Are Carbon Fees Effective for Reducing GHG Emissions in Transportation?

By Jonathan Marshall[1]

***Summary**: Some critics of carbon fees claim that major sectors of the U.S. economy, such as transportation, are insensitive to market prices for fossil fuels. They assert that few people will respond to carbon fees by changing their driving habits. Research shows these doubters are wrong: drivers faced with higher fuel prices because of structural changes in the market (e.g., increased taxes) do use significantly less gasoline and diesel over time as they find ways to adjust. Rising carbon fees would also incent rapid innovation and cost-reduction in electric vehicles, spurring a dramatic and rapid shift to cleaner vehicles.*

Introduction

The 2018 election has given new political life to legislative proposals for addressing climate disruption by curbing greenhouse gas emissions. Carbon fee-and-dividend bills have been introduced in the House and Senate, with bipartisan sponsorship and support from eminent economists and climate scientists. Some analysts, however, have cautioned that carbon fees will have almost no effect on some sectors of the economy, most notably transportation. Fuel prices, they say, have little impact on driving behavior, because fuel is a small part of many people's budgets, and because many drivers have few alternatives to using their cars for commuting and errands.[2]

These claims, if true, would be damning. Transportation accounts for 30 percent of all energy-related CO2 emissions, more than any other economic sector. Emissions from cars and trucks—the focus of this brief—contributed more than 80 percent of total emissions from the transport sector in 2017.[3]

How does fuel consumption respond to carbon taxes?

Drivers do have choices. They can respond to higher prices for gasoline and diesel in several ways. They may take fewer and shorter discretionary trips. They may conserve substantial fuel simply by avoiding excessive highway speeds and by inflating their tires to proper pressures.[4] They may switch to public transportation or carpool where available. In the longer term, they can and do buy more fuel-efficient vehicles.[5] Over time, they may even move closer to work to avoid long commutes.

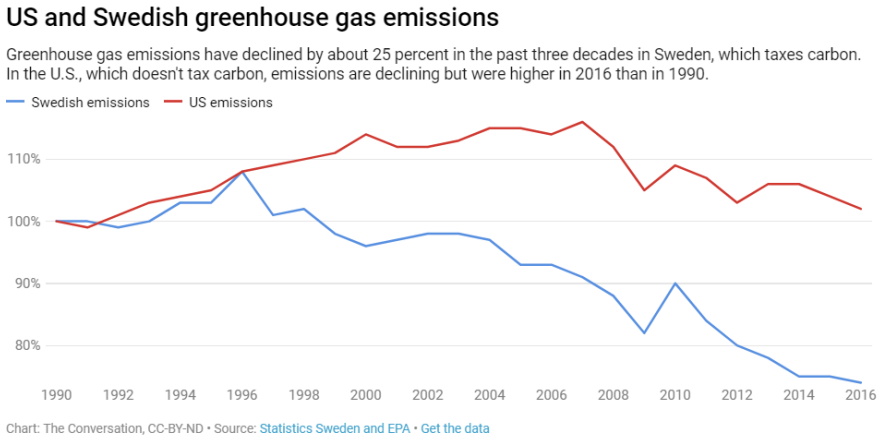
Why, then, are critics pessimistic about the effectiveness of carbon taxes? Several studies over the last 15 years suggest that the responsiveness of drivers to changes in gasoline price has declined over time. Typical studies found that a 10 percent increase in the price of gasoline cut short-term consumption by a mere 1 percent; in the longer run (usually not defined), as people acquire more efficient vehicles or adjust their commuting behavior, such a price change might induce a drop in demand of 2 to 4 percent—still nothing dramatic.[6]

But a new wave of empirical studies offers solid grounds for more optimism. Recent analyses suggest that *consumers are much more responsive to price changes caused by new taxes than by normal market fluctuations*. One reason may be that most tax changes are accompanied by a great deal of publicity, making consumers more sensitive to what they are paying. Another likely reason is that consumers rightly understand that taxes are structural, long-term price increases, not short-term price swings they can "ride out."

