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Title Vehicle type choice under the influence of a tax reform and rising fuel prices

Track General Papers

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Abstract **Extended Abstract**

Reductions in car use are very challenging (Graham-Rowe et al., 2011; Moore et al., 2010; Poudenx, 2008). This has motivated a growing political interest in improving the fuel efficiency of private vehicles. It is seen as one of the most important measures available to achieve significant reductions in emissions (Frondel et al., 2011; Stanley et al., 2011). An efficient way to reduce the problem would be to introduce a tax per unit of emissions. As noted by West (2004) this would induce households to drive fewer miles and buy vehicles with higher fuel efficiency and lower emissions per km. In principle, such effects could be achieved for through fuel taxes. The effects of gasoline taxes are investigated, e.g. in Goldberg (1998), West (2004), and Gillingham (2011). But raising fuel taxes substantially is highly controversial in most countries, so a lot of research has been done to evaluate the effects of alternative vehicle taxes on vehicle ownership and use.

The Danish registration tax on private vehicles was changed in 2007 toward a differentiation based on fuel efficiency. Petrol vehicles capable of more than 16 km/l and diesel vehicles capable of more than 18 km/l became up to 19% cheaper. Petrol vehicles capable of less than 16 km/l and diesel vehicles capable of less than 18 km/l became up to 4% more expensive. The intention of the reform was to increase fuel efficiency in the Danish vehicle fleet, and looking at descriptive statistics it seemed to be very successful, because the fuel efficiency of new cars registered in Denmark during 2007 rose throughout the year. The average fuel efficiency increased from 15.9 km/l across the four months before the reform in May to 17.4 km/l across the eight months after the reform. The increase was partly driven by an increase in the diesel share from 0.24 before May to 0.40 after May 2007. But the fuel efficiency also increased conditional on fuel type. For petrol cars, the corresponding average fuel efficiency rose from 15.1 km/l to 16.0 km/l from the first to the third trimester, and for diesel cars it rose from 18.6 km/l to 20.0 km/l as seen in Table 1. Table 1 also shows that these changes are large compared to the changes in previous years, e.g. in 2006 the average fuel efficiency increased from 15.8 km/l to 16.0 km/l and the diesel share increased from 0.20 to 0.23.

Jan-Apr
May-Aug
Sep-Dec
2005
Average petrol fuel efficiency (km/l)
15.2
15.1
14.9

Average diesel fuel efficiency (km/l)
20.2
20.0

19.3

Diesel share
0.18
0.19
0.20
2006
Average petrol fuel efficiency (km/l)
15.1
15.2
15.2

Average diesel fuel efficiency (km/l)
19.1
18.9
18.8

Diesel share
0.20
0.23
0.23
2007
Average petrol fuel efficiency (km/l)
15.1
15.7
16.0

Average diesel fuel efficiency (km/l)
18.6
19.8
20.0

Diesel share
0.24
0.36
0.44
2008
Average petrol fuel efficiency (km/l)
16.4
17.0
17.4

Average diesel fuel efficiency (km/l)
20.2
20.3
20.2

Diesel share
0.42
0.40
0.36

Table 1: Average fuel efficiency and fuel type across trimesters from 2005 to 2008.

In this paper, I develop a model to analyse and compare the tax reform to several other possible causes of the changes in purchasing behaviour that occurred in 2007.

To focus the paper, I only analyse how the factors affect the composition of the new-vehicle market assuming the population of new-car buyers to be fixed. I develop a mixed logit model to capture vehicle type choice.

Using the model, I analyse the purchasing behaviour to see to what extent a vehicle tax reform similar to the 2007 reform may explain changes in vehicle type choice. I simulate market shares with and without the tax reform to calculate average fuel efficiency and the diesel share. I also test to what extent the changes in average fuel efficiency and the diesel share may be explained by the rise in fuel prices and technological development.

To investigate the extent to which the tax reform may explain the behavioural changes in vehicle purchases in 2007, I simulated how the estimated model would predict the average fuel efficiency and diesel share for 2005-2008 without the reform. This simulation was then repeated under a scenario where the tax reform was implemented and a scenario where fuel prices increased by 16% similar to the rise in 2007. The results are shown in Table 9. All statistics are calculated using the full sample for all four years to avoid sample differences to influence variations in the statistics across the years.

No reform
Tax reform
Fuel prices up
2005
Average fuel efficiency (km/l)
15.64
15.91
15.88

Diesel share (frequency)
0.20
0.22
0.23
2006
Average fuel efficiency (km/l)
15.85
16.07
16.06

Diesel share (frequency)
0.20
0.22
0.23
2007
Average fuel efficiency (km/l)
16.76
17.07

17.02

Diesel share (frequency)
0.31
0.33
0.34
2008
Average fuel efficiency (km/l)
17.81
18.09
18.03

Diesel share (frequency)
0.39
0.41
0.42

Table 9: Average fuel efficiency and fuel type with and without the tax reform.

These simulations show that the tax reform and increasing fuel prices only account for a minor change in fuel efficiency and the diesel share while the effect of technological development across the years is much larger in 2006-2008.

In conclusion, the results indicated that the changes due to technological development were much larger than the effects of both the tax reform and rising fuel prices. While the tax reform was chosen to resemble the Danish 2007 reform, the analysis is relevant at a global level as many other countries have similar tax reforms.

Two recent papers (Rogan et al., 2011; Zimmermannova, 2012) have both evaluated similar tax reforms to the Danish and concluded that they were very successful when looking at the differences in fuel efficiency before and after the reform. This paper does not contradict these findings but it does highlight that there could be other sources that influenced the change toward more fuel efficient cars simultaneously. In particular, it highlights the role of technological development as a (main) driver in the changes of fuel efficiency which has also been observed in the U.S. (Greene, 2009).

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