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Michael T. Heaney
University of Northern Iowa

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On August 9, 1993, U.S. President Bill Clinton signed into law a 4.3 cents per gallon increase in the federal gasoline tax. This increase, which brought the new federal tax level to 15.4 cents per gallon, was chosen from a menu of alternate options for energy taxation, including a British Thermal Unit (BTU) based tax and a tax on sulfur emissions. The increase was met with considerable political resistance and only passed by a narrow margin—2 votes in the House of Representatives and a tie broken in the Senate by the Vice President—after a protracted ten month debate.

Although it has been estimated that the increased gasoline tax will raise $25 billion per year in tax revenues (D'Amato 1993, p. S7730), its passage seems to have been motivated primarily by a desire to achieve environmental and public policy objectives. In this article I will explore the economic rationale behind use of the federal gasoline tax, examine whether additional gasoline taxes are needed in the United States, employ economic reasoning to consider some of the tax's possible effects, and consider ways in which stated policy objectives might be achieved more effectively.

SOCIAL COSTS AND GASOLINE CONSUMPTION

Many transactions that take place within a market economy affect only the persons engaged in the transaction, and thus consist entirely of private costs. For example, if an individual purchases a set of pencils, the benefits and costs of the transaction will probably be divided exclusively between the buyer and the seller. However, many other activities that take place within a market economy involve social costs; that is, they affect third parties who are not involved in the production or consumption of the good in question. For example, if a textile mill pollutes the environment, it will affect many people who will not consume the mill's goods. In the absence of government action, producers and consumers of textiles will set textile prices without taking into

account the costs imposed on these third parties.[1] Since these social costs are not included in production and consumption decisions, textiles will always appear less expensive to the private market than they are to the society as a whole. Therefore, more textiles will be produced than would be produced if the total cost to society were included in the price.

Gasoline is a political target of environmental groups and other organizations because it has numerous external social costs. When a motorist purchases a gallon of gasoline, the motorist tends to consider only the private cost paid to the gas station.[2] However, consumption of that gasoline will contribute to environmental problems, highway fatalities, deterioration of roads and bridges, dependence on foreign oil supplies, and other social problems.

Environmental damage is perhaps the most obvious social cost of gasoline consumption. Automobile emissions are one of the largest sources of air pollution in the world. As Tom Tietenberg has noted, in the United States alone there are over 100 million motor vehicles and "though each individual vehicle represents a minuscule part of the problem, mobile sources collectively represent a significant proportion of three criteria pollutants—ozone, carbon monoxide, and nitrogen dioxide" (1992, p. 451). In contrast, highway fatalities are one of the least commonly cited external effects of gasoline consumption. The effects of highway fatalities, though, are by no means insignificant. Leigh and Wilkinson note that "because many of the victims are young, the total number of life-years lost in vehicle accidents is nearly as great as the number lost to heart disease" (1991, p. 474). The social contributions lost through such fatalities (and injuries) are truly incalculable. These researchers have found, in addition, that highway fatalities are positively correlated with the number of miles driven and the average vehicle speed on the highways. Moreover, a negative correlation exists between the average age of drivers and highway fatalities since younger drivers have less experience driving and generally enjoy risk more than other motorists.

The crumbling of America's highway infrastructure is a more visible social cost associated with gasoline consumption. Roads and bridges experience incremental wear and tear every time an individual drives a vehicle. Without sufficient maintenance, that wear and tear accumulates. Consequently, bridges have collapsed and roads have crumpled, taking the lives of numerous Americans every year (Aschauer 1991, p. 39).

