Nebraska subsidizes ethanol at the rate of 20 cents per gallon and Iowa at the rate of 10 cents per gallon. Including the federal subsidy adds 54 cents per gallon to these figures.

Table 2: Ethanol Subsidies by State

STATE	State Fuel Tax Exemption	Producer Subsidy	Federal Fuel Tax Exemption	Total Subsidy Per Gal Ethanol*
Minnesota	$0.50	$0.20	$0.54	$1.24
Iowa	$0.10	-	$0.54	$0.64
North Dakota	-	$0.40	$0.54	$0.94
Nebraska	-	$0.20	$0.54	$0.74
South Dakota	$0.20	$0.20	$0.54	$0.94

*Does not include the value of loan subsidies and mandated use of ethanol products.

The intent of the various subsidy programs is to promote the use of ethanol by making gasohol competitive with gasoline. The price of ethanol at the retail pump is determined by the wholesale price of gasoline, the wholesale price of ethanol, the blender's credit (federal and State gasoline tax exemption), and wholesaler and retailer margins. In this example, the data is taken for southeast South Dakota in November of 1999. The wholesale price of unleaded gasoline without taxes was $0.718 per gallon and the wholesale price of gasohol without the tax was $0.757 per gallon.[5] In other words, the wholesale price of gasohol without taxes was $0.039 per gallon higher than unleaded gasoline. Since we do not have the actual price of ethanol we do not know if there are different wholesale margins on ethanol and unleaded gasoline. To get the wholesale prices of unleaded gasoline and gasohol we need to add the Federal and state taxes applicable to each. The wholesale price with taxes of unleaded gasoline and gasohol is $1.142 and

[5] It is interesting to note that the value of the ethanol subsidy in several states exceeds the value of gasoline.

$1.107, respectively. In other words, the spread is reversed with the wholesale price of unleaded gasoline $0.035 higher than the price of gasohol. This occurs because of the different taxes applied to unleaded gasoline and gasohol. In this case, ethanol is over-subsidized in the state of South Dakota.[6] Hence the subsidy more than equalizes the price of unleaded gasoline and gasohol, actually pushing the price of gasohol below the price of unleaded gasoline. It is interesting to note that a rough survey of the local (Vermillion and Sioux Falls, SD) retail prices of unleaded gasoline and gasohol showed that gasohol either sold at the same price or one cent below the price of unleaded gasoline. Obviously, the retailer margin is higher on gasohol than on unleaded gasoline.

Table 3: Price of Unleaded and Gasohol and Taxes

Type	Wholesale Price (no taxes)	Federal Tax	State Tax	Tank Inspection Fee*	Wholesale Price (taxes)
Unleaded	$0.718	$0.184	$0.22	$0.02	$1.142
Gasohol	$0.757	$0.130	$0.20	$0.02	$1.107

*In South Dakota the tank inspection fee is used to fund the direct subsidy to ethanol producers.

3. ARGUMENTS FOR THE SUBSIDY

The value of these subsidies are substantial. The annual cost of the ethanol subsidies are in excess of one billion dollars per year. Since these are costs that the taxpayer must pay in the form of higher taxes or higher prices it is a legitimate question to ask whether the benefits of these subsidies are greater than their costs. As expected, supporters of the ethanol subsidies argue that they are well worth the cost and even higher subsidies would pay for themselves.

[6] See K.N. Rask, "Clean Air and Renewable Fuels: The market for Fuel Ethanol in the US From 1984 to 1984,"

The benefits of the ethanol subsidies fall into the following categories:

1. higher corn prices,
2. new jobs and increased income created by ethanol producers,
3. environmental benefits in the form of cleaner air,
4. increased security from interruptions in petroleum supplies,
5. improvements in the balance of trade by increased energy independence,
6. federal budget savings through a reduction in farm subsidies.

Higher Corn Prices

One of the major arguments for the development of renewable fuels such as corn-based ethanol is that it would create new markets for agricultural commodities, particularly corn. This new demand would raise the price of corn thereby benefiting U.S. corn producers. Because other feed grains and wheat can be substituted for corn in some uses higher corn prices could also lead to higher prices for these commodities. In communities where ethanol plants are located it would provide a steady market for corn and increase the local price by reducing the basis (difference between the terminal price and local price) by reducing the need to ship corn to the market.

