WHAT DRIVES THE DECREASE IN AVERAGE CO_2 EMISSIONS FROM NEW PASSENGER CARS IN FINLAND OR IS IT ALL JUST SCAM?

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Overview

The use of passenger cars is a major contributor to CO_2 emissions, for example, in the European Union passenger cars are responsible for 12% of the total CO_2 emissions. Amid the commitment of the Finnish government to reduce emissions from transport by 39% relative to 2005, a forecast of the future development of the CO_2 emissions from passenger cars would be helpful for the government to make well informed policy decisions. In order to perform the forecast, we take a "cohort based approach" in which the total fleet of passenger cars in road traffic in Finland is decomposed to cohorts of cars taken in use each year (i.e., cohorts of 2014, 2013, 2012 …). We can model the CO_2 emissions of each cohort separately, given the information of the average CO_2 emissions of a cohort, the size of the cohort, and the average mileage per year. To estimate the total emissions of the fleet in any given year, we simply sum up the emissions of all cohorts. This paper undertakes a task of figuring out what drives the changes in the average CO_2 emissions, in particular the dramatic decrease since 2007. The task is essential for the forecast of the future CO_2 emissions. We estimate a benchmark emissions generating function for each cohort using convex nonparametric least squares (CNLS). The benchmark function allows us to decompose the decrease in the average emissions to components representing technical change (car industry manufactures more CO_2 efficient cars), efficiency change (consumers purchase more CO_2 efficient cars), and rebound effects (consumers purchase more CO_2 efficient cars but at the same time switch to bigger cars with more powerful engines). To take as well into account test manipulations (e.g., the Volkswagen scandal), we adjust the estimated technical change component by the gap between the official and the real-world CO_2 emissions.

The paper is organized as follows: After the introduction the second section presents the CNLS approach that is employed to estimate the benchmark emissions generating function. The third section elaborates the decomposition of the changes in the average CO_2 emissions between cohorts. In section four we describe the empirical data on the cohorts of passenger cars in Finland, collected from the Finnish Transport Safety Agency (Trafi). In Section five we report the empirical results for the years 2002-2014 and derive several policy implications. The final section concludes the paper.

Methods

Convex Nonparametric Least Squares (CNLS); Decomposition Analysis.

Results

First, the benchmark emissions generating function is constructed for each of the cohorts of 2002-2014 by using the CNLS approach.

Second, the changes in the average CO_2 emissions (on average -3% per year since 2002) are decomposed to technical change, efficiency change and rebound effect, with the impact of test manipulations taken into account.

Third, after adjusting for test manipulations (1% of gap) the average CO_2 emissions has decreased 2% per year since 2002, and the effective technical change component has contributed to almost all the reductions as the efficiency change and the rebound effect components (their product reflects the consumer behavior) are almost zero on average.

Conclusions

Technical change is fundamental to the future CO_2 reductions from passenger cars. From the perspective of authorities, it is of great significance to make the car industry keep developing greener technologies in passenger cars, and it is also necessary to make consumers play a greater role in reducing CO_2 emissions by using tax measures and incentives. The empirical results of paper will be used in further studies for forecasting the future CO_2 emissions from passenger cars in Finland.

References

Kuosmanen, T. (2008). Representation theorem for convex nonparametric least squares. *The Econometrics Journal*, *11*(2), 308-325.

Kuosmanen, T., & Johnson, A. L. (2010). Data envelopment analysis as nonparametric least-squares regression. *Operations Research*, *58*(1), 149-160.

Kuosmanen, T. (2013). Green productivity in agriculture: A critical synthesis. *Report prepared for the OECD Joint Working Party on Agriculture and the Environment*.

Dings, J. (2013). Mind the Gap! Why official car fuel economy figures don't match up to reality. *Transport and Environment*.