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A Higher Diesel Tax Increases Road Damage

Linda Cohen and Kevin Roth
University of California, Irvine

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Issue

Tractor-trailers dominate the truck cargo industry. Between 1990 and 2010, this industry grew significantly; vehicle miles traveled increased 87 percent and ton-miles increased by 47 percent. While the growth of trucking miles and ton-miles is a positive indicator of economic transformation and expansion, the trucking sector also produces negative externalities, including but not limited to pavement damage. Pavement damage is closely tied to vehicle weight, which is a product of private market decisions driven by the cost of delivery per ton and the frequency of delivery. Understanding the interplay between fuel cost and private sector decisions on truck dispatch (i.e., frequency and load of trucks) is key to understanding infrastructure damage.

Research Findings

To gain a better understanding of the impact of fuel prices on truck dispatch, data was collected from weigh-in-motion (WIM) sensors from New York and California, representing 1.28 billion and 0.2 billion truck records respectively. WIM sensors are typically a strip embedded across all lanes of the roadway, which automatically measure the number of axles, axle spacing, weight, and speed of trucks passing. This data was used to generate daily measures of average truck weight, total Equivalent Standard Axle Loads (which is the standard measure for characterizing road damage caused by vehicles), and total vehicle count. Because strong demand for trucking causes both truck weight and diesel prices to increase, an "instrumental variables" statistical approach was used to tease out the causal impact of diesel price on truck weight, focusing on diesel price changes caused solely by inclement weather events and associated truck weight changes. Key findings are presented as follows:

Higher diesel prices are associated with fewer but heavier trucks. A 10 percent increase in diesel prices lowers total truck traffic by around 1 percent but increases the average weight of 5-axle trucks by 3.2 percent. The relationship between fuel price and truck weight arises from dispatch decisions faced by trucking firms. Absent transportation costs, it would be optimal to move individual goods between the origin and destination at exactly the time the good is to be used or sold. However, as transportation costs increase, it becomes profitable to spatially and temporally aggregate loads. Heavier trucks use more fuel overall, but fuel consumption per ton of cargo—the relevant cost measure for the commercial trucking industry—is lower.

A shift to fewer and heavier trucks produces a net increase in road damage. A 10 percent increase in diesel prices increases net pavement damage by 19 percent due to the increase in the average truck weight. If road damage and vehicle weight had a linear relationship, then redistributing shipments on fewer but heavier trucks would be of little consequence, but road damage sharply increases as the weight per truck axle increases . For example, adding 1,000 pounds to an already fully loaded 5-axle truck generates 38 times more damage than adding 1,000 pounds to an empty one.

Approximately 11% of the revenue from a diesel tax increase is lost to additional road damage. Policy discussions surrounding diesel fuel taxes often focus on how revenues will be used to build and maintain highway infrastructure and how the resulting infrastructure will contribute to economic growth (CBO, 2015). However, increasing the diesel tax for the purpose of raising revenues for road maintenance in turn increases the need for maintenance.

Combining a fuel tax with an axle-weight tax can address truck externalities more directly. Imposing a fuel tax to address congestion and pollution, together with an axle-weight tax to price in road damage can yield a socially optimal strategy.

However, fuel economy standards can better address freight externalities than a diesel tax alone. Where axle weight taxes are not possible, it may be optimal to use fuel economy standards which reduce carbon emissions while encouraging freight haulers to spread loads across more vehicles and in turn reduce road damage. While the benefits from increasing fuel economy standard for trucks comes at the expense of additional driving related costs of congestion, accidents, and noise, these external costs are outweighed by the lower road maintenance expense associated with a diesel tax.

More Information

This policy brief is drawn from the "The Effect of Trucks Dispatch Decisions on Pavement Damage and Other Externalities" research report authored by Linda Cohen and Kevin Roth with the Institute of Transportation Studies at UC Irvine. The full report can be found at www.ucits.org/research-project/2017-34. For more information, contact Linda Cohen at lrcohen@uci.edu.

[1]The American Trucking Research Institute breaks down per-mile motor carrier costs in 2013 as 38% fuel, 34% labor, and 28% other vehicle-based expenses. See Torrey, W. Ford, and Dan Murray. 2014. An Analysis of the Operational Costs of Trucking: A 2014 Update. American Trucking Research Institute, www.atri-online.org

[2]Small, Kenneth A., & Clifford Winston. 1986. "Efficient pricing and investment solutions to highway infrastructure needs." The American Economic Review76 (2): 165-69.

[3]A single heavy truck generates more road damage than 1000 passenger vehicles, yet heavy trucks contribute only 36 percent of the taxes that generate the Highway Trust Fund. See Joint Committee on Taxation. 2015. Long-term Financing of the Highway Trust Fund. JCX-92-15. If roads are not optimally maintained, they will cause an additional external cost in damage to other vehicles. See Winston, Clifford. 2013. "On the performance of the performance of the U.S. transportation system: Caution ahead." Journal of Economic Literature 51 (30): 773 –824.

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