

TAXES VERSUS STANDARDS: POLICIES FOR THE REDUCTION OF GASOLINE CONSUMPTION

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Fossil fuel consumption and greenhouse gas emissions from the personal transportation sector promise to be key challenges facing the next generation of policy makers. In 1999, transportation became the largest end-use producer of carbon dioxide from fossil fuels in the United States. Gasoline-powered vehicles are responsible for about 60% of the carbon from the transportation sector. They also emit the majority of carbon monoxide, as well as substantial proportions of oxides of nitrogen and volatile organic compounds (Davis, 2004).

The transportation sector became the largest producer of carbon dioxide for two reasons. First, with the exception of 2007 and 2008, when gas prices reached new highs and the U.S. economy slumped into recession, households increased the number of miles they drove (Federal Highway Administration, 2009). Second, the vehicle fleet has become less fuel efficient so that in 2005, households on average used more gasoline per mile driven than they used per mile in 1987 (Davis, 2007). This is a stunning statistic, given that overall, the U.S. economy uses far less energy per unit of output now than it did 30 years ago.

Why did the transportation sector become less fuel efficient? After all, passenger cars sold now get about 7 or 8 more miles per gallon, on average, than those sold in 1978. And light-duty trucks, the category that includes pickups, vans, and sport-utility vehicles (SUVs), experienced an increase in fuel efficiency of about 3 miles per gallon since 1978. But the market share of light-duty trucks, which are less fuel efficient than cars, increased

dramatically over that time period, rising from less than one third of vehicles purchased in 1988 to more than half by 2000. Increases in SUV purchases were primarily responsible for the increase. The increase in the number of these less fuel-efficient vehicles, relative to the number of passenger cars, brought down the overall fuel economy of the U.S. vehicle fleet.

At the same time, problems related to traffic congestion and dependence on foreign oil intensified, and awareness of the likely impacts of climate change increased. Policy makers have therefore directed their attention toward policies for the reduction of gasoline consumption.

This chapter summarizes the current state of economic knowledge on whether government intervention in gasoline and fuel economy markets is justified, and if so, what form policies should take if they are to efficiently and effectively reduce gasoline consumption. It begins by defining market failure due to the presence of externalities and by describing the kinds of policies generally used to address such market failures in the United States. It then quantifies the external costs associated with gasoline consumption, concluding that the presence of a number of externalities in gasoline markets justifies government intervention in those markets. Following discussion of the relative efficiency of various policies that may correct failures in the gasoline market, this chapter considers the possibility that not only do consumers fail to internalize the costs they impose on others by consuming gasoline but they also fail to fully account for the fuel

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savings that can be had by buying a more fuel-efficient vehicle. If consumers are fallible in this way, then not only is intervention in gasoline markets justifiable on efficiency grounds, but so is intervention in the market for fuel economy. The same is true if automakers fail to provide a sufficiently broad and varied selection of fuel-efficient vehicles. The chapter concludes with a discussion of distributional considerations of policies for the reduction of gasoline consumption and with suggestions for directions for future research.

Justifications for and Types of Government Intervention

When consumers decide how much gasoline and the kind of vehicle to buy, or producers decide how much to sell, they weigh the private costs of their activities against the benefits. For example, consumers evaluate the prices of various vehicles, the costs of operating such vehicles, the price of gasoline, and the prices of alternative modes of transport. Producers compare the revenues that they expect to earn with the costs of refining and distributing gasoline or of producing various types of vehicles. Without proper incentives, however, consumers and producers will not include the costs that they impose on the environment and others in their decisions of how much and what to consume and produce. This failure to include these external costs in decisions results in a market failure: Drivers buy and use and producers sell too much gasoline and vehicles that are too inefficient. When market failure occurs, usually a case can be made for government intervention (West & Wolverton, 2005).

Governments have typically used both command-and-control (CAC) regulation and market-based incentives to resolve market failures. Prior to 1990, virtually every environmental regulation in the United States and elsewhere took the form of CAC regulations, and they are still commonly used. These regulations are so named because they command that emissions be controlled to meet a given minimum or maximum standard. As such, they tend to be either technology based or performance based.

