How Regulations Can Succeed Where Taxes Do Not: An Examination of Automobile Fuel Efficiency

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Abstract

In 1975 the United States government required automobile manufacturers to increase the corporate average fuel economy of their products. Why were such CAFE regulations more effective than increases in the price of gasoline in improving fuel economy? Our answer focuses on myopia by consumers, myopia by producers, and the rational incentive to delay irreversible investments.

1 Introduction

Much policy analysis asks whether a policy was effective, and examines whether different policies could have been more effective or more efficient. Often unasked and unanswered, however, is the issue of why a policy was effective. This paper examines regulations in the United States requiring automobile manufacturers to increase the fuel efficiency of their vehicles. Could such regulations make a difference when higher oil prices in 1979 and 1980 already gave consumers a great incentive to demand more fuel-efficient vehicles? A related question is whether command and control regulation can be more effective than an increased tax on gasoline. The standard answer is No. But given the extensive data showing that fuel-efficiency regulations did matter, an inquiry into why they mattered is appropriate.

2 History of CAFE

Following the energy crisis of 1973, Congress enacted the Energy Policy and Conservation Act, mandating minimum corporate average fuel economy (CAFE) standards for all new light-duty passenger vehicles sold in the United States. Each automobile manufacturer was essentially required to double the fuel-efficiency.[1] The efficiency targets were to be phased in: 18.5 mpg for the 1978 model year, 21 mpg for the 1980 model year, and 27.5 mpg for the 1986 model year.[2] The Act imposed a fine of $5 per car sold per 0.1 mpg shortfall, but firms earned credits when they exceeded standards. In no year did any American manufacturer pay fines, though some foreign firms did.[3]

[1]The measure of fuel efficiency for a manufacturer was the average miles per gallon (mpg) of its entire fleet. Congress voted against a proposal to require each vehicle to meet the standards.

[2]For 1981 through 1984 the Secretary of Transportation determined the fuel economy standards. For 1985 or after the Secretary of Transportation could modify the standard in a range of 26-27.5 mpg, but subject to Congressional veto. See *United States Code*, Title 15, section 2002. The standards mandated by the 1975 Act were relaxed three times, by the authority granted to the Secretary of Transportation. Standards for the 1986 model year were relaxed to 26 mpg in October 1985; standards for the 1987 and 1988 model years were relaxed to 26 mpg in October 1986; standards for the 1989 model year were relaxed to 26.5 mpg in September 1988.

[3]For example, in 1991 the federal government collected total fines of $54,578,880. Of these, BMW paid $14,878,160, and Mercedes-Benz paid $17,556,105.

3 Effects of CAFE

As the table below shows, fuel economy of new cars increased by over 60 percent between 1975 and 1985. Fuel efficiency and remained at the higher level even when gasoline prices declined after 1983.[4] All three domestic producers greatly increased the fuel economy of their vehicles. Even Rolls-Royce, whose customers we suspect would not prefer to sacrifice performance or quality for increased fuel economy, improved fuel economy by over 25 percent since 1978.

Fuel Efficiency of US Produced Automobiles

Model Year	Federal Standard	Chrysler	Ford	GM	Industry
1975					15.8
1978	18.0	18.4	18.4	19.0	18.7
1979	19.0	20.5	19.2	19.1	19.3
1980	20.0	22.3	22.9	22.6	22.6
1981	22.0	26.8	24.1	23.8	24.2
1982	24.0	27.6	25.0	24.6	25.0
1983	26.0	26.9	24.3	24.0	24.4
1984	27.0	27.8	25.8	24.9	25.5
1985	27.5	27.8	26.6	25.8	26.3
1986	26.0	27.8	27.0	26.6	26.9
1987	26.0	27.5	26.9	26.9	27.0
1988	26.0	28.5	26.6	27.6	27.4
1989	26.5	28.0	26.6	27.2	27.2
1990	27.5	27.4	26.3	27.1	26.9
1991	27.5	27.5	27.7	27.2	27.3
1992	27.5	27.8	27.3	26.8	27.0

A comparison of changes in fuel efficiency in different countries also suggests that CAFE regulations mattered.[5] Since the oil crisis of 1973, average mpg in the U.S. fleet increased by 45 percent; in France it declined, in Japan it was unchanged,

[4]Data come from Department of Transportation, National Highway Traffic Safety Administration, “Automotive Fuel Economy Program Report to Congress" *Federal Register* 58 FR 6837, February 2, 1993.

