RESEARCH SUMMARY

The Economics of Attribute-Based Regulation: Theory and Evidence from Fuel Economy Standards

by Koichiro Ito and James Sallee

KEY TAKEAWAYS

1. Fuel economy standards can be effective in reducing oil consumption and greenhouse gas emissions to achieve energy security, climate and pollution goals.

2. As countries, including the United States, reevaluate fuel economy standards, they should reconsider the unintended consequence of a size-based approach such as footprint- or weight-based standards.

3. The authors study weight-based fuel economy standards in Japan, which offer a unique platform to evaluate real life changes because they have existed for more than three decades and seen several policy reforms.

4. The weight-based standard incentivizes automakers to increase vehicle weight as a means to achieve compliance without significantly improving fuel economy.

5. A flat standard that allows for compliance trading, by which those who achieve the standard can sell credits to those who do not, is the most effective policy design. This more efficient policy would achieve the fuel economy target for less than half the cost of size-based regulations.

Introduction

With the original goal of reducing oil consumption following a national oil embargo in the mid-1970's, the United States began a program to regulate vehicle fuel efficiency. In the years that followed, improving efficiency in order to reduce greenhouse gas emissions became an additional goal of the program. By 2012, the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) jointly came together to issue new regulations governing light-duty vehicle carbon dioxide emissions and fuel efficiency for the period 2017-2025.

Known as the National Program, the rules envisioned significant improvements in efficiency, growing from a targeted performance of 30.1 miles per gallon (mpg) in 2012 to an estimated combined fleet average of 54.5 mpg in 2025—an increase of 81 percent. The rules—and indeed, the decades of fuel economy regulation that began in 1975—have produced important economic, energy and environmental benefits. The efficiency of the entire, on-road U.S. passenger car fleet stood at just 14 mpg in 1977, the year before the first standards came into effect. By 2014, it stood at 25.4 mpg. Light truck fleet efficiency increased from 11.2 mpg to 18.5 mpg over the same period. While market pressures and technological changes have contributed to these improvements, the rules have played an important role in improving vehicle efficiency and reducing greenhouse gas emissions.

One important feature of the National Program is that it is attribute based, making it unique from past fuel economy rules which prescribed fleet-wide averages for cars and trucks. Under an attribute-based approach, a particular characteristic is used to sort vehicles into groups with differing requirements. In this case, the attribute is the 'footprint,' which is the rectangle formed by the four points where a vehicle's tires touch the ground. Each motor vehicle footprint bin is required to achieve increasing levels of efficiency annually over the course of the National Program, with smaller vehicles facing steeper increases and larger vehicles facing more modest requirements.

An automaker's compliance level is determined by the average fuel economy or GHG efficiency produced by the mix of vehicles it sells in a given year. In other words, each automaker has individually tailored compliance and performance levels based on the vehicles it produces and sells. Further, if the automaker goes beyond its compliance target in a given year, the company generates "credits," denominated in tonnes of greenhouse gas emissions, which they can bank to cover future shortfalls or sell to other companies that would otherwise come up short of their target.

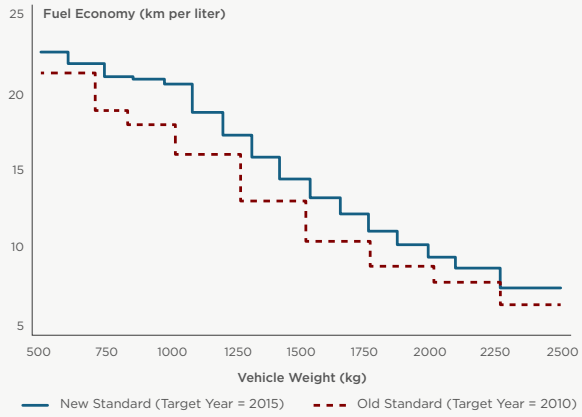
This paper studies the cost and benefit of an attribute-based program over other approaches, such as a trading scheme. It does so noting that the four largest car markets—China, Europe, Japan and the United States—all use an attribute-based approach. This regulatory approach is also popular in other regulatory settings. Regulations such as the Clean Air Act, the Family Medical Leave Act, and the Affordable Care Act are attribute based because they exempt some firms based on size.