Technology-based regulations mandate the control technology or production process that producers must use to meet the emissions or fuel economy standard set by the government. Such a standard might take the form of a requirement that a particular kind of vehicle, an electric vehicle for example, be adopted by all state and local governments. One problem with this type of CAC regulation is that it applies a one-size-fits-all policy to producers and consumers that may face very different costs of reducing gasoline consumption. Thus, while gasoline is reduced to the desired level, it is accomplished at a higher cost than might have occurred if firms and consumers were allowed to determine the most cost-effective means for meeting the standard. Alternatively, if more flexible policies were used,

more gasoline reduction or higher environmental quality and fuel efficiency could be achieved at the same cost. Technology-based CAC policies do not encourage vehicle manufacturers or consumers to find new and innovative fuel-saving strategies, nor do they provide an incentive to reduce consumption beyond the set level.

Performance-based regulations are more flexible CAC policies; they mandate that a standard be reached but allow producers and consumers to choose the method by which to meet the standard. Still, once they have reached the level specified by the standard, producers and consumers face little incentive to increase fuel economy or reduce gasoline consumption any further.

Market-based policies, on the other hand, are regulations that encourage behavior through price signals rather than through explicit instructions or mandates (Stavins, 2000). Many market-based instruments function as follows: A firm or a consumer faces a potential penalty in the form of a tax or permit price per unit of gasoline, emissions, or fuel inefficiency. The firm or consumer can choose to pay for existing gasoline or low fuel economy via the tax or permit, or they can instead reduce gasoline consumption or increase fuel economy to avoid paying the penalty. Other market-based policies might subsidize fuel economy. For example, the federal government subsidizes hybrid vehicles until manufacturers reach a specific production volume, and several states provide similar incentives.

Market-based policies give consumers and automakers more flexibility than most CAC policies. First, the method for reducing gasoline consumption is not specified, giving drivers or manufacturers with heterogeneous costs the flexibility to use the least costly fuel-saving method. Second, since market-based incentives force producers and consumers to pay taxes, buy permits, or forgo subsidies when they sell or drive fuel-inefficient vehicles, they provide an always-present incentive to take measures that reduce gasoline consumption. Such incentives, therefore, also promote innovation in fuel-saving technologies (for discussion of the effects of incentives on innovation, see, for example, Jaffe & Stavins, 1995; Laffont & Tirole, 1996; Parry, 1998).

Only in a very narrow set of circumstances could such market failures be addressed without government intervention. In a seminal article, Ronald Coase (1960) lists three conditions that must be met for an externality problem to be resolved without government intervention. There must be (1) well-established property rights, (2) a willingness of affected parties to bargain, and (3) a small number of parties affected. Although it might be possible to legislate rights for, say, fuel economy or a stable climate, it is less likely that oil companies, automakers, and those affected by the external costs of driving would be willing to bargain effectively. And as the number of parties affected by climate change includes the global population, Coase's third condition is clearly violated.

Failures in the Market for Gasoline

Think about the last time you drove or rode in a car. Did you consider the fact that your car pollutes the air with hazardous emissions, adds greenhouse gases to a warming atmosphere, increases congestion and the likelihood of accidents on the road, and exacerbates reliance on oil imported from areas prone to war and dictatorial regimes? More importantly, if you did think about these external effects of your gasoline consumption and driving, did you drive or ride in a car less than you would have had gasoline consumption been harmless, and did you opt for a more fuel-efficient vehicle? Maybe you did. But do most Americans? Probably not. This means that even if you are paying \$4.00 per gallon for gasoline, you are paying too little. That \$4.00 covers the costs of oil, refining, distribution, marketing, and state and federal gas taxes. But as we shall see below, the taxes per gallon fall far short of covering external costs.

Quantifying the External Costs of Gasoline Consumption

The external costs related to gasoline consumption are substantial, which implies that in the absence of government intervention, the gasoline market fails to operate efficiently. Parry, Margaret Walls, and Winston Harrington (2007) divide these costs into two categories: per gallon externalities and per mile externalities.

Per gallon externalities involve costs imposed on others when gasoline is burned, regardless of how many miles were driven when it was burned. Parry et al. (2007) suggest that a reasonable estimate for the costs of greenhouse gases per gallon of gasoline is 6¢, while the estimate of costs due to increased oil dependency is 12¢ per gallon (both in 2007 U.S. dollars).

