An Evaluation of the EPAct: Has It Reduced U.S. Dependence on Foreign Oil?

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In 1992, Congress passed the Energy Policy Act (EPAct), whose goals are to enhance our nation's energy security and improve environmental quality by reducing U.S. dependence on foreign oil imports. The EPAct mandated that federal and state government fleets purchase and operate increasing percentages of alternative fuel vehicles. This paper uses state data for the years 1999–2003 and multiple regression analysis to conclude that there is no evidence to suggest that the EPAct's federal mandate had a significant impact in reducing our nation's dependence on foreign oil imports

Introduction

On Oct. 24, 1992 Congress passed the Energy Policy Act (EPAct). The goals of the EPAct are to enhance our nation's energy security and improve environmental quality by reducing U.S. dependence on foreign oil imports. To this end, the EPAct establishes mandates and incentives for using alternative fuels not derived from petroleum, such as:

- "Methanol, ethanol, and other alcohols
- Blends of 85% or more of alcohol with gasoline
- Natural gas and liquid fuels domestically produced from natural gas
- Liquefied petroleum gas (propane)
- Coal-derived liquid fuels
- Hydrogen
- Electricity
- Biodiesel (B100)" ("EPAct Alternative Fuels")

Under the EPAct, federal and state government fleets are required to purchase and operate a specific percentage of alternative fuel vehicles (AFVs). Beginning in car model year 1997 (Sept. 1996), the EPAct mandated that a percentage of new light-duty vehicles purchased by state government fleets had to be alternative fuel vehicles. Alternative fuel vehicles include any dedicated, flexible-fuel, or dual-fuel vehicle designed to operate on at least one alternative fuel. Alternative fuel vehicles come in a variety of vehicle models such as sedans, pickup trucks, sport utility vehicles, vans, shuttle buses, medium-duty vehicles (such as delivery trucks), heavy-duty buses, and heavy-duty trucks.

The percentage of new light-duty AFVs a state is required to purchase is as follows:

- Model year 1997 – 10% AFVs
- Model year 1998 – 15% AFVs
- Model year 1999 – 25% AFVs
- Model year 2000 – 50% AFVs
- Model year 2001 and thereafter – 75% AFVs ("Guidebook," 2001)

Hypotheses and Design

The design of this study is a non-experimental, panel design using cross-section and time-series data. The study consisted of all 50 U.S. states for the years 1999-2003 (n=230, excluding 20 missing values). Using statistical controls, the purpose of this paper is to examine whether the EPAct, in its mandate of state governments to purchase increasing percentages of alternative fuel vehicles, has led to a reduction of our nation's dependence on foreign oil imports.

There are two conflicting arguments to this end. The Energy Policy Act rests on the assumption that an increase in consumption of alternative fuels will lead to a decrease in consumption of regular gasoline. Critics claim, however, that an increase in the number of alternative fuel vehicles, most of which operate on a combination of alternative fuels and regular gasoline, will lead to an increase in consumption of regular gasoline because consumers (in this case, public agency employees) will be able to drive more and farther for the same price. To test whether the EPAct is meeting its stated goals of reducing U.S. dependence on foreign oil a two-tailed significance test will be used, where $\alpha = .05$ and the critical value of the t-statistic is ± 1.96. If the test statistic is greater than ± 1.96 the null hypothesis will be rejected.

The main hypotheses below will be tested using two different multiple regression models.

H_o: $B = 0$ The EPAct's federal mandates on states to purchase alternative fuel vehicles has no impact on our nation's dependence on foreign oil imports.

H_a: $B \neq 0$ The EPAct's federal mandates on states to purchase alternative fuel vehicles has an impact, either positive or negative, on our nation's dependence on foreign oil imports.

Method I

The independent variable (X) is the percentage of state fleet vehicles that are alternative fuel vehicles. This figure was obtained by dividing the number of alternative fuel vehicles in use by state agencies (source: Energy Information Administration, Form EIA-886 Annual Survey of AFV Users) by the total number of automobiles ["Automobiles" does not include buses, trucks, truck tractors, trailers or motorcycles] in each state's fleet (source: Federal Highway Administration, Highway Statistics, 1999-2003). The dependent variable (Y) is the amount of gasoline consumption by state (regular, midgrade and premium), measured in thousand gallons/day (source: Energy Information Administration). Gasoline consumption was chosen to operationalize "foreign oil imports" because data on oil imports could not be collected by state. Confounding Z variables that were statistically controlled for in the study are:

Z1 – Total vehicle miles traveled by state, measured in millions (source: Bureau of Transportation Statistics)

Z2 – Average price of regular gasoline by state, measured in dollars/ gallon – tax excluded (source: Energy Information Administration).