A fourth social cost of gasoline consumption arises from dependence on foreign oil. The more dependent the United States is on foreign oil supplies, the more threatened it is by instability abroad. Of course, the extent to which this factor is a social cost depends on the probability and severity of instability. While this probability may seem remote, it is prudent to recall the devastating inflationary pressures placed on the American economy in 1973-74 and again

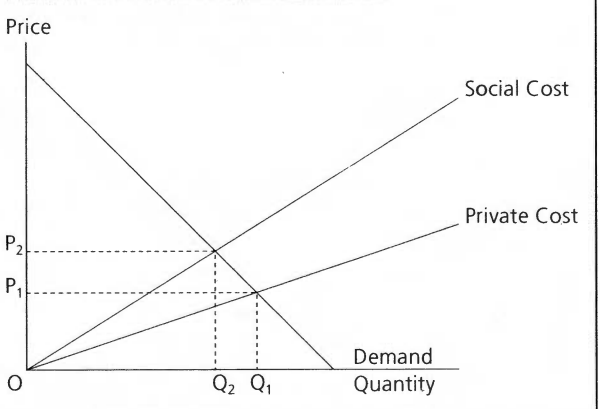
in 1979-80 by oil shocks induced by the Organization of Petroleum Exporting Companies (OPEC). Also, many analysts believe the Gulf War of 1991 was fought to assure access to Middle East oil. The risk of instability is one this nation may be willing to bear; however, the cost of this risk may not be reflected in the price of U.S. gasoline.

DO AMERICANS PAY THE SOCIAL COSTS OF GASOLINE CONSUMPTION?

The existence of social costs from gasoline consumption ensures that the cost of gasoline will always be higher for the society as a whole than for an individual motorist. This situation is depicted graphically in Figure 1. If motorists are not required to pay the social costs of gasoline consumption, then demand will intersect the private cost at a point different from the intersection of demand and social cost. Thus, because they are not paying the social costs of gasoline consumption, motorists will pay a lower price (P_1 rather than P_2) and will choose to drive more miles than they otherwise would (Q_1 rather than Q_2).

Economists have developed a number of policy tools to address the problem of social cost, including effluent fees,[3] pollution permits, various taxing schemes, and regulation. Perhaps the most famous of these tools was first proposed by British economist Arthur C. Pigou in 1920. Pigou suggested that if a good is priced too low (i.e., without concern for external social costs), then a tax should be placed on each unit of output so that it compensates for the difference between social cost and private cost (Pigou 1932). By assessing this tax on each unit of the good, price is expected to rise from P_1 to P_2 and quantity is expected to fall from Q_1 to Q_2 (Figure 1).

FIGURE 1. Private versus Social Costs



The United States and other industrialized nations have adopted taxes on gasoline in the form of a Pigouvian tax. However, it is very difficult to know how to set the level of this tax properly. The difficulty arises from the immense amount of data required to determine the incremental social cost of gasoline consumption. Consider, for example, the difficulty in determining the social costs from automobile pollution alone. First, the amount of pollution must be determined. This determination would require knowing what vehicles are being driven, how much they are being driven, and how much pollution they emit. This information is simply not available in nations with decentralized governmental systems, such as the United States. Second, the marginal damage from pollution must be estimated. This estimation requires knowledge of differential environmental impacts between urban and rural areas. Moreover, health effects on individual persons must be identified and dollar damages placed on those effects. Since some individuals will die from these health effects, a dollar value must be placed on these human lives. Due to all of these considerations, it is difficult to measure accurately and objectively the social costs of gasoline consumption and, thus, to determine if the United States has set the proper level for gasoline taxes. Nevertheless, one might gain some insight into the issue from an international comparison of gasoline taxes and prices.

The United States has the lowest gasoline taxes and prices in the industrialized world. Table 1 lists taxes and prices for eight industrialized nations. Of the nations listed, France imposes the highest per gallon tax of $2.95, compared to only $0.37 in the United States. Moreover, the actual

TABLE 1. International Gasoline Prices
Prices on September 26, 1994, Current U.S. Dollars

Nation	Tax* per gallon	Average price per gallon	Percent Tax
France	$2.95	$3.71	79.5%
Italy	$2.81	$3.78	74.3%
Germany	$2.54	$3.47	73.2%
Netherlands	$2.36	$3.40	69.4%
Belgium	$2.19	$3.21	68.2%
United Kingdom	$1.85	$2.80	66.1%
Japan	$2.14	$4.60	46.5%
United States	$0.37	$1.13	32.7%

Source: U.S. Department of Energy, unpublished.
*Includes taxes at all levels of government: federal, state, and local.

price per gallon in the United States ($1.13) is less than half of the next lowest nation, the United Kingdom ($2.80).[4] Differences have risen sharply in recent years as other nations have been aggressively raising prices. For example, the United Kingdom implemented a ten percent tax increase in March 1992 and Germany implemented a thirty-six percent tax increase in 1991 (Koretz 1993, p. 14).