Of course, uncertainty in the science of climate change and its effects, not to mention uncertainty about the relationship among gasoline consumption, oil dependency, and terrorism, imply that the true magnitude of these costs is itself extremely uncertain. But even if the per gallon external costs of gasoline consumption are much higher than the best guesses in Parry et al. (2007), it is very likely that the per mile external costs swamp per gallon costs. Traffic congestion in the United States causes drivers to lose billions of dollars per year of one of their most valuable resources: time. For this reason, external costs due to congestion are estimated to be a whopping \$1.05 per gallon (in 2007 dollars). Costs from increases in accidents due to increases in gasoline consumption when more miles are driven, plus costs from local pollutants such as carbon monoxide and ozone, add up to another \$1.05, for a total of \$2.10 per gallon in per mile external costs of gasoline consumption.

In addition to the per mile costs discussed by Parry et al. (2007), an increase in miles driven also involves a

more subtle but sizable cost. The argument goes like this: Because they face a tax that depends on how many hours they work, workers work too little, which implies that labor markets operate inefficiently. Any policy that further reduces the number of hours worked will exacerbate this inefficiency. It turns out that making either gasoline or miles cheaper, and thereby increasing miles driven, also reduces hours worked. If it costs a worker less to drive, for example, he or she might be more likely to take work off early on a Friday to drive to a weekend retreat. Sarah West and Robertson Williams (2007) find that because labor markets are so large, small reductions in hours worked that occur when miles driven increase involve potentially large efficiency losses, with the costs of reduced work hours amounting to about a third of the sum of the external costs estimated by Parry et al. (2007).

The magnitude of these external costs, when taken together and when compared to each other, has two important complications. First, existing federal and state gasoline taxes, which sum to an average of 40¢ per gallon, do not cover external costs. Second, since the costs associated with driving a mile far exceed the costs of burning the gasoline in isolation, any policy that increases miles driven is likely to be quite costly in terms of its effects on congestion and accidents.

Policies to Correct Failures in Gasoline Markets

It seems clear that gasoline markets will be inefficient if left to themselves. What should be done, then, to induce gasoline producers, automakers, and drivers to internalize the costs they impose on others? Any policy that does this successfully must induce consumers to use less gasoline. Mindful of the relatively high per mile costs of congestion and accidents, one can place policies that reduce gasoline consumption into two categories: those that also reduce miles driven and those that increase miles driven.

In the absence of an additional market failure (for example, a failure in the market for fuel economy, discussed at length below) or political or administrative constraints, a policy that also reduces miles driven—or at least one that does not increase miles driven—will be preferable to policies that reduce gasoline consumption but also increase miles driven.

Policies that increase the price paid per gallon or the price paid per mile can be expected to reduce both gasoline consumption and miles driven. Such policies include a tax per gallon of gasoline, a carbon tax or cap-and-trade program, a direct tax on vehicle-miles driven, or a pay-as-you-drive (PAYD) insurance premium (see Parry et al., 2007, for general discussion and Parry, 2004, 2005, for a more specific treatment of the PAYD insurance premium).

The gasoline tax has the advantage of being easy to administer, and in terms of per gallon externalities, it internalizes costs perfectly. It efficiently encourages drivers to consider their effects on the climate, since the amount of

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carbon released by a gallon of gasoline is independent of the manner in which it is combusted. The same is true for the effects on oil dependency. It is important to note that a gasoline price floor, which would set a minimum price for gasoline, would not attain the same efficient outcome as would a gasoline tax. Such a policy, which has been discussed in the U.S. Congress, would likely lead to inefficient gasoline shortages, when binding, and inefficiently low gasoline prices, when not binding.

When faced with a tax on gasoline, drivers will choose the most cost-effective method of reducing consumption. Consumers that live near work may opt to walk, bike, or take public transportation. Others might choose to change air filters more often, to monitor tire pressure more vigilantly, or to reduce highway driving speed. An increased tax on gasoline would also induce consumers to change their vehicle purchasing behavior. They might buy a Toyota Camry with a four-cylinder engine when they would have otherwise purchased one with six cylinders. Or they may replace a less efficient car with an established hybrid, such as a Toyota Prius, or with one of the newly emerging vehicle technologies. Advances in battery technology have now moved electric vehicles off the drawing board. High-end electric vehicles are currently available from Tesla Motors, and General Motors's Volt electric car is scheduled to go on sale in 2010. Low-end, inexpensive golf-cart type vehicles are being upgraded to meet crash protection standards. Plug-in hybrids are being readied for production. Gasoline taxes would increase the demand for these vehicles and reduce the demand for conventional gasoline-powered cars and trucks.