Research Design

The authors study the Japanese fuel economy standard, using data from the Japanese Ministry of Land, Infrastructure, Transportation, and Tourism (MLIT). To be in compliance with the regulation, firms must have a sales-weighted average fuel economy that exceeds the sales-weighted average target of their vehicles, given their weights. There is also no trading of compliance credits across firms, although it is one of the key issues in the ongoing policy debate.

Unlike the program in the United States, as well as in Europe, the Japanese fuel economy standard has existed for more than three decades and seen several policy reforms. Another interesting feature of the Japanese regulation is that the fuel economy target has declining "steps" (see figure 1). Automakers have strong incentives near the edge of each step to increase car weight to move up to the next weight category. Moving up to the next weight category substantially lowers the fuel economy target.

Figure 1 · Fuel Economy Standards in Japan



The dashed line shows the fuel economy standards in Japan until 2010. The solid line shows the new standards with a 2015 target year.

The researchers' data, which covers all new vehicles sold in Japan from 2001 through 2013, spans the two most recent policy regimes. In 2009, the Japanese government introduced new standards, as well as a new subsidy that applied to each car model rather than the corporate average. If a car had fuel economy higher than the subsidy cutoff consumers purchasing that car received a direct subsidy of approximately $1,000 for most cars. In addition, cars with fuel economy 10 percent and 20 percent higher than the subsidy cutoff received more generous subsidies in the form of tax exemptions.

This policy change—whereby vehicles were judged based on both weight (to be in compliance) and fuel economy (to receive the subsidy)—became vital to the researchers' methodology because it allowed them to compare how the targeted goal of the policy (i.e. fuel economy) changed relative to the attribute-based scheme (i.e. weight). The researchers

constructed panel data of 439 domestic cars by comparing the weight and fuel economy of cars sold under the old policy to those sold under the new policy.

The researchers study two factors:

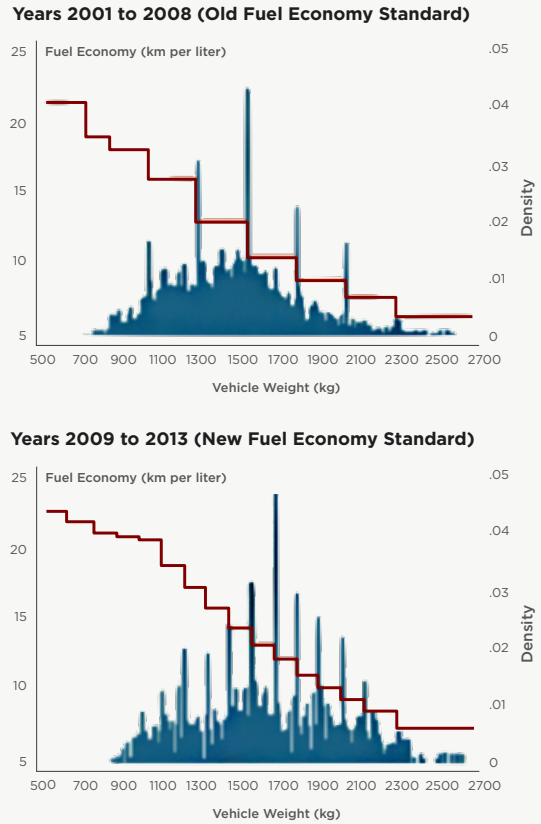
1. Do automakers manipulate the weight of the vehicles according to compliance levels?

2. What is the most efficient policy: attribute-based fuel economy standards, a flat standard without compliance trading, or a flat standard with compliance trading?

Findings

1. Automakers change the weight of their vehicles in response to attributed-based compliance targets. The authors found that attribute-based fuel economy standards incentivized the automakers to increase vehicle weight. When plotting vehicle weight in relation to the fuel economy target schedule, the researchers found that there is a mass of cars located at the bottom of the step function of fuel economy, suggesting automakers manipulate weight to have less stringent compliance targets. When the compliance levels changed under a new policy, the vehicle weights shifted with them.

