Spatial Effects of Transportation CO2 Emission Control Policy in the U.S. States

Jaewon Lim, Ph.D.
Associate Professor
School of Public Policy & Leadership
Greenspun College of Urban Affairs
University of Nevada, Las Vegas
e-mail: jaewon.lim@unlv.edu

DooHwan Won, Ph.D. *
Professor
Department of Economics
College of Economics and International Trade
Pusan National University
e-mail: doohwan@pusan.ac.kr

Sandy Dall'erba, Ph.D.
Associate Professor
Department of Agricultural and Consumer Economics
College of Agricultural, Consumer and Environmental Sciences
University of Illinois At Urbana-Champaign
e-mail: dallerba@illinois.edu

According to *Today in Energy*[1], the CO_2 emissions due to energy use were 14% lower in 2017 than in 2005 in the U.S. The CO2 emissions have also declined seven of the ten years of the 2007-2017 period. The decline is clearly noticeable in the electric power sector where a drop in coal consumption has taken place since 2007. However, the overall decrease has slowed down due to the increasing CO2 emissions of the transportation sector. Traditionally, the largest source of CO2 emission among the four major energy consumption sectors - electric power, industrial, residential and commercial, and transportation- had been the electric power sector. However, in 2016, the transportation sector became the largest source of CO2 emission among these sectors. The dominant energy source of the transportation sector has persistently been petroleum, with a share above 96%. Its share in 2017 was 97.6%, a bit more than the 96.8% share of 1973. Historically, the U.S. federal government has been playing a leading role to control hydrocarbon and carbon monoxide emissions from automobiles and other mobile sources of pollution. The Clean Air Act Amendment of 1965 was the first national standards set for hydrocarbon and carbon monoxide emissions from automobiles. The Clean Air Act Amendment of 1970 set the newer emission standards goal that would reduce emissions by 90 percent below uncontrolled levels.

The automobile industry has always been in favor of federal standards in order to avoid seeing each state pass its own standards. Since the inception of the California Air Resources Board (CARB) in1967, only California is able to set its own standards due to its unique weather, geography, skyrocketing

* Corresponding Author
[1] U.S. Energy Information Administration (EIA) publishes *Today in Energy*, a series of short articles with energy-related news and information and the link is https://www.eia.gov/todayinenergy/.

population and vehicle fleet. For instance, in 2004, CARB approved the nation's first GHG (Greenhouse Gas) emission standards specifically for cars (An and Sauer, 2004). CARB mandated the automakers to reduce the average GHG emissions (in grams) per mile by 22% for MY (Model Year) 2009-2012 compared to MY 2002, followed by the additional reduction for MY 2013-2016 by 30%[2]. In 2012, CARB adopted more stringent GHG standards that mandated a fleet-side average emission reduction of approximately 4.6% annually for MY 2017-2025. California's ZEV (Zero-Emission Vehicle) program was also updated in 2012. It requires to increase the production of electric and plug-in hybrid vehicles from 2018 to 2025. There are thirteen other states[3] that had adopted CARB's restrictive tailpipe emission standard prior to 2010. These "CARB states" follow the California's standards with the aim to control CO2 emission specifically from vehicles. States in the U.S. have the option to either comply with less restrictive EPA's standards or to adopt the more restrictive CARB's standard. The local authorities take further responsibility to reduce emission from mobile sources of air pollution.

During the Obama administration's period, the EPA's tailpipe standard was revised to be in line with the increased standard for fuel economy under CAFE (Corporate Average Fuel Economy) of NHTSA (National Highway Traffic Safety Administration) (Lattanzio et al., 2018). EPA's standard specifically limits the amount of carbon dioxide that can be emitted per mile and this corresponds to the DOT's increased standard. In 2012, EPA adopted a revised GHG standards for MY 2017-2025 vehicles in line with the more stringent CARB's standards. During 2016, EPA and NHTSA jointly with CARB published the draft TAR (Technical Assessment Report) for the feasibility study of the currently mandated standards considering the associated cost and concluded that the new standards are viable and achievable by the target year of 2025. However, under the Trump administration EPA completed the new Midterm Evaluation in April 2018 and administrator Pruitt announced that the new standards set by the Obama administration were too ambitious, too stringent, and therefore should be revised. He also challenged the validity of the Clean Air Act (CAA) that granted California a waiver to set its own stricter standards for vehicle emissions (EPA Press Office, 2018). The conflicting view on the feasibility of the expansion of CARB's standards mainly rooted in the lack of scientific studies analyzing the sub-national policy impact of CARB's tailpipe emission standards on GHG emission. An exception is a recent study by Lim and Won (2019) which focuses on the long-term policy effect of the CARB standard on CO2 reduction in the U.S.