A tax on gasoline would also induce consumers to seek cheaper fuel alternatives for their conventional vehicles. About 49% of the gasoline in the United States is already E10 (gasohol), which is 10% ethanol. Brazil has completely freed itself from foreign oil dependence, with virtually all its cars running on E85, which is 85% ethanol. There are already 6 million "flex-fuel" vehicles in the United States that can run on E85 right now. Used conventional cars can be converted to flex-fuel for about \$100 in parts, including replacing the computer chip that controls the air mixture, attaching new fittings to the fuel lines, and replacing the rubber seals with nonrubber seals. Wal-Mart is working out the details with Murphy Oil Company to make E85 available at Sam's Club and Wal-Mart gas stations throughout the United States.

Switching to corn-based E85 is likely to reduce the per gallon costs of oil dependence, but it is also likely to result in higher greenhouse gases and greater health costs due to increases in particulate matter. Ethanol from sugar cane, however, is much more efficient than ethanol from corn, and ethanol from cellulose is another promising and rapidly developing alternative (see Hill et al., 2009, for more on the differences among various sources of and processes for producing ethanol).

However they respond to a gasoline tax, consumers will choose the cheapest of the set of all behaviors that reduce

miles driven or increase miles per gallon. The same would be true if they were faced with a carbon tax or if producers were required to pay a fee for a carbon permit. Direct taxes on miles driven or PAYD insurance would also reduce miles driven and lead to reductions in gasoline consumption. While these mileage fees could efficiently internalize the per mile externalities discussed above, they have been challenged by some who suggest that consumers may tamper with their odometers or that calculating miles driven using GPS technology may infringe on civil liberties.

On the other hand, any policy that acts only to increase fuel efficiency involves the undesirable incentive to drive more miles. Increases in fuel economy reduce the cost per mile, since they increase the number of miles that can be driven per gallon. As with any good, the law of demand holds here—as the price of miles drops, the quantity of miles driven rises.

The United States' main policy to increase fuel economy is Corporate Average Fuel Economy (CAFE) standards. It also assesses so-called gas guzzler taxes, but only on the most inefficient passenger cars, which are exclusively luxury sports cars. CAFE standards mandate that each vehicle manufacturer attain a specific average fuel economy in the cars it sells, and another applies for light trucks. At the time this book went to press, the federal government was in the process of overhauling these rules. The new rules will almost certainly impose more stringent (higher) fuel economy requirements.

CAFE is a CAC regulation. In particular, CAFE is a performance-based standard that allows manufacturers to choose the method by which to meet the standard. As such, performance-based standards are more flexible than a technology standard, which mandates that all manufacturers supply specific technologies (such as electric vehicles).

Still, once automakers have reached the level specified by the standard, they face little incentive to increase fuel economy any further. And CAFE applies a one-size-fits-all policy to firms that may differ widely in size and cost structure. Thus, while fuel economy is increased to the level desired by policy makers (which may be inefficiently low or high), it is accomplished at a higher cost to firms and consumers than might have occurred if different firms were allowed to attain different levels of average fuel economy. If firms for whom innovation in fuel economy technology is easier were induced to sell more vehicles than firms for whom such technology is more difficult, fuel economy goals could be attained at lower overall costs to society.

Feebates, which subsidize the purchase or manufacture of fuel-efficient vehicles and tax fuel-inefficient vehicles, would solve this problem, since manufacturers could choose exactly how to respond to the policy. Those who innovate cheaply would respond more than those for whom innovation is costly. A tax on fuel-inefficient vehicles would also be efficient, but the feebate has the potential advantage of being inherently revenue neutral, so any tax revenues taken in by the program would be rebated in the

form of subsidies to fuel efficiency. Such revenue neutrality is generally more attractive to policy makers in the United States, who risk damage to their popularity when they increase the overall tax burden placed on their constituents.

