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I am pleased to comment on The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026: Passenger Cars and Light Trucks. I am an associate professor in the Department of Agricultural and Resource Economics at the University of Maryland, and I am a senior fellow at Resources for the Future (RFF). The views expressed in this comment are my own and represent positions of neither the University of Maryland nor or RFF.

This comment focuses on the analysis of the rebound effect conducted by the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA). For reasons explained below, I urge the agencies to:

- Adopt a clear structure for weighting the available studies that estimate the rebound effect;
- Place relatively high weight on studies that use odometer readings to measure vehicle miles traveled (VMT), estimate the effect of vehicle fuel economy on VMT, and quantify rebound in the medium or long term; and
- Ignore estimates from other countries.

For purposes of this comment I define the rebound effect as the fractional change in VMT caused by a 1 percent decrease in per-mile fuel costs that arises from tighter standards. For example, a rebound effect of -0.2 would imply that a 1 percent reduction in fuel costs arising from tighter standards raises VMT by 0.2 percent. The rebound effect is an important parameter in the agencies' benefit-cost analysis. The larger is the rebound effect, the greater the VMT and fuel consumption with tighter standards, and the smaller the fuel consumption and greenhouse gas (GHG) benefits of the standards. The agencies are adopting a rebound effect of 0.2, doubling the magnitude of 0.1 that they assumed in prior rulemakings.

As the agencies note, a huge literature on the rebound effect goes back to the 1970s. Because these studies report a wide range of estimates, the agencies must weigh the evidence to arrive at a central estimate for their benefit-cost analysis. It is appropriate that the agencies focus on the recent literature to reflect changes in economic conditions (such as income growth) and improvements in data and empirical methods since the time that earlier studies were conducted.

However, just the recent studies yield a large range of rebound estimates, from very close to zero to roughly 0.4. The agencies offer little rationale supporting their choice of 0.2, other than the fact that it is similar to the simple (unweighted) mean of several recent studies listed in the

Notice of Proposed Rulemaking (NPRM); and that it appears to be close to an estimate in a recently published paper by Hymel and Small (although that interpretation is debatable).¹

Given the importance of the rebound effect in the benefit-cost analysis, I urge the agencies to adopt a more rigorous approach to evaluating the recent literature. Ideally, the rebound estimate that the agencies use should represent the increase in average VMT caused by changing the standards, for vehicles sold in the US during the time period the agencies are analyzing. This objective suggests that the agencies use four criteria in evaluating how much weight to place on each individual study.

First, the agencies should give preference to studies that use VMT estimates based on repeated vehicle odometer readings. Many studies, including my own that the agencies cite in the NPRM, rely on self-reported estimates of VMT.² As I have shown in a previous study, such estimates may be noisy when compared to VMT calculated from multiple odometer readings.³ Studies that use VMT based on multiple odometer readings therefore should have lower measurement error, and yield preferable estimates from a statistical point of view.

Note that each individual odometer-based study typically uses data from a single state, whereas many of the other studies use nationally-representative samples. This shortcoming of the odometer-based studies is mitigated by the growing number of studies that cover different states. Moreover, a preference for odometer-based studies would be consistent with the argument that the agencies make in the NPRM for using the IHS/Polk data rather than the National Household Travel Survey (NHTS) data to estimate vehicle scrappage rates, because the IHS/Polk data include odometer readings whereas the NHTS data include self-reported VMT.

Second, the agencies should give preference to high quality studies that estimate the effect of fuel economy, rather than fuel prices, on VMT. Fuel economy and GHG standards affect fuel costs by raising new vehicle fuel economy. For that reason, the rebound estimate should be based on changes in fuel costs caused by changes in fuel economy, rather than fuel prices. Many studies in the literature use fuel price variation, either in addition to or instead of, fuel economy variation to estimate the rebound effect. However, in theory VMT could respond differently to fuel prices than to fuel economy. For example, if consumers expect fuel price changes to be temporary, they may respond less to a given fuel price change than to a fuel economy change of the same magnitude. Alternatively, consumers could respond more to a given fuel price change than to a fuel economy change, for instance if they pay more attention to fuel prices than to their vehicles' fuel economy.

One caveat for studies using fuel economy variation is that a vehicle's fuel economy may be correlated with unobserved attributes of the household, which creates statistical challenges. For example, consider two households, one of which has members commuting long distances and the other has members commuting short distance. The household with the long-distance commuters

¹ See Hymel, K. and K. Small (2015), "The Rebound Effect for Automobile Travel: Asymmetric Response to Price Changes and Novel Features of the 2000s," *Energy Economics* v49: 93-103.

² See Linn, J. The Rebound Effect for Passenger Vehicles. *The Energy Journal* v37.

³ See Li, S., J. Linn, and E. Muehlegger. "Gasoline Taxes and Consumer Behavior." *American Economic Journal: Economic Policy* v6: 302-42.

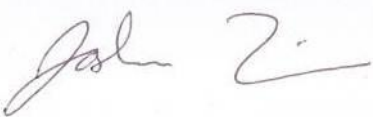
may obtain vehicles that have high fuel economy to save on fuel costs. In typical survey data, the researcher might observe the fuel economy of the vehicles belonging to the two households as well as their VMT. If the researcher does not control for the commuting differences (which are often not available in survey data), the researcher would mistakenly infer that higher fuel economy causes high VMT. The agencies should give preference to studies that address such omitted variables bias and reverse causality.

Third, the agencies should give preference to rebound estimates that can be adapted to economic conditions during the time period covered by the benefit-cost analysis. The agencies' benefit-cost analysis covers vehicles sold in multiple years over the expected lifetimes of those vehicles. Because households typically hold onto their vehicles for 5-9 years (see data from the 2017 NHTS), they would have a considerable amount of time to adjust their behavior to changes in fuel economy. Consequently, the rebound estimate the agencies should account for the time period over which households can adjust their travel behavior in response to the higher fuel economy. Many studies estimate short-run rebound estimates, reflecting changes within a few months or a year. The agencies should give preference to estimates based on longer-term responses. The agencies should also give preference to rebound estimates that can be adjusted to reflect expected future economic conditions, such as income and fuel prices.

Fourth, the agencies should give preference to studies using US data. Rebound studies have shown that the magnitude of the rebound effect may depend on income, the relative costs of other transportation modes such as bus or subway, and congestion costs. These factors could cause rebound estimates to differ across countries. In principle the agencies could try to account for these cross-country differences and adjust the international estimates to the US context. But given the large number of high quality studies on the US, it would be preferable simply to drop those studies.

Thank you for consideration of these comments.

Sincerely,

A handwritten signature in blue ink, appearing to read "Joshua Linn". The signature is written in a cursive style with a horizontal line extending to the right.

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