Several possible explanations can be offered for the international variation in taxes. One explanation is that incremental social costs vary from nation to nation because they have different levels of congestion, and thus varying problems with the environment, highway fatalities, and infrastructure maintenance. Furthermore, nations may have differing views of the cost of dependence on foreign oil supplies. A second possible explanation is that gasoline taxes are a comparably more efficient means of collecting revenue in other nations than in the United States. For example, nations with high income tax rates may also experience high rates of income tax avoidance and, thus, must seek other means of raising revenue.

While each of these reasons may contribute marginally to the international variation in gasoline prices and taxes, it is unlikely that such substantial variation can be accounted for solely on these bases. Instead, it seems likely that political resistance to raising taxes has kept the tax on gasoline unrealistically low in the United States; in short, the Pigouvian tax on gasoline has not been properly set. Therefore, it seems reasonable to suggest that the United States should substantially raise taxes on gasoline so that they are more in line with taxes in other industrialized nations and, more importantly, with actual social costs.

HOW GASOLINE TAXES CUT CONSUMPTION

In a market economy, the government cannot guarantee that a tax will reduce consumption of a particular good. Instead, the government can only provide incentives for consumers and producers to behave in certain ways, and thus indirectly create the type of behavior considered desirable. For example, the federal gasoline tax increase of 1993 did not lead to an immediate increase in the average price of gasoline. Why it did not is a matter of speculation. Perhaps the price of gasoline was going to fall, and the tax kept it from falling. Or, perhaps retailers believed consumers would not purchase a sufficient quantity of gasoline if the price went up.

The extent to which a Pigouvian tax affects consumption depends on the responsiveness of consumers to price changes. This responsiveness is formally referred to as the "price elasticity of demand."[5] Empirical studies have documented that gasoline demand is price inelastic in the short run; that is, raising prices does not appear greatly to affect demand. For example, Dahl

(1982) examined data from forty-one countries over the period 1970-1978. She found that the price elasticity of gasoline demand is approximately -.20, and stays relatively constant among countries when nations with very low gasoline prices (such as Saudi Arabia and Bolivia) are excluded. A similar study was conducted by Greene and Chen (1983) who examined data from the American states during 1975-1980. Their results are consistent with Dahl's, with the highest estimate in Ohio (-.138) and the lowest estimate in Iowa (-.377). Since demand for gasoline appears to be inelastic in the short run, a large percentage increase in tax would be necessary to have a significant negative effect on gasoline consumption.

Empirical studies demonstrate that the demand for gasoline becomes potentially more elastic in the long run.[6] Therefore, long-run reductions of gasoline consumption from a tax increase will be much greater than short run reductions (Khazzoom 1991). For example, Blair, Kaserman, and Tepel (1984) have emphasized the role of improved mileage on gasoline demand: when gasoline prices rise, consumers have an incentive to drive more fuel efficient vehicles in order to reduce the cost of travel per mile. Improved fuel efficiency can arise from more frequent tune-ups and maintenance, as well as from the use of more fuel efficient cars. Greene and Hu (1984) noted that this efficiency is often attained in multi-vehicle households by leaving the old gas-guzzler in the garage and using another vehicle with better gas mileage. Or, as Hill (1986) pointed out, higher gasoline prices make consumers look more carefully at gas mileage when purchasing a new vehicle. The substitution of more-fuel- efficient for less-fuel-efficient automobiles in the long run implies that higher gasoline taxes may substantially reduce gasoline consumption, but may not have as great an effect on the total number of miles driven. Of course, raising taxes could force some motorists to stop using their personal automobiles. Such an effect would stimulate increased demand for public transportation. Therefore, a gasoline tax increase which "fuels" fuel efficiency would probably have a greater effect on externalities such as air pollution (since fuel-efficient cars emit fewer pollutants), but a lesser effect on infrastructure deterioration, fatalities, and other social costs which depend on the number of miles driven.

