Economics Letters 160 (2017) 20–23

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Environmental protectionism: The case of CAFE

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HIGHLIGHTS

- In 2011 the US altered automobile fuel economy standards to vary with vehicle size.
- The switch favored domestic vehicles over imports.
- The switch was equivalent to a tariff on imported vehicles

ARTICLE INFO

Article history:
Received 22 May 2017
Received in revised form 26 July 2017
Accepted 18 August 2017
Available online 23 August 2017

JEL classification:
F1
Q4

Keywords:
Pollution
Regulations
Fuel economy
Automobiles

ABSTRACT

In 2011 the US changed its automobile fuel economy standards from a uniform, fleet-wide average, miles-per-gallon target, to one that varies with car sizes. Smaller cars now must meet stricter standards. While the motive for any policy change can be disputed, the consequence of this change looks like environmental protectionism, because the favored larger cars are disproportionately assembled in the US. The change imposes costs on imported cars equivalent to a tariff of $50 to $200 per vehicle.

Introduction: Environmental Protectionism

International trade agreements like the General Agreement on Tariffs and Trade (GATT) prohibit countries from using environmental standards as protectionism, either by weakening their standards to favor domestic producers against foreign competitors, or by targeting imported goods with stricter standards. Specifically, Article XX of the GATT forbids using domestic regulations as a "disguised restriction on international trade". The NAFTA and the Trans Pacific Partnership contain nearly identical language.

That countries might attempt this type of "environmental protectionism" should not be surprising, at least in theory. Ederington (2001) provides the straightforward intuition. Textbook protectionism relies on tariffs, such as the US tax on imported cars (2.5 percent) and light trucks (25 percent).[1] That favors domestic producers at the cost of higher prices paid by domestic consumers. As an alternative, countries could protect domestic industries by loosening the environmental regulations they face. That would favor domestic producers at the cost of lower environmental quality for domestic residents.

In practice, Ederington and Minier (2003) show that American environmental regulations are less stringent for industries confronting more import competition. That provides circumstantial statistical evidence of environmental protectionism, but no smoking gun. It does not identify any particular regulation as a disguised trade restriction.

One such example might be found in Miravete et al. (2016). They show that automobile emissions regulations in the European Union (EU) are stricter than in the US for carbon dioxide (CO_2), but less strict for nitrogen oxides (NO_X).[2] That distinction favors European-made cars with diesel engines, amounting to a 13–16 percent tariff on imports. But interpreting that as protectionism depends on whether the EU or the US has the "right" standard for each pollutant. Did the EU choose a lax NO_X standard to protect European diesel manufacturers, or did the US choose a lax CO_2 standard to protect US manufacturers from imported diesels? Or

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[1] See McCalman and Spearot (2013) for an analysis of this policy.

[2] Also see Klier and Linn (2016), and European Parliament (2016).

http://dx.doi.org/10.1016/j.econlet.2017.08.019
0165-1765/

Table 1
Difference in average mpg and footprint, US and non-US cars and light trucks.

	2012		2015	
	MPG (1)	**Footprint** (2)	**MPG** (3)	**Footprint** (4)
Cars				
US-assembled	33.2	46.0	36.0	46.3
Imported	33.6	44.6	36.5	45.0
Difference	**−0.5**	**1.5**	**−0.5**	**1.4**
Big 3	30.4	46.8	32.6	47.0
Non-Big 3	34.8	45.1	37.9	45.5
Difference	**−4.4**	**1.7**	**−5.3**	**1.5**
Light Trucks				
US-assembled	22.7	57.9	25.3	56.9
Imported	26.8	47.6	29.0	47.2
Difference	**−4.1**	**10.3**	**−3.7**	**9.7**
Big 3	22.2	59.0	24.8	58.2
Non-Big 3	25.3	51.7	27.8	50.4
Difference	**−3.1**	**7.3**	**−3.0**	**7.8**

Source: EPA Trends and Auto-News.com US-assembled refers to vehicles produced domestically, according to autonews.com. Big 3 automaker refers to Chrysler, Ford and GM, but excludes the Fiat division of Chrysler. Sales from Auto-News are mostly available only by make and model, not by trim. So vehicle specifications were averaged across each model, and then the model sales were applied to those average characteristics.

perhaps the difference has a less protectionist explanation, like the fact that the US began regulating auto emissions first, at a time when local NO_X pollution attracted more concern than climate change from CO_2.

The 2011 modifications to US fuel economy standards may provide a more clear-cut example. Whether intentional or not, the 2011 change to size-adjusted regulations also amounts to an indirect restriction on international trade, equivalent to a tariff on imported cars.