[5]See also Schipper, et al. (1993).

and in other countries it barely improved. Given that the US fleet includes many cars built before CAFE standards became effective, it is not surprising that the US fleet is on average less fuel-efficient. New cars in the United States have mpg very similar to those in Europe and Japan, even though the price of gasoline in the United States is half of that in Germany, or a third of that in Sweden.[6]

Fuel Economy in Various Countries

Year	Japan	France	Italy	Sweden	UK	Germany	US
1973	21.4	27.9	27.8	21.5	21.7	21.9	13.0
1974	21.4	27.6			21.8	22.1	13.1
1975	21.4	27.2			22.5	21.9	13.2
1976	21.4	26.2		22.1	22.6	21.8	13.2
1977	21.4	26.3			22.4	21.6	13.5
1978	19.6	25.9		21.8	22.0	21.4	13.7
1979	19.6	26.3	27.8		21.5	21.7	14.0
1980	19.6	27.5	28.7		22.6	21.5	14.9
1981	19.6	28.0	28.0	21.6	23.5	21.6	15.3
1982	21.4	26.8	28.0	21.5	23.6	21.6	15.9
1983	21.4	26.6	28.2	21.8	23.7	21.6	16.3
1984	21.4	26.8	28.7	21.8	23.7	21.6	16.8
1985	21.4	26.9	28.9	22.0	24.1	21.6	17.1
1986	21.4	26.8	29.4	22.4	24.0	21.6	17.1
1987	21.4	26.9	29.9	22.8	24.4	21.8	17.5
1988	21.4	26.5	30.1	23.1	24.1	22.0	18.4
1989		26.9	30.6	23.1	25.3	22.4	18.9

Not all agree that CAFE is desirable or effective.[7] Officials in the administration of President Ford testified against mandatory fuel-economy standards, saying that consumers had sufficient incentives to buy fuel-efficient cars.[8] The National Highway Traffic Safety Administration, charged with enforcing the CAFE standards, takes an ambiguous position. It claims, for example, that the market, and

[6]For data on fuel prices, see *Statistical Abstract of the United States*, 1993-1994, Table 1417.

[7]For a survey see National Research Council (1992).

[8]House Report No. 94-340, Committee on Interstate and Foreign Commerce on PL-94-163, Energy Policy and Conservation Act of 1975.

not the CAFE program, is primarily responsible for the approximately 15 percent weight reductions that occurred since 1975. Crandall, *et al.* (1986) claim that OPEC's gasoline price increases were the force that induced consumers to purchase more fuel-efficient cars, and that the CAFE standards were irrelevant.[9]

Some analysts therefore claim that an increased tax on gasoline would have been a better policy. Thus, Leone and Parkinson (1990) argue that a 2.4 cents tax per gallon would have saved as much fuel consumption as CAFE, at about one-seventh the social cost. A study sponsored by the Motor Vehicle Manufacturers Association claims that a 40 mpg CAFE standard would cost consumers $104 per ton of carbon dioxide removed, or $45 per barrel of oil saved. By contrast, a gasoline tax would cost only $23 per ton of carbon dioxide removed and only $10 per barrel of oil save. Other studies (see National Research Council (1992)) find that the tax necessary to meet CAFE standards may be as high as a dollar per gallon.[10]

4 Why Regulations May Work

The argument against CAFE and in favor of taxation or a reliance on the market rests on a chain of incentives:

- An increase in gasoline prices causes consumers to demand more fuel-efficient cars.
- Manufacturers foresee this change in consumer demand.
- Hence manufacturers will make investments to produce fuel efficient cars.