Both CAFE and feebates, however, increase miles driven by reducing the price per mile. This is the rebound effect, where gasoline consumption rebounds because driving is cheaper, offsets some of the reduction in gasoline made possible by higher fuel economy. Ken Small and Kurt Van Dender (2007) estimate this effect is about 10% of the initial reduction in gasoline consumption due to more stringent CAFE standards. Unless consumers fail to buy or producers fail to offer the efficient amount of fuel economy for reasons other than the existence of the external costs discussed above, then gasoline taxes, carbon taxes, or carbon cap-and-trade programs are almost certainly more efficient than policies that increase fuel economy but also increase miles driven.

Failures in the Market for Fuel Economy

The conclusion that a gasoline tax is an efficient (and thus preferable) policy instrument for the reduction of gasoline consumption rests on an economic model in which consumers make fully informed, rational decisions regarding both how many miles to drive and what vehicle to buy. It also requires that automakers provide consumers with an efficiently varied set of vehicles from which to choose. There are reasons to think that these conditions may not hold. In particular, there is evidence that consumers may not sufficiently value fuel economy when making the decision about what car to buy, and logical arguments suggest that producers offer fewer than the optimal number of choices of fuel efficiencies.

Possibilities for Market Failure due to Consumer Fallibility

Consumers may undervalue fuel economy because they do not fully and correctly calculate the present discounted value of the flow of future operating costs, which depend on driving behavior, fuel economy, and the future price of gasoline. That is, when choosing between a more fuel-efficient and a less fuel-efficient vehicle, a consumer may not correctly calculate or perceive the difference in what he or she will pay for gasoline in the one vehicle versus the other over the entire period during which he or she will own the vehicle.

This implies that in the absence of a corrective policy, consumers will buy too little fuel economy. It also implies that consumers will underreact to a greenhouse gas policy that raises the value of fuel economy by increasing the price of gasoline. As such, an additional policy, such as the CAFE standard, or a feebate, which subsidizes the purchase of fuel-efficient vehicles and taxes the purchase of

inefficient vehicles, can be welfare improving, even when carbon emissions have been priced optimally via a gasoline tax, a carbon tax, or a cap-and-trade program (see Fischer, Harrington, & Parry, 2007; Greene, Patterson, Singh, & Li, 2005; National Research Council, 2002; Train, David, & Levine, 1997, for discussions of the possibility that CAFE or feebates may be efficient in the presence of such consumer fallibility).

A growing body of evidence suggests many reasons to think that consumers may make systematic mistakes regarding the value of fuel economy. First, experimental evidence suggests that consumers are confused by the non-linearity of cost savings in miles-per-gallon-rated fuel economy (Larrick & Soll, 2008). For example, an increase in fuel economy from 15 to 16 miles per gallon implies a greater cost savings than an increase from 30 to 31 miles per gallon, but consumers tend to think these changes result in the same cost savings. Second, qualitative evidence from surveys of new car buyers suggests that most consumers are unable to articulate the key building blocks required for a present discounted-value analysis, including typical mileage, fuel economy ratings of their current vehicles, and a discount rate (Turrentine & Kurani, 2007). Third, analysis of data from the Michigan Survey of Consumers produces several results that are difficult to explain in a model of infallible consumers. Each month, the survey asks a sample of households whether it is a good time to buy a vehicle and why. Even when controlling for the real price of gasoline (the price that consumers pay, adjusted by inflation to account for the changes in purchasing power over time), consumers are more likely to cite gasoline prices and fuel economy as important when nominal gasoline prices (the price that is posted on gasoline station signs) are high and when prices have just changed. They also appear to respond more strongly to gasoline price increases than decreases (Sallee & West, 2007). There is also evidence that consumers act the same way when buying other durable goods, such as refrigerators and air conditioners—they do not fully account for the differences in energy costs when deciding between buying a more expensive but more fuel-efficient appliance and a cheaper but less fuel-efficient appliance (Dubin & McFadden, 1984; Hausman, 1979).

Skeptics, however, point out that of a vehicle's many characteristics, consumers probably understand fuel economy better than most of its other characteristics (Kleit, 2004). After all, a vehicle's fuel economy rating appears in large type on a window sticker placed on every new vehicle sold in the United States. And other researchers have found that consumers buying used cars do seem to fully account for differences in future operating costs across vehicle models (Dreyfus & Viscusi, 1995).