The studies discussed above have demonstrated that fuel efficiency is an important component of the gasoline demand equation. If fuel efficiency is so important, then why don't automobile manufacturers build more efficient vehicles? Cook (1993) argues that although the technology exists to build automobiles which get 40 miles per gallon, automobile manufacturers choose not to build such vehicles due to insufficient demand. Cook maintains that one reason U.S. citizens do not purchase more fuel-efficient vehicles is that the price of gasoline is low enough that a trade-off for other amenities (e.g.,

larger vehicle size) occurs.

As an alternative to gasoline taxes, Congress attempted to mitigate the problem by imposing Corporate Average Fuel Economy (CAFE) standards with the Energy Policy and Conservation Act of 1975 (Mayo and Mathis 1988, p. 212). The Act mandated that all new passenger cars sold in the United States beginning in 1978 meet a minimum fuel efficiency standard of 18.0 miles per gallon. The Act gradually increased the standard to 27.5 miles per gallon by 1990, where it presently remains. The Clinton Administration has proposed increasing the standard to somewhere between 31 and 33 miles per gallon by 2001. However, as of the writing of this article, no action has been taken on this issue.

The record of CAFE standards is mixed. The average mileage of domestically produced cars has risen from below 18.0 miles per gallon to 27.3 miles per gallon (Cook 1993, p. 61). However, Japanese automobile manufacturers have actually lowered their fuel mileage from around 33.0 miles per gallon to only 29.0 miles per gallon. In doing so, the Japanese have increased automobile size and improved amenities so that their automobiles have increased appeal to American consumers. Furthermore, several foreign manufacturers (e.g., Mercedes-Benz) choose to pay fines imposed by the American government rather than meet mileage standards. CAFE standards also have an inherent limitation in that they only apply to new vehicles, which constitute a minuscule proportion of the automobile fleet. Indeed, Mayo and Mathis (1988) have pointed out that CAFE standards may have artificially preserved the life of the pre-1978 fleet of automobiles, which is not required to meet mileage standards.

As long as there is some government-set or manufacturer-set minimum standard for gas mileage, low gasoline prices will provide all parties involved an economic incentive to circumvent the standard. However, a gasoline tax will not permit the same type of circumvention. A gasoline tax applies to new and old vehicles alike. If gasoline prices rise by 45 percent, then consumers will need to drive automobiles which will attain 45 percent better gas mileage or reduce total miles driven if they desire to hold constant their gasoline spending. As noted above, such changes are technologically feasible, but will occur only if there is sufficient demand in the market.

REDISTRIBUTIVE EFFECTS

When considering a tax increase on gasoline to deal with social costs of gasoline consumption, it is also necessary to consider the redistributive effects of such a tax. The extent to which the burden of a tax increase is redistributed depends on the "tax incidence." When producers or retailers bear the burden of a tax in the form of a lower net price, it is considered to be "shifted back-

ward." If the burden of the tax is passed along to the consumer in the form of higher prices, then the tax is said to be "shifted forward." Elasticity may provide some insight on this issue, since goods which are price inelastic in demand tend to be shifted forward. Conversely, goods which are price elastic in demand tend to be shifted backward. Since the short-term demand for gasoline is inelastic, it is expected that the burden of any gasoline tax increase will fall principally upon consumers, at least in the short run.

If this burden is shifted to consumers, then it is important to analyze the effect of the tax on social equity. How does the new tax change the existing distribution of benefits and burdens in the economic system? This question raises complex considerations that can only be resolved by long run empirical analysis of gasoline consumption. Thus, possible effects can only be tentatively discussed at this time.