The 2011 Footprint-Based CAFE Standards

Since 1978 the US Department of Transportation (DOT) has overseen Corporate Average Fuel Economy (CAFE) standards. These are average miles-per-gallon (mpg) targets for new cars and light trucks sold in the US. Each automobile manufacturer must ensure that the sales-weighted average of the vehicles it sells in the US exceeds a minimum threshold mpg. In 2007 Congress authorized a tightening of the mpg threshold, called for credits to be tradable among vehicle manufacturers, and required that the targets be "attribute based". That is, the rule would not be a uniform fleetwide average, but rather a weighted average based on some attribute of the cars sold.

Consequently, new CAFE rules after model year 2011 have had targets that differ based on vehicles' sizes as measured by their "footprints"—the area under their four tires. Cars and light trucks with larger footprints can have lower mpg. Fig. 1 plots the footprint-based standard for cars.[3] The left hand axis plots fuel economy.[4] A horizontal line at 33.3 mpg depicts the overall target. If the 2012 regulation were a uniform standard like all the CAFE rules before 2011, carmakers would each have to meet a sales-weighted average of 33.3 mpg. They could sell inefficient cars (below the horizontal line), but those would have to be matched by enough efficient cars (above the line) so that the sales-weighted average did not fall below 33.3 mpg.

Table 2
Difference in average mpg per vehicle between the overall target and footprint-based CAFE standard.

Model Year	2012	2013	2014	2015
US-assembled	0.62	0.65	0.56	0.70
Imported	−0.68	−0.62	−0.44	−0.75
Difference	**1.30**	**1.27**	**1.00**	**1.45**
Big 3	1.00	0.93	0.85	1.06
Non-Big 3	−0.20	−0.07	−0.05	−0.15
Difference	**1.20**	**1.00**	**0.90**	**1.21**

Source: See Table 1. Includes both cars and light trucks.

The thick segmented line in Fig. 1 plots the new footprint-based CAFE standard for cars. Each car's fuel economy is judged relative to a formula for cars of its size. New large cars in 2012, with footprints greater than 56 square feet, needed to achieve only 28 mpg. New small cars, with footprints smaller than 41 square feet, had to get 36 mpg. As before, any individual model could miss its target, but would need to be offset by sales of cars that exceed their footprint-adjusted targets.

The change from a flat 33.3 mpg standard to the new footprint-based standard constitutes a form of disguised protectionism—intended or not. To see why, Fig. 1 denotes car models assembled in the US with crosses and models assembled elsewhere and imported with circles.[5] The cars in region "A" on the graph all fail to meet the actual 2012 footprint-based standard but would have met a uniform standard at 33 mpg. All of those newly non-compliant cars are imported. The cars in region "B" meet the new footprint-based standard but would have failed a uniform standard. Many of those newly favored cars are assembled in the US. The change to the footprint standard advantages domestic cars over imports. A similar graph drawn for light trucks also demonstrates a footprint-based bias for US manufacturers.

That domestic advantage from the footprint-based standard extends well beyond the cars that switch from compliant to non-compliant or vice versa in regions A and B. Carmakers that exceed their overall targets by any amount can now sell credits to carmakers that fall short by any amount. Carmakers that fall short can either buy those credits or pay fines of $55 per mpg below the standard, per vehicle sold.

Table 1 provides some summary statistics. In 2012, the average fuel economy of cars assembled and sold in the US was 33.2 mpg. The average for imported cars was 33.6 mpg. The difference, 0.5 mpg, means imports had a slightly easier time meeting the uniform CAFE target. At the time, fines for non-compliance were $55 per mpg per car. So a rough estimate of the advantage is $27.50 per car—$55 times 0.5 mpg.[6] The second set of figures in Table 1 calculates that same difference, but distinguishes car models by whether they belong to one of the "Big Three" US carmakers – General Motors, Ford, and Chrysler – rather than where they are assembled.

[3] The actual formula for cars is: Target MPG $= 1 \div (\min[\max(c \times \text{Footprint} + d, \frac{1}{a}), \frac{1}{b}])$ where for model year 2012 cars a =35.95, b =27.95, c =0.0005308, and d =0.006057. The standard gets more stringent each year by raising a and b, and lowering d. Light trucks face a similar segmented formula with lower MPG targets.

[4] The actual metric used by DOT engineers is gallons per hundred miles (gphm), because fuel savings are linear in gphm. But since Americans are accustomed to mpg, DOT converts the gphm target to mpg.