A 1990 study by the Wharton Econometric Forecasting Association model of U.S. Agriculture performed for the U.S. General Accounting Office (GAO)[7] estimated that if annual ethanol production were doubled from 2.2 billion gallons, corn prices would increase by 19 cents per bushel (9 percent) and that if production were tripled the price increases would be 32 cents per bushel (15 percent). They also projected that other feedgrain (such

---

Energy Economics 20 (1998) 339 for a discussion of oversubsidization..

[7] U.S. General Accounting Office, Report to the Chairman, Subcommittee on Energy and Power, Committee on Energy and Commerce, House of Representatives. "Alcohol Fuels Impacts From Increased Use of Ethanol Blended Fuels." GAO/RCED-90-156, July, 1990.

as sorghum) prices would increase by about 2 cents per bushel and that higher corn prices would increase corn production about 4.2 million acres. The higher corn prices would negatively affect livestock producers by increasing feed costs and reduce foreign exports. The GAO study also found that soybean producers and processors would be negatively affected through a lower price of soybeans because of the increased supply of corn by-products that compete with soybean meal and oil. The low growth scenario predicted a drop in soybean prices of 35 cents per bushel (6 percent) and the high-growth scenario predicted a decrease of 66 cents per bushel. They also predicted a drop in soybean acreage of approximately 1.4 million bushels.

A 1993 study by the U.S. Department of Agriculture, Economic Research Service[8] showed similar but much less pronounced effects than did the GAO study. They projected the impacts assuming a 2 billion gallon increase and a 5 billion gallon increase. Under the 2 billion gallon increase scenario, they predicted corn price increases of 1 cent per bushel and increase corn production of 3.4 percent. Under the 5 billion gallon increase scenario, they predicted corn price increases of 19 cents per bushel and increased corn acreage of 12 percent. Soybean prices would fall 6 cents per bushel and production by 1 percent under the low-growth scenario and prices would fall 31 cents per bushel and production would decrease by 5.5 percent under the high-growth scenario.

Another study prepared by Michael K. Evans for the Midwestern Governor's Conference[9] found that 1997 demand for ethanol is 1.52 billion gallons or 0.60 billion bushels of corn which increases the price of corn 45 cents per bushel. He concludes that

[8] Petrulis, M., Sommer, J., and Hines, F. "Ethanol Production and Employment." Agricultural Information Bulletin Number 678.
[9] Michael k. Evans, "The Economic Impact of the Demand for Ethanol," Prepared for the Midwestern Governor's Conference, February 1997.

since corn and soybeans are substitutes higher corn prices will mean higher soybean prices and while more protein-rich feed and corn oil will compete with similar soybean products the net effect on soybean prices is probably zero.

A subsidiary argument of the corn price argument is the impact of higher corn prices on federal government farm subsidies. The USDA Economic Research Study (1990), the GAO study (1993), and the Evans study (1997) all conclude that under the old farm program a rise in corn prices would reduce Federal farm program expenditures by reducing deficiency payments. This argument relates to the old farm program not the new Freedom to Farm legislation that eliminates price support programs for most crops, corn included, by 2002. Under the 1995 Freedom to Farm program the farm program will change in such a way that higher corn prices will not affect deficiency payments.

Employment Impact

The potential for new jobs because of the ethanol subsidies has also been listed as one the benefits. It is argued that higher farm incomes will generate additional spending, particularly in rural areas, thereby creating more jobs and income. In addition, the construction and operation of ethanol plants will obviously generate jobs and income in the areas where these are located. Since the industry is fairly capital intensive direct job creation is modest but the types of jobs created are better than average in terms of pay.

The 1993 USDA study concluded that increasing ethanol production by 2 billion gallons would create 28,000 new jobs of which 15,000 would be in farm or farm-related activities. A study by the National Corn Growers Association (NCGA) projects that currently projected ethanol growth by 2000 will create 273 thousand jobs nationwide. The Evans study includes that current ethanol production creates 13,300 jobs nationwide (based 1.52

billion gallons). These estimates appear more in line with the USDA study than the NCGA study.