An important 2009 paper by Lucas Davis and Lutz Kilian found that state and federal fuel tax changes had almost *five times* as much short-term impact as ordinary price changes on demand for gasoline. Based on prices then prevailing, they estimated that a 10-cent-per-gallon increase in the gasoline tax (equal to a very modest carbon tax of about $10 per ton of CO2) would cut vehicle carbon emissions by about 1.5 percent. "The long-run response is likely to be considerably larger as drivers substitute toward more fuel-efficient vehicles," they added.[7]

Still newer studies provide data on changes in demand for transportation fuels in response to carbon taxes.[8] Economists at the University of Ottawa determined that British Columbia's modest carbon tax, which rose from C$10 per ton of CO2 in 2008 to C$30 in 2012, strongly affected drivers. At a rate of $25 per ton of CO2, the tax drove down short-term gasoline demand more than 12 percent, an effect roughly *seven times greater* than suggested by traditional price-based studies of consumer behavior. Over the first four years, they calculated, "the BC carbon tax led to a total reduction in emissions from gasoline consumption of over 3.5 million tCO2e when compared with a counterfactual scenario of no tax."[9]

In the early 1990s, Sweden replaced existing transport fuel taxes with a carbon tax and a value-added tax. These taxes drove down CO2 emissions in Sweden's transportation sector by 11 percent, *more than three times* what would be expected from ordinary price increases.[10] High fuel prices, combined with tax incentives for the purchase of clean vehicles, have made Sweden a world leader in electric vehicle adoption.[11]



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The *long-run* impact of carbon taxes on transportation is likely to be far more significant

The rapid rise of electric vehicle sales around the world, and dramatic improvements in battery technology and production costs, suggest that the long-run impact of higher carbon taxes on gasoline and diesel consumption could be far greater than the short-term studies suggest. For the first time in more than a century, consumers have a viable option not simply to buy more fuel-efficient vehicles, but to substitute away from fossil-fuel-burning vehicles altogether.[12]

In 2018, electric vehicle sales in the US soared 130 percent over 2017.[13] Worldwide, cumulative sales of passenger EVs passed 4 million last year and are forecast to exceed 5 million in just the first half of 2019. Large federal and state subsidies account for a good deal of this exponential market growth, but other factors include the very low operating costs of EVs (maintenance and charging), and an 85 percent drop in the price of lithium-ion batteries since 2010. Bloomberg New Energy Finance predicts that by the mid-2020s, new EVs will start selling for less than traditional internal combustion (IC) vehicles, making the decision to switch all the easier, and without the need for subsidies. The *Wall Street Journal*'s auto columnist, Dan Neil, recently predicted that "During the reasonable service life of any vehicle I buy today, I expect the demand for IC-powered vehicles will drop to practically zero, equivalent to the current market penetration of flip phones. No one will want them."[14]

A significant rise in EV market share would have dramatic effects on carbon emissions. "Electric vehicles now have greenhouse gas emissions equal to an 80 MPG car, much lower than any gasoline-only car available," according to a 2018 analysis by the Union of Concerned Scientists.[15] As the U.S. power grid grows ever cleaner with the rapid demise of coal plants and the rise of wind and solar energy, EVs will enjoy an ever-smaller climate "footprint" relative to IC vehicles.

Meaningful carbon taxes would accelerate these favorable trends in several ways. They would hasten the production of emissions-free power; narrow or close the cost-of-ownership gap between internal combustion and electric vehicles; and promote cost-saving innovations in EV production and charging-station deployments. Combined with individual tax rebates, they would also offset some or all of the regressive impact on lower income quintiles of federal and state EV subsidies, which overwhelmingly benefit the top income quintile.[16]

Carbon taxes are more cost-effective than existing regulations

Analysts who dispute the efficacy of carbon taxes in the transportation sector often point to fuel efficiency standards, like CAFE, as preferable tools for lowering greenhouse gas emissions in the vehicle fleet. Unfortunately, such standards do nothing to lower emissions from existing vehicles. They do little or nothing to grow consumer demand for clean vehicles. Last but not least, they suffer from what economists call the "rebound effect:" more efficient fossil-fueled vehicles reduce the per-mile cost of driving, inducing some people to drive more, which offsets some of the predicted drop in emissions. Higher fuel taxes, on the other hand, encourage customers to purchase cleaner vehicles *and* to drive them less.