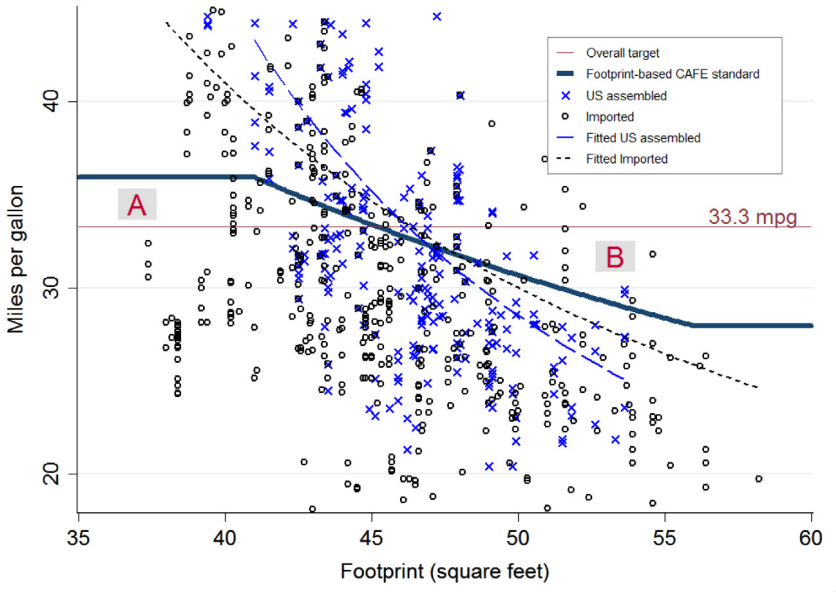
[5] Car specifications come from the EPA Trends dataset, obtained from the EPA by request. Sales by country of assembly come from http://www.autonews.com.

[6] Traded credit prices are not publicly available, but Leard and McConnell (2015) provide some estimates from court filings. Hyundai and Kia forfeited credits as part of legal settlements, which EPA estimated were worth $78 per mpg per car. And Tesla's SEC filing valued its sales of credits at $68 per mpg per car. Both are based on the EPA's greenhouse gas emissions standard, which look similar to the DOT's footprint-based fuel economy standards, and the fact that they exceed the DOT's $55/mpg fine suggests the EPA standard may be tougher to meet. To be conservative, I use the $55 DOT value for credits.

Table 3
Fuel economy as a function of car footprint.
Weighted OLS with weights equal to car sales in each year. Heteroskedastic consistent standard errors in parentheses.

	2012		2015	
Dependent variable: gallons per hundred miles (gphm)	**Domestic**	**Imported**	**Domestic**	**Imported**
Footprint	0.133*	0.089*	0.164*	0.078*
	(0.027)	(0.016)	(0.034)	(0.019)
Constant	−3.14*	−1.13	−4.76*	−0.90
	(1.35)	(0.76)	(1.55)	(0.89)
Number of car models	63	105	68	105
R^2	0.25	0.18	0.33	0.15

*statistically significant at 5 percent.



Note: Cars only. A similar graph for light trucks available from the author.
Sources: The rules come from the DOT/EPA joint final rule, "Light-Duty Greenhouse Gas Emission Standards and Corporate Average Fuel Standards; Final Rule," Federal Register Vol. 75 No. 88, May 7, 2010; vehicle characteristics from the EPAs *Fuel Economy Trends* database (request from the EPA); and annual vehicle sales from *Automotive News* (www.autonews.com).

Fig. 1. Car models by fuel economy and footprint. Model Year 2012.

That difference is 4.4 mpg, and the foreign cost advantage would be $242 per car.

The bottom panel of Table 1 repeats the calculations for light trucks, which face a different version of the CAFE standard. As with cars, US-assembled trucks and Big 3 trucks are less fuel efficient than their imported and non-Big-3 competitors.

The main explanation for the advantage non-US vehicles have complying with uniform CAFE rules is that they are smaller. Domestic cars are 1.5 square feet larger than non-US cars, and domestic trucks are 7 to 10 square feet larger, depending on the year and definition of "domestic". Switching to a CAFE standard that grants larger vehicles less stringent mpg targets would benefit US manufacturers.

Table 2 calculates the magnitude of advantage conferred to US cars and trucks from that switch. It first calculates the annual sales-weighted average difference between the footprint-based CAFE standard and the overall goal, vehicle by vehicle, separately for domestic and imported cars and light trucks. The switch to footprint-based standards in 2012 granted the average US-assembled vehicle an extra 0.62 mpg, and cost the average imported vehicle 0.68 mpg, for an overall difference of 1.3 mpg. Given the fine of $55 per mpg, that amounts to a $71.50 per vehicle gain for domestic producers. Across all four model years and both definitions of domestic, the footprint-based penalty on imports ranges from 0.90 mpg to 1.45 mpg. At $55 per mpg, that is $50 to $80 per vehicle.