An important issue to evaluate is whether gasoline taxes are "progressive" or "regressive." A progressive tax with respect to income is one which causes the heaviest tax burden to fall on upper-income persons. Conversely, a regressive tax with respect to income is one which causes the heaviest tax burden to fall on those with lower incomes. A general ethical principle sometimes employed in the analysis of tax systems is that the overall tax structure should be progressive rather than regressive. The price-inelastic nature of short-term gasoline consumption provides some insight into the question of whether U.S. gasoline taxes are progressive or regressive in the short run. Assuming that consumers will not be able to modify their purchases substantially in the short run, those groups that have traditionally spent a larger portion of their income and other resources on gasoline will bear the greatest burden of gasoline taxes. Most analysts agree that gasoline taxes are highly regressive when taxes paid are taken as a percentage of *annual income level.* However, this analysis does not settle the question, since alternate approaches have been proposed for evaluating a tax's redistributive nature.

One recently proposed argument suggests that taxes paid as a percentage of *annual expenditure level* is a better indicator of the real burden of a tax than taxes paid as a percentage of annual income level (Poterba 1991). This argument is based on the *Life Cycle Hypothesis*, which was originally proposed by Franco Modigliani in the 1950s and 1960s (Peterson 1988, p. 181). Modigliani argued that individuals plan their consumption in any given year on the basis of their expected income over their life cycle. This hypothesis explains why younger people and senior citizens (who generally have lower expected incomes than other groups) tend to spend more than their annual income in a given year: young people expect to earn more as they rise in the workforce, while many senior citizens have already accumulated a nest-egg. On the other hand, middle-aged people (who generally have higher expected incomes than

young people and senior citizens) tend to save more of their annual income. Therefore, it is argued that annual expenditure, rather than annual income, is the appropriate indicator of whether an individual is high, middle, or low income.

Poterba (1991) demonstrated the difference between calculating gasoline taxes as a percentage of income and as a percentage of expenditure (Table 2). Gasoline taxes appear regressive when calculated as a percentage of income, since as income rises, the percentage of income spent on gasoline falls. However, this relationship changes when gasoline taxes are computed as a percentage of annual expenditure. Gasoline taxes rise as a percentage of expenditure from the lowest deciles to the middle deciles, but decline as a percentage of expenditure from the middle to the highest deciles. In other words, the burden of a gasoline tax falls most heavily upon the shoulders of the middle class.

TABLE 2. Gasoline Expenditure by Decile

Income Decile	Gas Spending as a Percent of Income	Expenditure Decile	Gas Spending as Percent of Total Spending
1*	6.74%	1*	4.25%
2	6.54%	2	6.52%
3	6.36%	3	6.84%
4	6.08%	4	7.55%
5	4.97%	5	6.62%
6	4.69%	6	7.04%
7	4.38%	7	6.72%
8	3.75%	8	5.99%
9	3.56%	9	6.09%
10	2.42%	10	4.25%
Mean	4.23%	Mean	6.10%
Std. Dev.	1.25%	Std. Dev.	1.02%

Source: Poterba 1991, pp. 150, 154; author's tabulations.
* "1" represents the lowest income/expenditure decile.

A second possible distributional effect from a higher tax on gasoline results from changes in the prices of goods and services related to gasoline consumption. Gasoline is an intermediate input in the provision of most goods and services. For example, gasoline is an intermediate input when a truck transports groceries to a market or when a pizza restaurant offers a delivery service. Moreover, the price of gasoline is a component of the price

of labor, since a large percentage of the U.S. population uses gasoline in its transit to work. Thus, a substantial increase in the price of gasoline may lead to an increase in the level of consumer prices. Also, industries which tend to be energy intensive have strongly opposed increases in the gasoline tax. The airline industry, for example, which is highly sensitive to changes in input prices, estimates that $2.8 billion will be lost each year as a result of Clinton's 4.3 cents per gallon increase (D'Amato 1993, p. S7729).