Environmental Impacts

Ethanol-based fuels have been touted as an environmentally friendly renewable energy source. Ethanol-blended gasoline increases the oxygen content of the fuel permitting the more complete combustion of the hydrocarbons which helps to alleviate air pollution problems due to carbon monoxide emissions. Because ethanol is low in reactivity and high in oxygen content it reduces ozone-forming volatile organic compounds (VOC). Environmental concerns about the use of petroleum based fuels has led the CAAA to mandate the use of cleaner burning fuels (oxygenated) in carbon monoxide non-attainment areas (selected metropolitan areas) in the winter months. Ethanol supporters argue that the use of ethanol-based oxygenates (ETBE) would bring environmental benefits without the harmful side-effects of MTBEs. Finally, since ethanol is produced from renewable agricultural commodities it reduces greenhouse gas emissions.

Strategic Value of Ethanol

Because the U.S. is a large petroleum importer it is subject to national security risks due to possible interruptions in supply. In 1998, the U.S imported approximately 55 percent of our petroleum consumption and almost one-half of these imports come from members of the Organization of Petroleum Exporting Countries (OPEC). Supply interruptions and large price increases in 1973-74 and 1979-80 are still fresh in the minds of many Americans. The basic argument here is that greater use of ethanol-based fuels would reduce our dependence on uncertain foreign imports of petroleum.

Improvement of Our Trade Balance

A related benefit of greater use of renewable domestic energy sources is that it would improve our trade balance. The basic argument here is that trade deficits are undesirable and their reduction brings positive benefits to the U.S trade balance.

4. ARGUMENTS AGAINST THE SUBSIDY

Those who argue against the ethanol subsidy view it as another form of special interest legislation that exploits the taxpayer for the benefit of farmers and ethanol producers. They argue that there is little or no merit to the arguments put forth by the subsidy supporters. They can argue on principle that there is no compelling reason why the taxpayer should subsidize private business, be it large or small, or agricultural or nonagricultural. Others can take a more utilitarian approach which does not necessarily object to the principle of government subsidies to private sector if it can be shown that the benefits of the subsidies exceed the cost. Those opponents who are in this camp argue that the benefits of the ethanol subsidy program are not worth their cost.

Higher Corn Prices

Ethanol subsidies will undoubtedly increase the production of ethanol thereby raising the demand for corn and raising corn prices. Higher corn prices are beneficial to corn producers but they mean higher costs for the users of corn, livestock producers and consumers. In this case, the gain realized by corn producers is a loss to the users of corn and there is no net benefits. In fact, there is a net welfare loss as higher corn prices due to artificial increases in demand (due to the ethanol subsidies) draw more resources into the production of corn than is optimal.

Employment Impact

The employment impacts of increased ethanol production are an illusion. In a full employment economy more employment in one sector of the economy must come from attracting resources out of other areas of the economy. For there to be a net positive employment impact it must assumed that there are group of people who are unemployed and now because of the increased production of ethanol or corn they find jobs that if not available they would be unemployed. One of the basic arguments of the proponents of ethanol subsidies is that they will spur developments in otherwise depressed rural areas thereby increasing employment. Since labor resources are not perfectly mobile this argument might have some merit. The problem is that to the extent that ethanol plants would use more educated and trained workers the immobility argument is less compelling. If the production of ethanol does create net new jobs the number would have to be quite modest. It is interesting that the studies of the employment effects of ethanol subsidies use a partial equilibrium approach basically ignore the larger macroeconomic effects of job creation. For instance, there is no mention of the jobs lost in the highway construction and maintenance area due to less tax revenue. Likewise, the loss of jobs in the areas that face higher corn prices is not considered. By using a partial equilibrium analysis the employment effects of ethanol subsidies are grossly overstated.

Environmental Impacts

The environmental benefits of ethanol development arise because it is a cleaner burning renewable energy source. This analysis is probably correct. However, ethanol-based fuels have there own set of problems. Because of the increased volatility of ethanol-blended fuels they raise levels of nitrogen oxide and evaporative hydrocarbon emissions

which are the major ingredients in acid rain and smog. Also, because ethanol-based fuels evaporate more quickly contributing than gasoline they may contribute to engine problems associated with vapor lock. It seems that the scientific judgements on the environmental merits of ethanol are still in dispute.