Thus, the regression equation that represents this method is:

$$Y_i = A + BX_i + C_1Z1_i + C_2Z2_i + \mu_i$$

Method II

The independent variable (X) is the number of alternative fuel vehicles in use by state agencies and the dependent variable (Y) is the amount of gasoline consumption by state (regular, midgrade and premium), measured in thousand gallons/day. Confounding Z variables that were statistically controlled for in the study are:

Z1 – Total vehicle miles traveled by state, measured in millions

Z2 – Average price of regular gasoline by state, measured in dollars/gallon – tax excluded

Z3 – Total number of automobiles in each state's fleet

Thus, the regression equation that represents this method is:

$$Y_i = A + BX_i + C_1Z1_i + C_2Z2_i + C_3Z3_i + \mu_i$$

Results

As evident in Table 1 below, the number of alternative fuel vehicles in use by state agencies ranges from 2 to 6,335, with a mean of approximately 685. In obtaining the data for this variable, some states were not able to provide information for certain years. There were 20 missing values for this variable. Second, the total number of automobiles in each state's fleet ranges from 1,177 to 212,663 vehicles, with a mean of approximately 24,403. Third, the percentage of state fleet vehicles that are alternative fuel vehicles has a range of .04 to 23.54%, with a mean of approximately 3.9%. Again, there were 20 missing values for this variable. Fourth, the average amount of gasoline consumption by state ranges from approximately 745 thousand gallons/day to 41,648 thousand gallons/day, with a mean of approximately 7,257 thousand gallons/day. Fifth, the average price of regular gasoline by state (tax excluded) ranges from .647 dollars/gallon to 1.497 dollars/gallon, with a mean of .987 dollars/gallon. Finally, total vehicles miles traveled by state ranges from 4,545 million to 323,592 million, with a mean of approximately 55,803 million miles.

Method I – Results

In looking at the results in Table 2 below, the main policy variable—percentage of state fleet vehicles that are alternative fuel vehicles—provides a test statistic

of –1.121. This variable fails to meet the critical value and therefore is not statistically significant. The only variable that is statistically significant in this model is total vehicles miles traveled. As total vehicles miles traveled increases by one million miles, the average amount of gasoline consumption increases by .132 thousand gallons/day.

The model used in this regression method has an adjusted R2 of .990, meaning that overall the model explains practically all of the variance in average gasoline consumption. With an F probability of .000, the model is statistically significant. However, the variable total vehicle miles traveled, which has a Beta weight of .994, contributes almost primarily to the significance of the model. Thus, the alternative hypothesis is rejected in favor of the null hypothesis. In other words, there is no evidence to suggest that the EPAct's federal mandate on states to purchase alternative fuel vehicles has an impact on our nation's dependence on foreign oil imports. Specifically, the percentage of alternative fuel vehicles in use by state agencies does not have a significant role in helping to reduce our nation's dependence on foreign oil imports. The results show that the EPAct is not meeting its stated goal.

Method II – Results

In looking at the results in Table 3 below, the main policy variable—number of alternative fuel vehicles in use by state agencies—provides a test statistic of 5.055. Given the critical value for $t = \pm 1.96$, it is concluded that the variable is statistically significant. As the number of alternative fuel vehicles in use by state agencies increases by one vehicle, the average amount of gasoline consumption increases by .294 thousand gallons/day. All control variables are also statistically significant. As total vehicle miles traveled increases by one million miles, the average amount of gasoline consumption increases by .121 thousand gallons/day. As the average price of regular gasoline increases by one dollar/gallon, the average amount of gasoline consumption decreases by 664.617 thousand gallons/day. As the total number of automobiles in a state's fleet increases by one automobile, the average amount of gasoline consumption increases by .001446 thousand gallons/day.

The model used in this regression method has an adjusted R2 of .992, meaning that overall the model explains practically all of the variance in average gasoline consumption. With an F probability of .000, the model is statistically significant. However, the variable total vehicle miles traveled, which has a Beta weight of .909, contributes almost primarily to the significance of the model.

