The impact of company cars on fuel choice and car characteristics

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Summary

We assess the extent to which employees receiving a company car choose a more environmentally friendly car compared to the scenario in which these individuals purchased a private car. We use micro register data covering Swedes and their car possession. To control for preferences for cars, we employ a combination of exact matching and Mahalanobis distance matching on socio-demographic variables, prior car characteristics, and prior company car possession. We find that the company cars are more likely to be an alternative fuelled vehicle but tend to be larger, heavier, and more powerful than private cars. New company cars consume 0.12 litres less fossil fuel per kilometre compared to new private cars. The welfare losses arising from the price distortion of company cars, increasing consumption of cars, outweigh the welfare gains arising from reduced carbon emissions and fuel costs. This results in an estimated welfare loss of €1122 per company car.

Keywords: Company car, fossil fuel consumption, transport economics

1. Introduction

Despite the urgency of climate abatement policies, policymakers and researchers have given surprisingly little attention to company cars provided as fringe benefits for private use, even though they are common among new cars in the EU (Harding, 2014). Previous studies have demonstrated that company cars result in substantial welfare losses by increasing car expenditures (Gutiérrez-i-Puigarnau and Van Ommeren, 2011), the size and power of the car (Engström et al., 2019), and car ownership and usage (Börjesson and Roberts, 2023; Metzler et al., 2019). The taxation of company cars in an OECD country is typically designed such that the employee pays a portion of the car's value as a taxable benefit subject to income tax. However, in most OECD countries, company cars can be possessed and driven at a lower cost than private cars (Harding, 2014). The argument in favour of generous taxation of company cars is that it speeds up the transition to more fuel-efficient cars (Black, 2008). Still, the literature analysing the impact of company cars on fuel efficiency and fuel type is scarce. Therefore, we investigate to what extent company cars are more likely to be alternative fuel vehicles or consume more fossil fuel and to what extent such effects impact the welfare effects of company cars.

Previous studies have that alternative fuelled vehicles (AFVs) are more common among company cars but also that they tend to be larger, heavier, and more powerful shown (Engström et al., 2019; Metzler et al., 2019). However, these studies have disregarded that the preferences of the individuals receiving a company car may differ from those of the private buyers of new cars.

Our study adds to a small but growing literature on the effect of company car policies on the choice of car. Koetse and Hoen (2014) estimate the preference for AFVs among company car receivers using a stated preference choice experiment on Dutch company car receivers. They find that company car receivers preferred conventionally fuelled cars to AFVs given current limitations in AFV technology but find that they would prefer some types of AFVs with improvements such as better availability of models. Dimitropoulos et al. (2014) used a similar stated preference choice experiment on Dutch company car receivers to empirically assess the welfare effects of the favourable tax treatment of electric and low-emissions cars. They find linking environmental impact with company car taxation leads to welfare losses of €70 to €159, and increasing the marginal tax rate for hybrids and electric vehicles leads to welfare gains.

2. Method

Empirical model

We study how company car taxation impacts the choice of new cars. To accomplish this, we assume that the employee receiving a company car would have bought a new private car had she not received a company car. We use a matching model to control the preferences that this employee would have had for a privately purchased car. We match on socio-demographic variables, characteristics of previously owned cars, and prior company car possession, which should capture the unobserved preferences for different car types.

We assume that the matched private car buyer did not receive a company car only because she was not offered one by her employer, not because she has different car preferences. Therefore, being offered a company car is unrelated to car preferences conditional on the matching variables. This assumption is reasonable because some companies provide company cars and others do not due to company policy.

We combine exact matching for categorical variables and Mahalanobis distance matching for continuous variables. The matching procedure involves two stages. Firstly, the Exact Matching groups individuals and is based on the categorical matching variable, while secondly, within each group, pairs are formed based on the lowest Mahalanobis distance. Standard balancing tests show that the matching variables are balanced after the matching procedure.