A third possible distributional effect of a higher gasoline tax is that it may help some urban dwellers on fixed incomes (e.g., social security beneficiaries). Since a significant percentage of these individuals do not make direct purchases of gasoline (they rely on public transportation), increases in indexed income may exceed increases in the price of the goods purchased. Of course, increased gasoline taxes may mean that gasoline-based public transit (e.g., buses) may raise fares. However, since these modes of transit use less gasoline per person per mile than do personal vehicles, it is likely that the increase in the general price level would exceed increases in transit fares. For example, suppose that the general price level rises two percent. Then, individuals whose incomes are indexed for inflation will see their incomes also rise two percent. If some of these people are not heavy consumers of gasoline, they will find their expenses will not rise the full two percent, causing their real income (or purchasing power) to increase. These effects may tend to reduce somewhat (or reverse) any regressive effects of the gasoline tax.[7]

A fourth factor which may mitigate the regressive nature of a gasoline tax increase is the long-run adjustment of the automobile market to higher gasoline prices. If automobile manufacturers begin to make more fuel-efficient vehicles, then gasoline price increases may not increase the total gasoline expenditure of low-income persons. Of course, it would take time for this effect to occur, since more fuel-efficient vehicles would first need to filter down into the used car market.

What difference does it make if the gasoline tax is progressive, regressive, or some combination of the two? The perception by policymakers as to which group bears the heaviest burden of any tax increase may lead to construction of compensatory programs to counteract the distributive effects of the tax. If policymakers believe that individuals in the lower-income deciles will assume the greatest burden of the gasoline tax increase, then additional support may be given to expansion of the Earned Income Tax Credit, the Food Stamp Program, or other programs that assist low-income individuals. If policymakers feel individuals in the middle-income deciles will pay the highest price, then additional support may be given for an income tax cut for the middle class. Thus, it may be less important for political purposes who actually bears the heaviest burden, and more important who is *perceived*

to bear the heaviest burden. Cynicism aside, however, it is vitally important for politicians and citizens to know who would be truly impacted by a substantial increase in gasoline taxes.

TOWARD AN EFFECTIVE PUBLIC POLICY

This article has made the case that a substantial increase in the federal gasoline tax would be a desirable public policy since it would bring gasoline prices more in line with actual social costs. Policymakers may have failed to make this seemingly simple adjustment due to other issues relating to the formulation and implementation of such a policy. In this section, some of the considerations relating to the formulation and implementation of a tax increase will be considered.

Table 3. Price of Gasoline in the United States over Time
Base Year = 1992

Year	Nominal price per gallon	Real price per gallon	Year	Nominal price per gallon	Real price per gallon
1960	$0.31	$1.45	1985	$1.18	$1.54
1965	$0.29	$1.33	1990	$1.16	$1.25
1970	$0.34	$1.23	1991	$1.13	$1.17
1975	$0.34	$1.39	1992	$1.05	$1.05
1980	$1.23	$2.10	1993	$1.03	$1.00
			1994	$1.02	$0.96

Sources: Cook 1990, p. 61; U.S. Department of Energy 1994, p. 31; author's tabulations.

Gasoline prices may be too low in the United States due to changes in market conditions. Prices rose sharply in 1980 due to cartel action by OPEC, but have been allowed to decline since then (see Table 3). However, just because the price to the private market is falling does not mean that the cost to society is also falling. Congress could prevent this decrease in prices by increasing taxes. However, as any student of American politics knows, virtually nothing is passed on Capital Hill without protracted debate and compromise. Congress has only occasionally decided to raise the gasoline tax. When increases have been passed, they have been insufficient to overcome the overall decline in the market. For example, the most recent tax increase was less than the rate of inflation.

The problem of decreasing gasoline prices could be corrected with a two-step change in policy. First, enact a large increase in the gasoline tax. Second,

adopt a policy which will yield automatic increases in the gasoline tax and, thus, keep the price of gasoline in line with inflation. Alternative methods could be used to implement this second change in policy. For example, Congress could enact a ten cent tax increase per-year, until the tax reached some desirable level (say, $2.00). Then, the tax could be linked to the consumer price index and increased automatically with inflation. This change would cost motorists more than the $25.80 per year which is expected under the Clinton tax increase (Tobias 1993, p. 53). However, the gradual nature of the change would allow producers and consumers to adjust their behavior without any sudden shocks. Moreover, once Congress passed such legislation, it may never again have to convene to increase gasoline taxes.