Thus, the null hypothesis is rejected in favor of the alternative hypothesis. In other words, the EPAct's federal mandate on states to purchase

alternative fuel vehicles has an impact our nation's dependence on foreign oil imports. Specifically, the number of alternative fuel vehicles in use by state agencies increases average consumption of gasoline. This conclusion supports the critics' claim that an increase in the number of alternative fuel vehicles, most of which operate on a combination of alternative fuels and regular gasoline, will lead to an increase in consumption of regular gasoline because consumers will be able to drive more and farther for the same price.

Conclusion and Policy Discussion

The results reported in this paper must be considered in light of some data limitations on two variables. Unfortunately, these limitations affect the main policy variables in this study—the number of alternative fuel vehicles in use by state agencies and the number of automobiles in each state's fleet.

As previously stated, some states were not able to provide data on the number of alternative fuel vehicles in use by state agencies for some years. The data for this variable was obtained from survey data from the Energy Information Administration (EIA). They report that several states were not covered by the survey or did not respond. It is for this reason that there were 20 missing values for this variable. Additionally, prior to 2003, in some cases there are huge fluctuations in the data reported. This can be attributed to one of two causes: 1) non-reporting agencies within a state or 2) poor coverage of the whole state fleet by the Energy Information Administration. In 2003, the EIA updated their data collection method to make sure they captured the correct data from all 50 states. The data on the number of alternative fuel vehicles in use by state agencies for the year 2003 is the most accurate and reliable. Finally, EIA reports that the data for California is under-reported by about 5,000 vehicles. They attribute this under-reporting to the fact that California's fleet gathering methods are not centralized (personal communication, Cynthia Sirk, EIA, Dec.7, 2004).

The data limitations on the number of automobiles in each state's fleet are similar, in that each state collects and reports their own data and a standardized method does not exist. The Federal Highway Administration reports that the data for this variable is

compiled chiefly from reports of State authorities, [and] is incomplete in many cases. Some States give State-owned vehicles only; others exclude from registration certain classes, such as fire apparatus and police vehicles. For the States not reporting State, county, and municipal vehicles separately from private and commercial vehicles and those reporting unsegregated totals only, classification by vehicle type has been approximated on the basis of other

available data or estimated. ("Highway Statistics," 1999-2003, Section II – Motor Vehicles, Table MV-7, footnote 2).

Despite these limitations on the data available, using two different multiple regression models and statistical controls, there is no evidence to suggest that the EPAct's federal mandate for states to purchase a specified percent of alternative fuel vehicles has had a significant impact in reducing our nation's dependence on foreign oil imports. In fact, the results support the critics' claim that increasing the number of alternative fuel vehicles increases the amount of gasoline consumption. While the goals of the EPAct to enhance our nation's energy security and improve environmental quality by reducing our dependence on foreign oil imports are certainly important, it is evident that the Act has not achieved these goals. This can be attributed to some major economic barriers and loopholes in the law.

Primarily, while the acquisition of alternative fuel vehicles is required for state fleets, use of alternative fuels in those vehicles is not required. Alternative fuel vehicles are classified as either dedicated or non-dedicated vehicles. Dedicated vehicles run exclusively on one type of fuel while non-dedicated vehicles can operate on either conventional or alternative fuel. Non-dedicated vehicles are broken down into three types: 1) bi-fueled vehicles which can operate on either an alternative fuel or a conventional fuel, but not at the same time, and have separate storage systems for each fuel; 2) flexible fueled vehicles which can operate on either an alternative or conventional fuel or on a combination, and have a single storage and combustion system; or 3) dual fuel vehicles which can burn two fuels simultaneously. In dual fuel vehicles, the fuels are not mixed in storage but are injected into the engine combustion chamber simultaneously (Joyce, n.d.). Out of the 25 different models of alternative fuel vehicles available for model year 2005, 23 are categorized as non-dedicated vehicles (U.S. Department of Energy, 2005).

Due to the price, availability and convenience of purchasing alternative fuels, the majority of non-dedicated alternative fuel vehicles (and thus the majority of all alternative fuel vehicles) are currently run on conventional gasoline rather than alternative fuels, thereby supporting critics of the EPAct who claim that gasoline consumption will increase with an increase in usage of alternative fuel vehicles. In order for the EPAct be more effective, alternative fuels will have to be more widely available, and at a reasonable cost, and their use will have to be mandated. Future studies on energy policy may want to look at these three factors as they relate to gasoline consumption and our dependence on foreign oil imports.