Let the observed outcome of car characteristics for individual *i* and time *t* be $A_{i,t}$. This outcome can be a continuous variable such as the fossil fuel consumption per kilometre, $F_{i,t}$, or the dummy variable indicating if the car is alternative fuel $\theta_{i,t}$. The outcome $A_{1,i,t}$ is compared to the counterfactual outcome $\widehat{A_{0,\iota,t}}$, which is the observed outcome for the private car purchased by the matched buyer *j* in year *t*. The average treatment effect on the treated (ATET) year *t* is

$$\beta_{A,t} = \frac{\sum_{i=1}^{N_t}(A_{1,i,t} - \hat{A}_{0,i,t})}{N_t}, \tag{1}$$

where $\beta_{A,ATET,t}$ is the effect on A of the company car policy. The effect of company car possession on for instance $\theta_{i,t}$ varies between years because the supply of cars by fuel type has varied substantially. We calculate the average effect for all years (T) used in the analysis

$$\beta_A = \frac{\sum_{t\in T}\sum_{i=1}^{N_t}(A_{1,i,t} - \hat{A}_{0,i,t})}{\sum_{t\in T} N_t}. \tag{2}$$

Our analysis focuses on fossil fuel consumption as the outcome, and the dummy for alternative fuel. However, we also apply (2.) to estimate the effect on a number of other continuous variables impacting the energy consumption of the car: engine power (kW), weight (kg), size (sq.-meters), and market value (€) according to the Swedish tax authority.

Our data contains fuel consumption reported by vehicle manufacturers, from 2008 onward. However, up until 2018 fuel consumption in these studies were based on the NEDC test procedure which is known to be flawed. To estimate (2), we therefore only use data from 2019 and 2020, when analysing the effect on fuel consumption, because these are the only years applying WLTP measurement.

Theoretical model

To compute the welfare effect of increased car consumption we adopt the theoretical framework of Gutiérrez-i-Puigarnau and van Ommeren (2011). In this framework, an individual acquires a new car corresponding to x car market-value units which is determined by the car's hedonic characteristics such as weight, size, and engine power. p is the price per market-value unit x. We derive the effect of company car possession on welfare using the car expenses px. We assume a car market with a horizontal supply curve, and no impact of the company car policy on worker productivity.

Following Gutiérrez-i-Puigarnau and van Ommeren, we assume that car expenses px equals the market value of the car V multiplied by the share of the market value α that the individual possessing the car pays annually, thus $px = \alpha V$. This yields the difference in car units for a given price $\Delta x_i = \frac{\alpha\Delta V}{p}$, where we estimate ΔV and take $\alpha = 0.4$ from Gutiérrez-i-Puigarnau and van Ommeren (2011). Given a linear demand for car units we can approximate the reduction in welfare due to increased car expenditure, ΔW^1, using the rule of a half

$$\Delta W^1 = \frac{1}{2}\Delta x \Delta p = \frac{1}{2}\alpha\Delta V\frac{\Delta p}{p}, \tag{3}$$

where $\Delta p/p$, is the price reduction from receiving a company car instead of purchasing it privately.

For carbon dioxide emissions the change in external cost over the car's entire lifetime T, equals

$$\Delta E = \sum_{t=0}^{T} \frac{u\Delta\gamma d_t}{(1+r)^t}, \qquad (4)$$

where $\Delta\gamma$ is the change in average kilogram carbon emissions equivalents per kilometre arising from differences in fuel type and fuel efficiency, u is the social cost of carbon dioxide equivalent per kilogram, d_t is the annual average driving distance and r is the discount rate.

The consumer surplus ΔCS arising from changes in the fuel price, arising from differences in fuel type and fuel efficiency is

$$\Delta CS = \sum_{t=0}^{T} \frac{(\Delta v + \Delta\tau)d_t}{(1+r)^t}, \qquad (5)$$

where v is the fuel price per kilometre excluding taxes and τ is the fuel tax per kilometre. Given that the change in fuel tax $\Delta\tau$ is a transfer to the government it does not affect the welfare, such that the change in welfare due to changes in fuel type and consumption is

$$\Delta W^2 = \Delta E + \Delta CS = \sum_{t=0}^{T} \frac{(u\Delta\gamma + \Delta v)d_t}{(1+r)^t}. \qquad (6)$$

Data

We use two linked micro-register databases provided by Statistics Sweden, covering the years 1999 to 2020. The first database encompasses yearly observations of all adult registered individuals in Sweden including socio-economic variables, whether they are taxed for a company car as a fringe benefit, and the corresponding fringe benefit value. The second database covers yearly observations of all privately and company-owned cars registered in Sweden, containing information such as fuel consumption, engine power, weight, size, and fuel type. There are two types of company car receivers, employed company car receivers, and self-employed company car receivers that own their firm (we exclude self-employed when referring to employed hereafter).