We shall examine these assumptions in turn.

4.1 Consumer expectations

Consider the textbook world of perfect rationality. The rational consumer considers the future path of gasoline prices and buys a car of appropriate efficiency. But how

[9] Greene (1990), provides a contrasting evaluation, and estimates that CAFE standards were at least twice as important as fuel price rises in increasing fuel efficiency.

[10] Congress, however, resoundingly rejected such an approach. The House had rejected by a vote of 345-72 a 20 cents per gallon gasoline tax the day before it adopted the CAFE standards in 1975. It also voted by 209-187 to reject a tax of 3 cents per gallon. See "Auto fuel economy standards mandated," *CQ Quarterly Report*, July 19,1975, p. 1525.

does the consumer estimate future prices? If he believes the current high prices are a temporary aberration, he will make not change his purchase decisions.

Now suppose you are the President in this hypothetical world. All your experts argue that gasoline use must be reduced, for a variety of economic and environmental reasons. Your cabinet presents you with two alternative energy conservation policies:

- The variable tax. Institute a fuel pricing policy that generates enough certainty in the minds of consumers to allow them to make efficient decisions. You should announce: "From now on, the real price of gasoline will be $2 per gallon. We will achieve this by placing a variable gasoline tax on top of the OPEC price. If the OPEC price should happen to fall, we will raise the tax enough to keep the final price at $2."

- The technology mandate. Require manufacturers to improve the fuel efficiency of their line of new light-duty vehicles.

Although the variable tax seems to solve the consumers' price forecasting problems, it does not. Consumers know that tax policies are subject to change with the whim of Congress or new Administrations. Such a tax policy is not credible, so consumers (even non-myopic ones) are unlikely to purchase the fuel-efficient cars that your experts say are needed.

Contrast a tax with the technology mandate. A tax may be removed after a few years. But manufacturers who retooled their assembly lines and learned how to produce fuel efficient cars will not reverse these changes even if a later government repeals the regulations.

4.2 Myopic consumers

An increase in gasoline prices is unlikely to increase vehicle fuel efficiency if consumers do not consider future operating costs when deciding what car to purchase. There is direct evidence on this point.

In the eight years following the 1973 oil embargo, the real price of gasoline increased by about fifty percent. The increased prices should have made gas-guzzling automobiles less desirable, giving a price premium to fuel-efficient cars. Kahn (1986) estimated the size of these effects: how much did an increase in gasoline prices reduce the price of low-mpg automobiles?

Consider a consumer choosing between cars with different fuel efficiencies, but that are similar in other respects. Kahn found that, on average, an increase in gasoline prices sufficient to cause a $1,000 per year difference in the expected operating costs of the two cars reduced the selling price of the inefficient car by only $370 to $500. That is, a $370 to $500 increase in purchase price would bring a $1,000 saving in operating cost the first year, and continued savings in later years. It is difficult to explain why farsighted consumers would refuse to spend more than $500 to gain a first-year saving of $1,000 in operating cost. The implicit discount rate needed to explain this decision is incredibly large.