Part of the reason that economists have yet to reach an agreement on the existence or magnitude of consumer myopia or fallibility is that until recently, data and computing requirements were too onerous. To properly identify consumer fallibility, one must isolate consumer

responses from a whole host of other factors, including broad economy-wide movements and a multitude of production and pricing behaviors on the part of automakers. Work that measures the effects of changes in gasoline prices in used-car markets is promising, since it can more easily control for the confounding effects of vehicle manufacturers' pricing decisions. Such work finds that consumers internalize a surprisingly small proportion of operating costs when deciding which used car to buy (see Kahn, 1986; Kilian & Sims, 2006; Sallee & West, 2009) and provides preliminary support for the notion that consumers are fallible.

Possibilities for Market Failure due to Producer Behavior

It is also possible that market failures exist on the producer side. But even less is known about producer behavior, especially because (quite understandably) automakers are hesitant to share information about their production and pricing strategies.

Portney, Parry, Gruenspecht, and Harrington (2003) list a number of reasons why producers may undersupply fuel economy. First, the vehicle industry is oligopolistic, since a relatively small number of firms dominate the market. This may imply that these firms do not face the same incentives to provide fuel economy as firms in more competitive markets. Instead, these companies may engage in strategic behaviors that result in a lower-than-optimal amount of innovation.

Second, although engineering studies indicate that it is in the interest of automakers to supply vehicles of greater fuel economy, such studies may not capture the full costs of developing and implementing a new technology. Third, if automakers are unable to reap the full returns of investment in fuel-saving technologies because of copycat activity on the part of competitors, they will invest in less technology than is socially optimal.

However, it may simply be the case that consumers are unwilling to forgo the performance attributes, such as acceleration, that would likely be lost if automakers were to sell models that are more fuel efficient. Automakers may simply be responding optimally to consumer demands. After all, as Portney et al. (2003) remind readers, there are already a wide variety of fuel-efficient models from which consumers can choose.

Policy Implications if the Market for Fuel Economy Is Inefficient

Findings of consumer fallibility or inefficient producer behavior have the potential to shake the world of environmental policy making, since they imply that a policy that sets a price on carbon will not be sufficient to efficiently reduce gasoline consumption, and therefore greenhouse gases, from the personal transportation sector.

If consumers or producers do not buy or supply an efficiently high amount of fuel economy, then to attain the efficient amount of gasoline consumption, a tax or fee on carbon or a tax on gasoline must be paired with another incentive that induces further improvements in fuel economy. If consumers are fallible or producers provide too little fuel economy because of strategic behavior, the increases in miles driven that come about from increases in fuel economy will be warranted.

For the reasons discussed above, a feebate—or even just a tax on fuel-inefficient vehicles—would be more efficient than making CAFE standards more stringent. If consumers are myopic enough, disregarding part or all of the future fuel cost savings from choosing a more fuel-efficient vehicle, making CAFE more stringent might increase efficiency. The same is true if producers' supply choices are sufficiently constrained by strategic or other considerations.

Distributional Concerns

Because the extent and the magnitude of externalities in gasoline markets are so clear, most economists focus their attention on the potential efficiency-improving characteristics of policies that internalize such externalities. Equity, or distributional, implications of a tax on gasoline or carbon, however, are often cited as one of the strongest arguments against increasing or imposing such taxes. Many worry that poor households will bear a greater burden since expenditure on gasoline tax would be a larger proportion of their incomes than it would be for wealthy households. That is, they worry that a gasoline tax is regressive, as opposed to progressive, where the amount paid in tax as a proportion of income increases as income increases. They also worry that households will bear more of the burden than producers.

As explained in West and Williams (2004), an ideal measure of tax incidence would begin with a calculation of all of the changes in prices that would occur throughout the economy in response to the change in the tax rate and proceed with a calculation of the effects of those price changes on households' well-being. The obvious effect of an increase in the gasoline tax is a rise in the consumer price of gasoline, imposing a burden on gasoline consumers. But an increase in the gasoline tax could also lower the producer price of gasoline, imposing a burden on the owners of gas stations, gasoline producers, and perhaps in turn, through lower wages, on workers in those industries. It could also affect the prices of other goods that use gasoline as an intermediate input.