A 2013 study published in *Energy Economics* by four economists at M.I.T. concluded that increased CAFE standards would cost the U.S. economy six to 14 times more than a federal

gas tax to achieve the same reduction in fuel use over a period of four decades. As the lead author explained, "That is because a gas tax provides immediate, direct incentives for drivers to reduce gasoline use, while the efficiency standards must squeeze the reduction out of new vehicles only. The new standards also encourage more driving, not less."[17] UC Davis economist Mark Jacobsen determined that owing to their high regulatory compliance costs and modest effectiveness, national fuel economy standards cost roughly $307 to eliminate one ton of CO2 emissions—a price far higher than any mainstream carbon tax proposal.[18]

Conclusion

One must agree with critics who point out that "at the tax levels that have been politically feasible thus far, carbon taxes alone are unlikely to solve the climate change problem."[19] The problem, of course, lies not with carbon taxes, but with the lack of political will in the United States and many other countries to set taxes high enough in the face of opposition from entrenched interests, like the fossil fuel industry. However, a predictable and rising carbon fee, if coupled with a dividend back to individual consumers and a border adjustment to avoid disadvantaging U.S. businesses internationally, may win widespread public support in today's political climate.[20]

Most proponents of carbon taxes also agree they should not be the *only* means of tackling climate disruption. Many economists endorse well-designed government subsidies and standards to spur basic research and cost reduction for early-stage clean technologies ranging from vehicle electrification to carbon capture and storage.[21]

But as the empirical evidence cited here demonstrates, higher carbon taxes should be the foundation of any program to reduce greenhouse gas emissions in transportation, the sector most responsible for them. Claiming otherwise will only slow political momentum for adopting this most promising and cost-effective policy to curb global climate disruption.

Notes

[1] Jonathan Marshall is former Economics Editor of the *San Francisco Chronicle.* He has written on carbon pricing for the *New York Times*, *Reason* magazine, *HuffingtonPost*, and other publications.

[2] See, for example, Justin Gillis, "Forget the Carbon Tax for Now," *New York Times*, December 27, 2018; David Roberts, "The 5 most important questions about carbon taxes, answered," Vox.com, October 18, 2018; 2018 Annual Report of the Independent Emissions Market Advisory Committee, October 22, 2018 (Cal-EPA), 13; Charles Komanoff, "What an energy efficiency hero gets wrong about carbon taxes," September 2015, Carbon Tax Center.

[3] U.S. Energy Information Administration, "How much carbon dioxide is produced from U.S. gasoline and diesel fuel consumption?," December 2018.

[4] The typical passenger car's rated fuel efficiency at 55 miles per hour drops 17 percent at 70 mph, and even more at higher speeds (MPGForSpeed.com and "Driving More Efficiently" at fueleconomy.gov).

[5] Rising gasoline prices powerfully affect consumer decisions to buy more fuel efficient cars. As Benjamin Leard and Joshua Linn noted in a blog for Resources for the Future, "Several studies have demonstrated a strong link between gasoline prices and market shares, particularly when gas prices were high or rising. For example, between 2003 and 2007, rising gasoline prices explain about half of the shift from large sport utility vehicles (SUVs) to smaller crossovers." "How Do Gasoline Prices Affect New Vehicle Sales?," February 3, 2016; also W. McManus, "The Link Between Gasoline Prices and Vehicle Sales," *Business Economics*, January 2007. A published study by Mansoureh Jeihani and Soheil Sibdari determined that a 10 percent increase in gasoline prices cuts demand for

SUVs by 13.7 percent and increases demand for efficient hybrids by 9.1 percent ("The Impact of Gas Price Trends on Vehicle Type Choice," *Journal of Economics and Economic Education Research* 11:2 (2010).

[6] Giovanni Circella, Susan Handy, and Marlon G. Boarnet, "Impacts of Gas Price on Passenger Vehicle Use and Greenhouse Gas Emissions," September 30, 2014; Jonathan E. Hughes, Christopher R. Knittel, and Daniel Sperling, "Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand," September 2006, NBER Working Paper 12530; Kenneth A. Small and Kurt Van Dender, "Fuel Efficiency and Motor Vehicle Travel: The Declining Rebound Effect," *Energy Journal*, vol. 28, no. 1 (2007), pp. 25-51. For a tabulation of other estimates dating back to the 1990s, see James Hamilton, "Understanding Crude Oil Prices," December 6, 2008. A plausible explanation is that rising incomes and better vehicle mileage have made fuel costs a smaller portion of most people's budgets.

[7] Lucas W. Davis and Lutz Kilian, "Estimating the Effect of a Gasoline Tax on Carbon Emissions," September 2009, NBER Working Paper 14685; subsequently published in *Journal of Applied Econometrics*, 26 (2011), 1187–1214. Shanjun Li, Joshua Linn, and Erich Muehlegger confirm that "gasoline taxes would be more effective at reducing gasoline consumption than suggested by previous empirical estimates of the effect of gasoline prices on gasoline consumption" ("Gasoline Taxes and Consumer Behavior," March 2012, NBER Working Paper 17891).