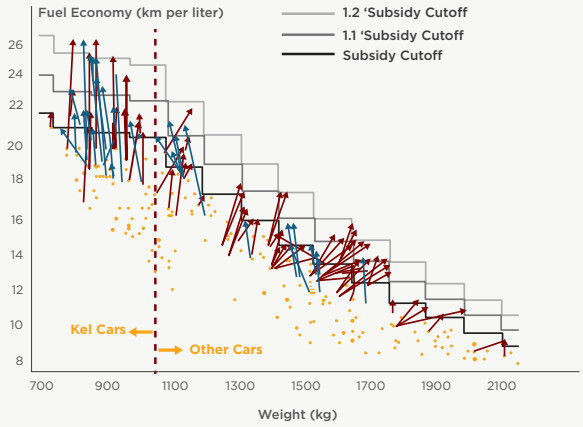
Figure 2 · Fuel Economy Standards and Histogram of Vehicles



The number of cars on the market rises significantly at the bottom of each step function, with the steps indicating the next weight category with a lower fuel economy target.

2. Ten percent of vehicles had their weight increased in response to the policy. The same trend is visible when plotting this shift along the subsidy cutoff. The arrows show the changes in fuel economy and weight for the same car model between 2008 and 2012 (e.g. the Toyota Corolla 2008 model vs. the Toyota Corolla 2012 model). The movement toward "northeast" of the diagram indicates that many cars had an increase in fuel economy but also an increase in weight to obtain the subsidy. Ten percent of Japanese vehicles had their weight increased in this way. Among the affected vehicles, the researchers estimate that weight rose by 110 kilograms on average.

Figure 3 · The Subsidy Eligibility Cutoff and the Responses to the Incentive



The solid lines are the three step functions that correspond to the three tiers of the new subsidy's eligibility cutoffs in 2012. A car had to be above the eligibility cutoff line to obtain the subsidy. The yellow dots show each car's fuel economy and weight in 2008—the year before the introduction of the subsidy. The arrows show how the weight and fuel economy changed for the cars that received the subsidy in 2012.

3. Attribute-based fuel economy standards cost twice as much as a flat standard that includes a mechanism to trade credits. When comparing the attribute-based fuel economy standards to a standard with a flat compliance level both with and without the ability to trade credits, the attribute-based scheme is twice as costly as a flat standard with compliance trading. A flat standard with compliance trading reduced the weight of cars broadly and had the lowest compliance cost.

4. When trading credits is not an option, attribute-based standards are more effective than a simple flat standard. When there is no option to trade credits, either for political or other reasons, attribute-based standards can be effective in spreading out compliance costs while also improving fuel economy by 10 percent. However, vehicle weight increased by about 3 percent.

The flat standard, by contrast, reduced the weight of vehicles, but at a higher compliance cost. On average, the flat standard results in compliance costs that are slightly higher than the attribute-based standards and 3.73 times higher than the flat standard that includes compliance trading.

Policy Implications

As a growing number of countries adopting attribute-based regulations across various industries, the study's results suggest that these schemes can undermine policy goals. Specifically, in relation to size-based policies to achieve vehicle fuel efficiency, the overall cost to the economy is quite large. This should spark concern about their use not only in Japan, where roughly 5 million vehicles are sold a year, but also in China (the world's largest car market), the EU, and India—all of which have weight-based fuel economy regulations.

In the context of the United States policy, the study's results offer one reason why the consumer fleet is trending more and more towards light trucks and SUVs. The footprint standards incentivize auto companies to produce larger vehicles. As the fuel economy standards are revaluated, these findings suggest that the footprint standards should be eliminated for a flat standard and the credit trading system maintained.

"Having a flat standard with compliance trading where automakers can trade credits is the best option, improving fuel economy at a low compliance cost. The U.S. fuel standards already have this trading scheme in place. Making a switch away from the footprint-based system and toward the most efficient policy option can be within reach."

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