However, calculating such effects requires a great deal of information, most notably the demand and supply elasticities for all relevant industries and the distribution of ownership of firms in those industries. A few papers either hazard a guess on the relative burden on producers and consumers (e.g., Congressional Budget Office, 2003) or

estimate the relative burdens explicitly (e.g., Skidmore, Peltier, & Alm, 2005). But most incidence studies assume that the supply of consumer goods is perfectly elastic. This implies that the imposition of a tax on a consumer good does not affect the producer price of that good and thus that the entire burden of the tax falls on consumers.

These studies find that the gasoline tax is indeed quite regressive, one of the most regressive taxes in the economy (see Poterba, 1991; West, 2004; West & Williams, 2004). This is not surprising, since gasoline, like all energy, is a necessity—as income increases, so does consumption of gasoline, but not by enough to make wealthy households spend more on it as a proportion of their income than do poor people.

But West and Williams (2004) suggest a simple way to mitigate or even completely overcome the regressivity of the gasoline tax. By using the revenues from the gasoline tax to reduce taxes on work, the policy can be made significantly less regressive. And by using the revenues to give rebates of the same amount to all households, the policy can actually be made progressive. Such rebates do not reduce the efficiency of the gasoline tax, since the tax still provides the incentive to reduce gasoline consumption. Indeed, if gasoline tax revenues are used to reduce labor taxes, the overall efficiency of the gas tax policy is improved.

In part because such regressivity-reducing revenue rebate schemes are available, but more importantly because the externalities from gasoline use are substantial, economists do not rule out taxes on gasoline because of equity concerns. Indeed, more often, they operate on a general principle that it is best to use environmental policies to internalize externalities, regardless of their distributional implications, while relying on the income tax system to attain equity goals.

Unfortunately, very little is known about the equity implications of CAFE standards. When CAFE standards are binding, making automakers do something they would not have otherwise done, they increase the price of new vehicles because they force automakers to incur costs when investing in fuel-saving vehicle technologies. Since wealthy households are more likely than poor households to buy new vehicles, one might posit that wealthy households would pay the higher prices for new vehicles. In this case, CAFE standards would be progressive. But autoworkers are likely to bear some of the burden of binding CAFE standards, and used-car markets are also likely to be affected by CAFE, making the overall incidence of CAFE uncertain.

Feebates, on the other hand, would make new fuel-efficient vehicles cheaper. Both consumers and producers might be expected to reap some of the benefits of such a subsidy, and those selling and those buying gas guzzlers would share the costs of the tax portion of the policy. To the extent that wealthy households buy more fuel-efficient vehicles than poor households and therefore are more

likely to receive a government subsidy, a feebate might be expected to be regressive.

Conclusion and Directions for Further Research

If consumers are making fully informed, rational decisions about what kind of vehicles to drive and producers both reap the full benefits of investment in fuel-saving technologies and act competitively when supplying fuel economy, then policy makers can rely on a gasoline tax, a carbon tax, or a carbon cap-and-trade program to efficiently reduce greenhouse gases from the personal transportation sector. In such a context, it is very unlikely that CAFE standards, now the primary policy used to encourage fuel saving in the United States, can be efficient alone or in conjunction with a tax on gasoline or carbon policy. The primary problem with CAFE is that it reduces the price of driving, thereby inducing consumers to impose greater congestion and accident costs on others. Since a feebate also reduces the price of driving, it too can be expected to be inefficient.

Only if some additional imperfection causes the market for fuel economy to fail, if consumers are short sighted, or if automakers are restricted or restrict themselves in supplying the optimal variety of fuel efficiencies, can we expect for CAFE or a feebate to improve efficiency. If the market for fuel economy fails, economic theory tells us that the one-size-fits-all nature of CAFE, at least as the policy currently stands, renders it less preferable than a feebate.

To determine whether a tax on gasoline, a carbon tax, or a carbon cap-and-trade program is sufficient to induce the optimal amount of gasoline consumption and greenhouse gas emissions from the transportation sector—and how to best implement such policies—researchers must now focus on three main areas. First, they need to identify and quantify potential failures in the market for fuel economy. Second, they should refine estimates of the external costs of gasoline as new information on the potential effects of climate change becomes available. Third, they should gain a greater understanding of the potential distributional effects of any policy designed to increase fuel economy.

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