[8] For a useful summary, see Steven Nadel, "Learning from 19 Carbon Taxes: What Does the Evidence Show?" ACEEE, Summer 2016.

[9] Nicholas Rivers and Brandon Schaufele, "Salience of Carbon Taxes in the Gasoline Market," January 24, 2015. Another study of the BC market estimates that the tax effect is 10 times greater than the normal effect of market prices on demand. Jean-Thomas Bernard, Grant Guenther, and Maral Kichian, "Price and Carbon Tax Effects on Gasoline and Diesel Demand," October 3, 2014, University of Laval. For a somewhat smaller result, see C. Lawley and V. Thivierge, "Refining the evidence: British Columbia's carbon tax and household gasoline consumption," *The Energy Journal* 29 (2018), 147-171.

[10] Julius J. Andersson, "Cars, Carbon Taxes and CO2 Emissions," March 2017, London School of Economics and Political Science. Andersson estimates a price elasticity of demand of -0.51 and a tax elasticity of demand of -1.57 over an "intermediate" period of several years. Sweden's carbon tax would have had a much more dramatic effect on fuel consumption if the country had not already had substantial fuel taxes averaging about 4 SEK per litre of gasoline (Andersson, 7).

[11] "New Swedish Car Policies Expected To Boost Electric Car Market Share In Sweden," CleanTechnica.com, May 2, 2018; Rikki Gibson, "What Can We Learn From Sweden About EV Adoption?" FleetCarma.com, July 5, 2018; "Demand for plug-in electric cars remains strong in Sweden," InsideEVs.com, October 3, 2018.

[12] Higher taxes on fossil fuels should also incent transitional production and use of low-carbon biofuels in existing light and heavy vehicles. Such drop-in fuels could accelerate the decarbonization of the transportation sector as demand for EVs ramps up. They are generally not economic to produce at today's low prices for gasoline and diesel.

[13] "Electric Vehicle Sales Up 130% In 2018, 210% In Q4 2018," CleanTechnica.com, January 3, 2019.

[14] Joe Romm, "Electric cars may already be making gas cars as obsolete as 'flip phones', experts say," ThinkProgress.com, January 2, 2019; Dan Neil, "Think Electric Vehicles Are Great Now? Just Wait," *Wall Street Journal*, December 26, 2018.

[15] David Reichmuth, "New Data Show Electric Vehicles Continue to Get Cleaner," Union of Concerned Scientists blog, March 8, 2018.

[16] Severin Borenstein and Lucas Davis, "The Distributional Effects of U.S. Clean Energy Tax Credits," Haas School of Business Working Paper 262, July 2015.

[17] Valerie J. Karplus, et. al., "Should a vehicle fuel economy standard be combined with an economy-wide greenhouse gas emissions constraint?," *Energy Economics* 36 (March 2013), 322-333; Valerie Karplus, "The Case for a Higher Gasoline Tax," *New York Times*, February 21, 2013.

[18] Mark R. Jacobsen, "Evaluating US Fuel Economy Standards in a Model with Producer and Household Heterogeneity," *American Economic Journal: Economic Policy*, 5:2 (2013); Kenneth Gillingham and James H. Stock, "The Cost of Reducing Greenhouse Gas Emissions," August 2, 2018.

[19] Steven Nadel, ACEEE, op. cit.

[20] A 2018 public opinion survey by the Yale Program on Climate Change Communications found that 71 percent of all registered voters, including 56 percent of Republicans, favor requiring fossil fuel companies to pay carbon taxes.

[21] See Gillingham and Stock, op. cit.; David Greene et al., "Analyzing the Transition to Electric Drive Vehicles in the U.S.," *Futures* 58 (April 2014), 34-52. But note that claims of market failure and program efficacy must be assessed carefully; see for example Joshua A. Blonz, "The Welfare Costs of Misaligned Incentives: Energy Inefficiency and the Principal-Agent Problem," November 28, 2018, U.C. Energy Institute Working Paper 297; Carl Blumstein and Margaret Taylor, "Rethinking the Energy-Efficiency Gap: Producers, Intermediaries, and Innovation," May 2013, Haas School of Business Working Paper 243.