Strategic Value of Ethanol Subsidies

Supporters of ethanol argue that our current reliance on the petroleum imports from politically volatile areas such as the Mideast places the U.S. at risk. This is certainly true. The question is whether ethanol could ever become a large enough share of our energy sources to make a significant difference. Currently, ethanol accounts for about 1/10 of 1 percent of our energy sources and even a hundred-fold increase in ethanol use would not insulate us from dependencies on foreign oil. On can ask if whether our military expenditures are one dollar less as a result of ethanol subsidies. It is very doubltful.

Improvement of Our Trade Balance

This argument is without merit. The trade balance is determined by a country's saving-investment balance not by the trade balance on any single commodity. If we were to reduce our imports of petroleum this would reduce the supply of dollars in foreign exchange markets causing a rise in the value of the dollar reducing exports and increasing imports in some other goods or services leaving the trade balance unchanged.

In sum the arguments in favor of ethanol subsidies appear to be without merit. Increases in the price of corn as a result of the subsidy only transfer money from one group to another with no gain. In fact, to the extent that more of society's scarce resources are devoted to the production corn in excess of what would be the case without the subsidy represents a net welfare loss. Any net gain in jobs is doubtful in a general equilibrium

sense. While there may be some environmental benefits they appear to be quite small. The strategic value of ethanol production is a myth and the idea that the trade balance would be affected by the ethanol subsidies is wrong-headed.

5. SIMPLE ECONOMIC ANALYSIS OF ETHANOL SUBSIDIES

In this section a simple but instructive model of the ethanol subsidy will be developed in an attempt to determine a rough idea of the welfare effects of the ethanol subsidy. The model is based on data for the state of South Dakota for which the author has detailed data on production, consumption, and both federal and state subsidies. The model should be generally applicable to other states.

In 1998, 17.9 million gallons of ethanol was consumed and 15.4 million gallons were produced in South Dakota ethanol plants. Based on the $0.20 per gallon of ethanol state subsidy, the gasoline tax exemption amounted to was a state gasoline tax revenue loss of $3.58 million. The federal subsidy of 54 cents per gallon of ethanol resulted in another $9.67 million loss of federal gasoline tax revenue. The 1998 producer subsidy to South Dakota ethanol producers amounted to $1.91 million based on production of 15.4 million gallons.[10] The 1998 ethanol subsidy amounted to $0.85 per gallon of ethanol consumed in South Dakota and $0.98 per gallon of ethanol produced in South Dakota.

1998 South Dakota Ethanol Subsidies

Subsidy Program	Ethanol Consumed	Subsidy
State Gasoline Tax Exemption	17.9 million gallons	$ 3.58 million

Federal Gasoline Tax Exemption	17.9 million gallons	$ 9.67 million
Producer Subsidy (SD producers)	9.5 million gallons	$ 1.91 million
	Total	$15.16 million
	Subsidy (consumption)	$0.85 per gallon
	Subsidy (SD production)	$0.98 per gallon

The model developed here does not require estimates of demand or supply elasticities for ethanol. The demand for ethanol is assumed to be a normal downward-sloping linear demand curve.[11] See Figure 1 for a graphical depiction of the model. The actual 1998 consumption of ethanol is 17.9 million gallons and the ethanol subsidy is $0.85 per gallon. The supply curve is assumed to be horizontal and crosses the price axis at the point where demand is zero, PWOS. In other words, it assumed that if ethanol were sold at its true cost (opportunity cost) the amount demanded would be zero. This was certainly the case before the subsidy program for ethanol began in the 1970s. That is, before the federal tax gasoline tax exemption for ethanol began in 1978 there was no use of ethanol as a motor fuel on a commercial basis. The price after the subsidy is PWS and the price without the subsidy is PWOS. The difference between the price without the subsidy and the price with the subsidy is $0.85 per gallon. The supply curve is horizontal at PWOS. The area in the PWOS A B triangle represents the deadweight loss. The deadweight loss occurs due to the inefficiency of producing 17.9 million gallons of ethanol at a cost which exceeds the

[10] Not all South Dakota ethanol production qualified for the 20 cents per gallon producer subsidy due to program limitations on annual producer subsidies per plant.
[11] Depending on the net environmental benefits of ethanol the demand curve could be higher or lower depending on the direction of the benefits.