A second economic barrier to the overall use of alternative fuel vehicles is cost. There is some evidence to suggest that the additional cost to states to

purchase and maintain alternative fuel vehicles is high. This is evident in the data on the number of alternative fuel vehicles in use by state agencies from 1999-2003. In some cases this number increased for a few years and then decreased.

In part due to the economic barriers in obtaining alternative fuels, alternative fuel vehicles have not caught on in the individual consumer market. What has caught on and becoming increasing popular with consumers are hybrid electric vehicles (HEVs). Hybrid electric vehicles do not qualify under the EPAct as alternative fuel vehicles because they are powered primarily by conventional gasoline. (Even though, in reality, alternative fuel vehicles are primarily run on conventional gasoline.) Thus, although some states may chose to purchase hybrid vehicles, it does not count toward the mandated percentage of alternative fuel vehicles.

Hybrid vehicles are seen as a benefit to the environment – they produce fewer emissions and are more fuel-efficient. To further encourage the purchase of hybrid vehicles by private consumers, the federal government and some state governments offer tax deductions or other incentives, such as use of HOV lanes regardless of vehicle occupancy. Currently, the Clean-Fuel Vehicle Property Tax Deduction is available through 2006. For hybrid electric vehicles purchased from 1992-2003 the deduction is $2,000, which is about how more a HEV costs compared to a standard vehicle. Vehicles purchased in 2004 are eligible for a $1,500 tax deduction while those purchased in 2005 and 2006 are eligible for a $1,000 and $500 tax deduction respectively ("Tax Deduction," 2003).

These incentives appear to be working. Polk Automotive Intelligence reports that hybrid vehicle registrations are up 25.8% in 2003 from 2002. Since hybrid cars were introduced in the market in 2000, hybrid vehicle sales have increased 570 percent with a compound annual growth rate of 88.6% ("Hybrid Vehicle Registrations," 2004). Additionally, the number of hybrid electric vehicle models available in the market has risen from one model in 2000 (the Honda Insight) to four models in 2005 ("Clean-Fuel Vehicle Deduction," n.d.), including the newly certified Ford Escape SUV ("Ford Escape Certified," 2004). There are several additional models of HEVs that major automotive corporations plan to release in 2005 and 2006. Some analysts predict that by the year 2010 there could be 50 different hybrid electric vehicle models in the market (Truett, 2004).

Clearly, hybrid electric vehicles are here to stay. As people become more conscience of protecting the environment and as gas prices continue to rise, hybrid sales will continue to increase. How has the availability of federal and state tax deductions and other incentives affected the growth of the

hybrid electric vehicle industry? Has this had the effect of reducing gasoline consumption and our country's reliance on foreign oil? This is a topic that needs further study, and was initially the topic of this paper. Unfortunately, data on the number of registrations of hybrid electric vehicles is not easily or cheaply obtainable.

With no end in sight to the war in Iraq, will we be forced to find and increase our use of alternative fuels? The EPAct's federal mandate on states to purchase increasing percentages of alternative fuel vehicles is a step in the right direction, although a small step. More needs to be done on the part of the government and individual consumers before the goals of enhancing our nation's energy security and improving environmental quality by reducing our dependence on foreign oil imports can be reached. The manner in which we think about transportation and energy use will have to change dramatically.

Tables

Table 1
Descriptive Statistics

	N	Min.	Max.	Mean	Std. Dev.
Number of AFVs in use by state agencies	230	2	6335	685.37	995.491
Total number of automobiles in state fleet	250	1177	212663	24403.46	35013.071
Percent of state fleet that is an AFV	230	.04	23.54	3.9034	4.56532
Average gasoline consumption—Thousand gallons/day	250	744.80	41648.20	7257.3468	7554.41926
Average price of regular gas—Dollars/Gallon, tax excluded	250	.647	1.497	.98652	.159606
Total vehicle miles traveled—millions	250	4545	323592	55803.37	56684.324
Valid N (listwise)	230				

Table 2

Regression of percentage of state fleet vehicles that are alternative fuel vehicles on amount of gasoline consumption (thousand gallons/day) with statistical controls for total vehicles miles traveled (millions) and average price of regular gasoline (dollars/gallon, tax excluded)

