THE POTENTIAL FOR IMPROVEMENT IN ON-ROAD TRUCK FUEL ECONOMY: EVIDENCE FROM THE VIUS

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Overview

Heavy-duty trucks are an increasingly important source of greenhouse gas emissions in the transportation sector. In 2011, U.S. Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) announced the final rule of Phase 1 fuel economy standards for medium and heavy-duty vehicles with model year from 2014 to 2018. The second phase of the regulations calls for reduction in fuel consumption (gallons/1,000 payload ton-mile) by 24% for combination tractors and 16% for vocational vehicles from 2018 to 2027. This is equivalent to about 3.09% per year improvement in fuel economy for combination trucks, and 1.96% for vocational vehicles. How challenging will such fuel economy improvements be? There is little information about fuel economy from trucks – it is not reported at the time of truck sale or during operation. One source of data, the Vehicle Inventory and Use Survey (VIUS), a random sample of the truck fleet in the U.S., provides valuable evidence about fuel economy of different types of trucks and how fuel economy has changed over time.

This study looks at the evidence about fuel economy and other truck attributes from VIUS, and provides implications for a dynamic baseline of improvements in fuel economy. We discuss the engine technologies and vehicle designs that potentially improve truck fuel economy. The combined effects of these advances are estimated as technological progress in our specifications. The rich information from VIUS about vehicle characteristics equips us to estimate the trade-off effects – how vehicle weight and engine power affect fuel economy.

Methods

Our first model exploits a log-log. We regress the natural log of trade-off factors, vehicle characteristics, fixed effects of region, survey year and model year on the natural log of fuel economy. The estimated coefficients of model year fixed effects are converted into percentage change in fuel economy to reflect the technological progress over time. Time-variant unobservables that are unrelated to technological progress are absorbed by the survey year fixed effects.

In the second model, we aggregate the data by survey year, fuel type, model year, body/trailer type, vehicle make, number of axles on the power unit and cab type to recover the average fuel economy at the truck model level. We compute the probability weights based on the distribution of truck models in the original dataset, and apply the probability weights to the regression with aggregate data.

Third, we apply the Oaxaca/Blinder method of decomposition to estimate the technological progress. The base period is from model year 1973 to 1975. We run the regression as specified in the first model only for observations from the base period, and use the estimated parameters from the base period to fit the fuel economy in each of the following model years. This method is equivalent to holding the coefficients of trade-off variables constant. The difference between actual and fitted fuel economy can be decomposed into an explained part and an unexplained. The explained part is the effect of changes in trade-off variables; the unexplained part reflects the technological progress.

Results

We find that 10% increase in vehicle weight is associated with 1.2% reduction in fuel economy for combination trucks and 2.3% for vocational vehicles. The trade-off effects between engine power and fuel economy is less dramatic. 10% increase in engine displacement reduces fuel economy by about 0.15% for the former group and 0.68% for the latter. The annual rate of technological progress from 1973 to 2002 is about 0.93% for combination trucks, and 0.83% for vocational vehicles. That is to say, absent of regulations, we can expect a business-as-usual improvement in fuel economy by 8.7% for combination trucks and 7.7% for vocational vehicles in 10 years.

Conclusions

In this study, we examine the trade-off relationship between fuel economy and vehicle attributes (weight and engine displacement, in particular). We also explore a dynamic baseline in fuel economy improvements by estimating the technological progress in the absence of regulations. We find that technological progress in fuel economy for combination trucks is about 31% from 1973 to 2002. It can be translated to 24% reduction in fuel consumption (gallons/1,000 ton payload mile). The annual rate is about 0.92%. If the progress of business-as-usual stays the same, from 2018 to 2027, approximately 8.0% reduction in fuel consumption can be expected, even without regulation. While the proposed rule calls for a 20% reduction, the remaining 12% will have to come from either more technological advances or changes in trade-off attributes, such as vehicle weight and engine power. For vocational vehicles, the technological progress in fuel economy is about 27% within 30 years, equating to a 21% reduction in fuel consumption. If technological advances remain the same from 2018 to 2027, fuel consumption will be reduced by 7.2%, just under half of the target.

Our findings suggest that it is important to count for the business-as-usual technological progress in improving fuel economy as analyzing the impacts of the new fuel efficiency standards for heavy-duty trucks. We recommend the agencies to consider such dynamic baseline in the final rule of phase 2 standards, as ignoring it may result in an overestimation of both the cost of the regulation, as well as the fuel consumption savings and greenhouse gas emissions reductions due to the new rules.