In July, 2016 the US DOT announced a long overdue inflation adjustment in the fines, from $55 to $140 per mpg, nearly tripling the regulatory advantage that the footprint-based standard confers on US vehicles. But in January they postponed that increase until 2019. If the fine increase does occur, the domestic advantage will rise to $126 to $203, based on the sales and configurations in Table 2.

There is one final reason the switch to footprint-based standards helps US manufacturers: The relationship between fuel economy and footprint is steeper for US-made cars than for imports. Table 3 regresses fuel economy (measured in gphm as per the CAFE formula) on footprint. Not surprisingly, larger cars use more gas. But an extra square foot of size is associated with more extra gas for US-made cars than for imports. Not only are US-made cars larger, larger US-made cars are less fuel efficient.

The relationships estimated in Table 3 are plotted in Fig. 1, converted from gphm back to mpg. Because the US line is steeper, US carmakers can gain more average fuel economy and compliance by selling more smaller cars and fewer larger cars. The footprint-based CAFE standard reduces the incentive to sell proportionally more smaller cars, by design. But because the US line is steeper, US carmakers retain more of the ability to meet the new standards by changing the mix of cars they sell.

Who pays for this? Jacobsen (2013) estimates the incidence of a 1 mpg increase in the stringency of the CAFE standards, finding

that car buyers bear 56 to 81 percent of the costs, depending on how long the policy has been in place.[7] But that is for a 1 mpg increase in the stringency of the standard as applied to all cars. The switch to footprint-based standards tightened the standards on the typical imported car and relaxed the standard faced by the typical domestic car, shifting the incidence of CAFE back onto imports by $50 to $80, or more if the fines are increased. If domestic and imported cars are perfect substitutes, producers bear the incidence of that shift—domestic manufacturers gain and importers lose. If domestic and imported cars are not substitutes, consumers will bear the incidence—buyers of domestic cars gain and buyers of imports lose, presumably in proportion similar to those estimated by Jacobsen.

The 2011 switch to footprint-based standards seems like a textbook example of environmental protectionism. But is there another explanation?

The Official Explanation

In making the change, the DOT cited safety concerns. The agency worried that the uniform CAFE standards encouraged carmakers to sell smaller and lighter cars, and that those tended to be more dangerous. As evidence, they cited a National Academy of Sciences (NAS) report that downsizing vehicles to comply with CAFE standards resulted in an additional 1,300 to 2,600 traffic fatalities per year (NAS, 2002).

But the NAS report includes a dissenting opinion highlighting two possible errors. First, it is true that in collisions between differently-sized vehicles, occupants of smaller cars are more likely to suffer injury. But that does not mean a proportional reduction in all cars' sizes would increase injuries. And second, the NAS analysis failed to account for driver characteristics. If cautious drivers choose larger cars, smaller cars will appear more dangerous. The dissenting members argued that the uniform CAFE standards had no net effect on traffic fatalities.

In 2017 the federal agencies completed another a review of the CAFE standards (EPA, 2017). Their analysis of safety relied on a report by Puckett and Kindelberger (2016) that regresses fatality risk on vehicle weight and footprint. But the report provides few details about the regressions and notes that vehicle mass and footprint are collinear. And the report fails to address either of the two dissenting criticisms in the original NAS report: unequal crashes matter more than proportional reductions in size or footprint, and riskier drivers may choose larger cars.[8]

In sum, the safety justification for the footprint-based CAFE standards rests on thin evidence. By contrast, the advantage footprint-based standards confer on US cars relative to imports can be seen clearly in Fig. 1 and Table 2. Intentional or not, the footprint-based standards amount to environmental protectionism.

Acknowledgments

Many thanks to Josh Ederington and Becka Brolinson for helpful conversations and Grady Killeen for research assistance.

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[7] The longer the policy is in place, the more it affects the used car market and hence consumers. Langer and Miller (2013) derive a comparable result, noting that manufacturers absorb 40 percent of the costs of gasoline price spikes by lowering the relative price of efficient cars.

[8] Ito and Sallee (2014) suggest an alternative benefit to footprint-based standards. If compliance credit trading is not possible, and if footprints are correlated with compliance costs, then footprint-based standards can help improve the rule's cost effectiveness by equalizing compliance costs across large and small cars. In their Japanese data, Ito and Sallee estimate that footprint-based standards achieve about half the cost-effectiveness gains of permit trading. But the US DOT did not rely on the Ito and Sallee claim in 2011 when switching to footprint-based CAFE, and it did implement credit trading alongside the new footprint-based rules.