The purpose of this paper is to examine the impact of CARB's tailpipe emission standard policy on the reduction of CO2 emissions emanating from the transportation sector. This policy is controversial and creates a conflict between the Trump administration's EPA and the CARB states. Using a spatial panel

[2] For details about tailpipe emission standards for states, visit https://database.aceee.org/state/tailpipe-emission-standards
[3] The CARB states are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington, as well as the District of Columbia.

dataset for 49 U.S. states over 1987-2015, we estimate both a Spatial Lag Model (SAR or SLM) and a Spatial AutoRegressive with additional AutoRefressive error structure (SARAR or SAC) as the latter captures the effect of omitted variables from the former.

In 2015, the annual CO2 emission from the transportation sector in the sample of 49 states was 5.74 MMT (million metric tons) per person. The per capita CO2 emission from the transportation sector in the fourteen states that currently have CARB's tailpipe standard in place is 4.91 MMT/person, whereas the per capita emission from the other thirty-five states without CARB's tailpipe emission standard is 6.20 MMT/person. Per capita CO2 emission from the transportation sector in the 35 states without the stricter tailpipe emission control policy was 26% higher than that in the 14 states with the CARB's policy implemented. Our coefficient estimates indicate that if all the states adopted CARB's stricter emission standards, there would have been additional 103 MMT CO2 emission reduction from the transportation sector during 2015. It is equivalent to removing 253.3 billion miles driven by an average passenger vehicle or reducing the consumption of 11.6 billion gallons of gasoline.[4] Mainly with the aim to finance public infrastructure projects, state and local governments have imposed various tax items through TIF (Tax Increment Financing). Increased price with additional tax items at the pump also impacts the gasoline consumption. Estimation results show that a 1% increase in gasoline price in the thirty-five states that do not implement CARB's stricter emission control policy, there would have been additional 3.0 MMT CO2 emission reduction in 2015. This is approximately 2.9% of the CO2 reduction estimated for CARB's tailpipe emission policy in the thirty-five states. Fuel efficiency has a limited effect compared to CARB's standard, but it has a much higher effect compared to gasoline price control policy. This result provides support for technological enhancement in the fuel efficiency of the average vehicle. Indeed, in order to achieve the CO2 emission reduction matching the CARB's emission standard policy, a 14.6% improvement in fuel efficiency (MPG) is required.

The estimation results of SAC indicate the expected effects of all three policy-related variables. CARB's stricter standards have the largest effects among the alternative policy approaches tested in this study. Local spatial effects of CARB's standards show the presence of spatial effects among neighboring states. All three policy approaches (CARB's emission standard, gasoline price policy, and fuel efficiency) should be combined to reach the CO_2 emission reduction goal set by these CARB's states. Evidence of intestate spillovers indicates that a state needs to collaborate with its neighbors as envisioned by the partnerships among EPA, NHTSA, and State of California. This approach provides a viable path to achieve the ambitious but still feasible CO_2 reduction goal set by CARB and adopted by EPA in 2012.

[4] Greenhouse Gas Equivalencies Calculator is available from the following link, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Increased supply of clean and more fuel-efficient vehicles from manufacturers will stimulate the substitution effects in fuel mix towards clean fuels. On the demand side, increased gasoline price will discourage the demand for gasoline and stimulate the substitution effects when effectively combined with policies that increase the supply of more affordable clean vehicles. It will also boost the clean fuel consumption in the transportation sector. Consequently, all three policy approaches tested in this study should be packaged together to reach the CO2 emission reduction goal in the U.S. It is highly recommended to continue the collaborative efforts among various stakeholders in order to achieve the ambitious but still feasible CO2 reduction goal set by CARB and adopted by EPA in 2012.