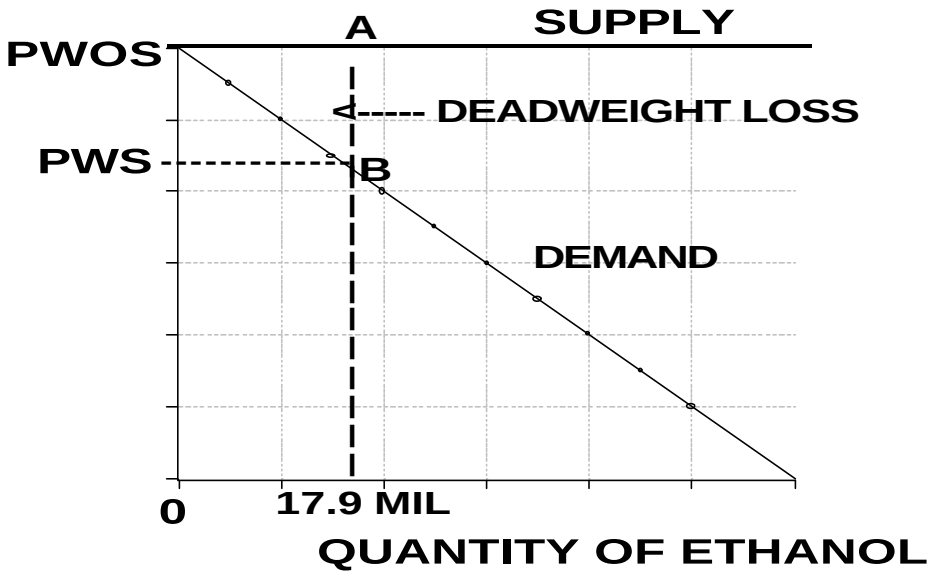
value society places on ethanol as evidenced by its willingness-to-pay (demand curve). The deadweight loss calculation is shown below.

Deadweight loss = 1/2 ($0.85 x 17.9 gallons) = $7.61 million

Or

$0.425 cents per gallon or 50% of the subsidy.

Figure 1: Ethanol Subsidies and Deadweight Loss



Of the $7.61 million deadweight loss $4.83 million is due to the federal subsidy and $2.78 million due to the state subsidies. This estimate of the deadweight loss is conservative since if the supply curve (opportunity cost) is higher or is not perfectly elastic the deadweight loss is greater. However, by assuming a perfectly elastic supply curve knowledge of the price elasticity of demand is unnecessary. This estimate must be considered the minimum deadweight loss and it could very well be higher. Once again this

conclusion is based on the assumption that there are little or no net environmental benefits which would raise the demand for ethanol.

This model can be generalized to the analysis of the federal subsidy at the U.S. level. In 1998, 1.774 billion gallons of ethanol were consumed. Assuming the $0.54 per gallon of ethanol subsidy the cost of the subsidy was $0.96 billion and deadweight loss was $0.48 billion.

6. CONCLUSIONS

Ethanol subsidies are in excess of one billion dollars per year. Are these justified? Supporters of ethanol argue subsidies are clearly in the public interest. They cite higher prices for corn, more rural development, lower federal farm subsidies, environmental benefits, less reliance on foreign oil, and a smaller the trade deficit. Critics of ethanol subsidies argue that the benefits of the subsidies are grossly overstated and do not stand up after closer examination. Higher corn prices provide no net benefits. Employment benefits are an illusion in a full employment economy. Lower federal farm subsidies do not occur in a Freedom to Farm policy world. Energy independence is a costly illusion. Trade deficits are not determined by the balance on any one economy but by the overall savings-investment balance of an economy.

A rough analysis of the welfare implications of the ethanol subsidies indicates that the deadweight loss is about 50 percent of the subsidy. This conclusion is based on a very simple model in which the demand curve is assumed to be downward sloping and the supply curve is perfectly elastic at the price where the quantity demanded is zero. The deadweight welfare loss triangle 1/2 the value of the subsidy times the quantity of ethanol purchased in the market. In the state of the South Dakota the welfare loss was $7.61

million of which $4.83 million is due to the federal subsidy and $2.78 million due to the state subsidies. Generalizing to the federal level, the $0.54 per gallon of ethanol subsidy for 1.774 billion gallons of ethanol represents a subsidy of $0.96 billion and deadweight loss of $0.48 billion.