Consumer myopia is also found in studies of consumers' implicit discount rates, which are both high and variable. For example, studies of purchase decisions for space heating systems show discount rates ranging from 2 percent a year to 68 percent; studies on energy-efficient refrigerators show discount rates of 30 percent to 300 percent; studies on water heaters show discount rates of 24 to 67 percent.[11]

Many works by economists commonly assume such myopia. Consider the theoretical justifications for social security. Textbooks inform students that "One rationale [for social security], and perhaps the most important one, is based on paternalism: People may be unwise, shortsighted, or ill-informed. When they are young, they may fail to save adequately for old age..." (Boadway and Wildasin 1984, p. 461); "The usual argument is that individuals are not farsighted enough to buy enough insurance for their own good and therefore the government must force them to. For example, it is popularly believed that in the absence of social security, most people would not accumulate enough assets to finance an adequate level of consumption during their retirement" (Rosen 1988, p. 195); "The programs were introduced partly for income distribution reasons...partly because it was felt that individuals might suffer from myopia and not provide adequately for their own retirement" (Blanchard and Fischer 1989, p. 110). In the professional literature such statements are made by Diamond (1977), Feldstein (1985, 1987), Atkinson (1987, pp. 808-809), and Kotlikoff (1987).

Empirical work supports this argument for myopia. Consider one implication of the assumption that consumers are not myopic and have rational expectations: consumption should respond to news of income changes rather than to the income changes themselves. Wilcox (1989) tested this idea by studying purchases made by recipients of Social Security benefits. He noted that increases in Social Security benefits are announced at least six weeks before taking effect. Consumers who have

[11] See Dubin (1992) Tables 1 and 2.

rational expectations should adjust their consumption immediately after learning about forthcoming changes in benefits, and not wait six weeks until they receive the higher benefits. But Wilcox finds strong evidence that consumption responds to actual rather than to anticipated changes in Social Security benefits.

Similar myopia is found in the behavior of taxpayers. In 1992, the income tax withholding tables were adjusted to reduce withholding. A typical worker received an extra $28.80 in take-home pay per month in March through December 1992, to be offset by a lower tax refund in 1993. The change in withholding amounted to 0.5 percent of Gross Domestic Product. President Bush, who proposed this change in his State of the Union address, intended that it provide a temporary stimulus to demand. But the policy change involved only the timing of income. If consumers are forward-looking, the change would have a negligible effect on consumption and aggregate demand.

Shapiro and Slemrod (1993) analyzed a survey taken shortly after the lower withholding went into effect. Forty-three percent of consumers reported spending the extra take-home pay—much more than the zero percent predicted by the standard models. The fraction of income earners who correctly noted the change in withholding rates a month after the change was only one-third.

4.3 Myopic producers

Firms usually pay attention to their markets, anticipate market changes, learn from their mistakes, and plan rationally. Such behavior, however, does not describe American automobile manufacturers over the past two decades. They ignored the urgent warnings made by analysts outside the industry. They ignored the successful practices of their foreign competitors. They were slow to recognize that the world had changed, and that they had to change with it. As a result, the American manufacturers lost market share and billions of dollars. One of the big three manufacturers, Chrysler, was saved from bankruptcy only by a government bailout. The auto industry does not provide a textbook case of rational profit-maximizing decisions.[12]

[12] *Automotive News* (January 24, 1994, p. 16) gives anecdotal evidence about suppliers to the industry. Toyota, the industry's most efficient producer, offers free advice to its suppliers about the Toyota Production System. Most of this advice requires no investment by the parts makers, and has produced efficiency gains of 50 to 100 percent. Nevertheless, out of the thousands of U.S. suppliers—391 of whom supply Toyota—only 22 have requested Toyota's free assistance.

Recent literature provides one reason for rational managers to reject potentially profitable investments. In particular, Scharfstein and Stein (1990) claim that rational managers may be unwilling to undertake some line of investment unless other firms do as well. Such behavior arises when managers are concerned about their reputations in the labor market: rational managers with imperfect information may find it advantageous to mimic the behavior of other managers. The essential idea was expressed by Keynes in *The General Theory* (1936, pp. 157-158):

> ... it is the long-term investor, he who most promotes the public interest, who will in practice come in for most criticism, wherever investment funds are managed by committees or boards or banks. For it is in the essence of his behavior that he should be eccentric, unconventional, and rash in the eyes of average opinion. If he is successful, that will only confirm the general belief in his rashness; and if in the short-run he is unsuccessful, which is very likely, he will not receive much mercy. Worldly wisdom teaches us that it is better for reputation to fail conventionally than to succeed unconventionally.