It is difficult to say exactly what such an increase would do to the average price of gasoline. The increased tax would be likely to force prices up and decrease the quantity of gasoline sold. Thus, producers and retailers of gasoline would need to increase their profit per gallon (and, thus, increase prices even further) if they wished to maintain the same level of average revenues from gasoline. A reasonable guess for the ultimate effect on gasoline prices is that they would probably rise close to the three to four dollars per gallon paid in other industrialized nations.

CONCLUSION

Although higher gasoline taxes will not entirely ameliorate the social costs of gasoline use described above, they can be important for making progress in these areas. Higher gasoline taxes would raise the price of gasoline and thus reduce gasoline consumption and the number of miles driven by motorists. These reductions may help mitigate incrementally the environmental, infrastructure, national security, and human costs described above. Moreover, revenues from the tax could be employed to "pay" some of the social costs, such as the cost of environmental clean-up programs and infrastructure maintenance. From this perspective, a more-stringent Pigouvian tax on gasoline would serve two main purposes. First, it would reduce the consumption of gasoline, and thus reduces damage to the environment and other social costs. Second, it would require those consumers and firms who are responsible for pollution and other social detriments to pay directly for the costs imposed on society. Americans have paid too little for their gasoline for far too long. Even incremental increases in the federal gasoline tax frequently have been defeated in a gridlocked Congress; they are only rarely victorious. It is time to enact a policy that will yield automatic increases in the gasoline tax as the rate of inflation increases. Only then will the average consumer have the incentive to take the steps that are necessary for a sound gasoline conservation policy in the United States.

NOTES

1 Ronald Coase (1960) has argued that if property rights are well-defined, the number of parties involved small, and the transaction costs minimal, then the freemarket will attain an efficient solution to the problem of social cost without the interference of government. However, these conditions are rarely satisfied in practice, since a large number of property owners are affected by pollution. Therefore, some form of government intervention is almost always needed.

2 Motorists probably also consider other private costs, such as oil, wear and tear, and the value of the passengers' time.

3 Effluent fees are taxes assessed on the basis of the amount of pollution emitted into the environment. For example, a tax assessed on new cars which was higher for cars with higher emissions of certain major pollutants would be an effluent fee.

4 Although current data was not available for Canada, previous data places it as the industrial nation with the second lowest gasoline prices. In the first quarter of 1992 the average price of gasoline in Canada was $1.79, including a $0.77 tax.

5 Elasticity is mathematically determined as the percentage change in quantity divided by the percentage change in price. For example, if the price of gasoline rises three percent and the quantity demanded falls two percent, then the price elasticity of demand = -2 + 3 -.66. If the percentage change in quantity is greater than the percentage change in price (that is, the price elasticity of demand is less than -1.00), then demand is said to be "price elastic." If the percentage change in price is greater than the percentage change in quantity (that is, the price elasticity of demand is between -1.00 and 0.00), then demand is said to be "price inelastic." Price elasticity of demand is usually given as a negative number due to the negative relationship between price and quantity: as price rises, quantity falls, and vice versa, other things being equal.

6 Rather than referring to any specific period of time, the short run is defined as the period of time in which one or more of the factors affecting the consumption of gasoline are fixed. Conversely, in the long run, all factors affecting the consumption of gasoline are variable. For example, in the short run, a motorist would be able to modify the number of

miles driven per week, car pool, use public transportation, or increase the frequency of oil changes to increase fuel efficiency; however, important variables such as the location of the workplace or the type of car driven may not be variable. However, in the long run, a motorist could adopt a change from a wider array of choices: the motorist could move closer to work (or get a new job) and, thus, reduce commuting length or purchase a more fuel-efficient automobile.

7 Conversely, low-income persons living in rural areas may be disproportionately hurt by higher gasoline prices, since they spend a higher than average percentage of their income on gasoline.

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