Variable	Coefficient	Std. Err.	Beta	t-statistic
Constant	371.172	340.045		1.092
Total vehicle miles traveled—millions	0.132	0.001	0.994	149.840
Average price of regular gasoline–Dollars/Gallon, tax excluded	-475.493	327.603	-0.010	-1.451
Percentage of state fleet vehicles that are alternative fuel vehicles	-12.490	11.143	-0.007	-1.121

Dependent variable = Amount of gasoline consumption (thousand gallons/day)

N = 230
R^2 = .990
Adj. R^2 = .990
F = 7579.510
F-prob = .000

Table 3

Regression of number of alternative fuel vehicles in use by state agencies on amount of gasoline consumption (thousand gallons/day) with statistical controls for total vehicles miles traveled (millions), average price of regular gasoline (dollars/gallon, tax excluded) and total number of automobiles in each state's fleet

Variable	Coefficient	Std. Err.	Beta	t-statistic
Constant	589.512	309.053		1.907
Total vehicle miles traveled—millions	0.121	0.002	0.909	59.051
Average price of regular gasoline—dollars/gallon, tax excluded	-664.617	296.208	-0.013	-2.244
Total number of automobiles in state fleet	1.446E-02	0.003	0.067	4.328
Nuber of AFVs in use by state agencies	0.294	0.058	0.038	5.055

Dependent variable = Amount of gasoline consumption (thousand gallons/day)

N = 230

R^2 = .992

Adj. R^2 = .992

F = 7020.615

F-prob = .000

References

Clean-Fuel Vehicle Deduction Available for Certain Models. (n.d.). Washington, DC: U.S. Department of the Treasury, Internal Revenue Service. Retrieved November 2004, from http://search.irs.gov/web/query.html?col=allirs&charset=utf-8&qp=&qs=-Wct%3A%22Internal+Revenue+Manual%22&qc=&qm=0&rf=0&oq=&qt=Clean-Fuel+Vehicle+Deduction+Available+for+Certain+Toyota+and+Honda+Models

EPAct Alternative Fuels. (n.d.). Washington, DC: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Retrieved November 2004, from http://www.eere.energy.gov/vehiclesandfuels/epact/about/epact_fuels.shtml

Ford Escape Certified as First SUV Hybrid; Meets New EPA, Calif. Standards. (2004, August 17). Message posted to Other Transportation and Air Quality Technical Assistance, archived at http://knowledge.fhwa.dot.gov/cops/italladdsup.nsf/docs/AE1CE8443D45963385256EF3006A4B90?opendocument&CurrentCategory=Other%20Transportation%20and%20Air%20Quality%20Technical%20Assistance

A Guidebook to the U.S. Department of Energy's Alternative Fuel Transportation Program for State and Alternative Fuel Provider Fleets. (2001, February). Washington, DC: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Retrieved November 2004, from http://www.eere.energy.gov/afdc/pdfs/bluebook.pdf

Highway Statistics. (1999-2003). Washington, DC: U.S. Department of Transportation, Federal Highway Administration. Retrieved November 2004, from http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm

Hybrid Vehicle Registrations up 25.8 Percent in 2003. (2004, April 22). Southfield, MI: Polk Automotive Intelligence. Retrieved November 2004, fromhttp://usa.polk.com/news/newsarchive/2004/news_2004_0422.htm

Joyce, M. (n.d.) Developments in U.S. Alternative Fuel Markets. Washington, DC: Energy Information Administration. Retrieved November 2004 from http://www.eia.doe.gov/cneaf/alternate/issues_trends/altfuelmarkets.html#N_1_

Tax Deduction: Hybrid Electric Vehicles. (2003, January). Washington, DC: U.S. Department of Energy, National Renewable Energy Laboratory. Retrieved November 2004, from http://www.nrel.gov/docs/gen/fy03/32873.pdf

Truett, R. (2004, December 8). Analysts predict more than 50 hybrid models will be available in North American by 2010.

AutoWeek. Retrieved November 2004 from http://www.autoweek.com/apps/pbcs.dll/article?AID=/20041208/FREE/412080703&SearchID=73238439079219

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, National Renewable Energy Laboratory. (2005). Model Year 2005: Alternative Fuel Vehicles and Advanced Technology Vehicles Available or Nearing Completion. [Table]. Retrieved November 2004, from http://www.eere.energy.gov/afdc/pdfs/my2005afv_atv.pdf