Thus, an unwillingness to invest by a few managers may discourage investment by many additional managers. An industry-wide regulation, such as CAFE, may therefore induce additional investment.

5 Delay

Even if the long-run effect of increased gasoline on fuel-efficiency is the same as a CAFE regulation, the short-run effects can greatly differ. The differences arise because a rational consumer or firm has an incentive to delay undertaking an investment. (For succinctness we shall call a consumer or a firm contemplating an investment an investor.)

The delay can be caused by two factors. First, in the short run a consumer consume can use less gasoline by driving less, tuning his car more frequently, increasing the tire pressure of his car, and so on. Such reductions in fuel consumption reduce a consumer's gain from purchasing a fuel-efficient car.

A different reason for delay arises with uncertainty about future costs or benefits. The relevant principles were first presented in the theory for option markets. Pindyck (1991) and Dixit (1992) present related principles for the timing

of investments. They show that a firm (or government) may gain by postponing a decision to adopt a profitable investment.

Delay may be advantageous when the following three conditions are satisfied. (1) The investment entails some sunk cost; this cost (such as expenditure on specific machinery or causation of environmental damage) cannot be recouped if the action is later reversed. (2) The decision maker is uncertain about future economic conditions, and can obtain additional information only gradually. (3) An investment not undertaken now can be undertaken later.

To illustrate the basic idea, consider an investment that in the current period costs 100 and in the next period generates benefits of either 80 or 140. Let these two outcomes be considered equally likely. For simplicity, let the inter temporal rate of time preference be zero. If the project is immediately adopted, the expected net benefit is $1/2(-100 + 80) + 1/2(-100 + 140) = 10$.

Suppose that if the decision is postponed for one period the benefits become known with certainty. Therefore, if the benefits turn out to be 80, the investment will not be made. If the benefits turn out to be 140 the investment will be made, for a net benefit of $-100 + 140 = 40$. Since these outcomes are equally likely, the expected benefits when the decision is postponed are $(1/2)0 + (1/2)40 = 20$. This expected benefit is greater than the expected benefit of 10 obtainable when the investment is made immediately. A risk-neutral consumer or firm should postpone the decision.

The benefit of postponement arises because it allows an investor to reject the investment when it turns out to have negative net benefits. More generally, postponement can be worthwhile if new information could induce the investor to change its decision.

The example can be generalized. It is not necessary that in later periods an investor knows with certainty the benefits of the investment. Instead, we can allow for a partial resolution of uncertainty. The technical analysis then employs the notion of information sets.[13] To illustrate, suppose that initially the investor believes the investment is equally likely to have net benefits of -20, 0, 10, or 20. The expected value is then 2.5. In the second period the investor gets some new information. It now knows that the net benefits lie either in the set $(-20, 0)$, or else in the set $(10, 20)$. Each set is equally likely *a priori*, and each value in each set is equally likely. Now the investor will make the investment only if it believes the benefits lie in the set $(10, 20)$.

[13] See, for example, Binmore (1992), section 10.4.

To apply these insights to our purposes, consider an increase in the price of gasoline caused by a tax or by reduced supply of oil by OPEC. A cost-benefit study may show that consumers would profit from purchasing more fuel-efficient automobiles. That, however, does not mean they will immediately do so. Rational consumers may prefer to wait until uncertainty about technology or gasoline prices is resolved. Similarly, even if consumers immediately demand more fuel-efficient vehicles, manufacturers may prefer to wait before undertaking costly research and development, redesign of cars, and retooling of assembly lines. Even if an increase in the price of gasoline has powerful effects, those effects may be delayed. Regulation, such as CAFE rules, can force quicker responses than taxes.

The data show that CAFE regulations worked. We now have some idea why.

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