A problem is that the Swedish tax authority does not collect characteristics of the company car, except the fringe benefit value, for all the individuals (in the first database) being taxed for a company car. The result is that while all private cars (in the second database) can be linked to the car owner (in the first database), only two-thirds of self-employed company car receivers, and one-third of employed company car receivers can be linked to a specific company car from 1999-2018. Furthermore, the problem increased after 2018 and for 2019 and 2020, we are only able to link self-employed company car receivers to a specific company car. The 1999 to 2018 sample includes 232 950 observations of receivers of new company cars and 1 963 559 observations of individuals purchasing a new private car, and the 2019 to 2020 sample includes 5183 observations of receivers of new company cars and 159 812 observations of individuals purchasing a new private car. However, not all the company car observations are used since they may not have a comparable private car buyer.

3. Results

Empirical results

Table 1 presents the effect of company car policy on the market value, the fossil fuel consumption per kilometre, and the probability of the new car being an alternative fuelled vehicle using data from 2019 and 2020.

Column one shows that new company cars have a €7844 higher market value than new private cars. We do not have data on the market value for all cars, reducing the sample by roughly 1000 observations. Our estimate is €2000 lower than the estimate of Gutiérrez-i-Puigarnau and van Ommeren (2011). The difference may be attributed to their study not confining the sample to new cars. Considering that company cars are on average newer than private cars and newer cars have an on average higher market value, a smaller difference in market value is expected.

Column two shows that company cars consume on average 0.12 litres less of fossil fuel per kilometre and column three that they are 20 percent more likely to be an alternative fuelled vehicle. These results suggest that the company car policy leads to more environmentally friendly cars. Comparing the estimated effects to the average fossil consumption among new private cars (0.59) and the share of alternative fuelled vehicles among new private cars (0.135) shows that there is a large percentual increase.

Table 1: Estimated difference in market value, fossil fuel consumption, and probability that the car uses an alternative fuel from 2019-2020

	(1) Market value	**(2) Fossil fuel consumption per kilometres (litres)**	**(3) AFV**
Company car	7843.6	-0.119	0.197
	(391.0)	(0.0064)	(0.0095)
N	3105	4 071	4 052
Average value among new private cars	30 894	0.593	0.135

Standard errors are shown in the parentheses.

Table 2 shows the effect of company car possession on the probability of the new car being an alternative fuelled vehicle (AFV), engine power, size, and weight. The table shows that new company cars are 5.6 percent points more likely to be an alternative fuelled vehicle. 15 percentage points lower than what is found in Table 3, suggesting that there are different effects dependent on year. The table shows that new company cars are 12.6 kW more powerful (corresponding to 17 percent points), are 0.33 m^2 larger (corresponding to 4 percent points), and are 149 kg heavier (corresponding to 9 percent points) than new private cars. Therefore, while new company cars consume less fossil fuel than new private cars in 2019 and 2020, there is a positive effect on car characteristics that increased energy consumption for the period 1999 to 2020.

Table 2: Effect of company car possession on car characteristics 2000-2020

	(1) AFV	**(2) Engine power (kW)**	**(3) Size (sq.-meters)**	**(4) Weight (kg)**
Company Car	0.056	12.6	0.329	148.7
	(0.0017)	(0.25)	(0.0062)	(2.01)
N	142 729	142 729	142 729	142 729
Average value among new private cars	0.052	103.0	7.99	1954.9

Standard errors are shown in the parentheses.

Welfare Analysis

In the 2019-2020 sample, the average purchase price for new company cars is €45,000, and the average fringe benefit is €4300, yielding a reduction in the effective price of 53.1 percent. Using equation (3) and the effect on market value from Table 1 we find a change in annual welfare from the increased car expenditure of -€899 per company car. Assuming a three-year company car holding period and a four percent discount rate, the resulting welfare loss amounts to €2595 over three years.

To calculate the welfare effect of reduced fuel cost and carbon dioxide emissions, we assume a car lifetime of 17 years (the average lifetime of a car in Sweden) and a four percent discount rate. The average annual driving distance over 17 years is taken from the population of all cars and equals 199,300 kilometres, to estimate the impact on carbon emissions we multiply the carbon emissions per litre of fuel by the fossil fuel consumption for each fuel type and estimate specification (2). For the fuel cost per kilometre, we multiply the fossil fuel consumption by the pump price (with and without tax). For the fuel cost for electric vehicles, we instead multiply the energy consumption per kilometre in kW with the price of electricity and the electricity tax and estimate the difference between new company cars and new private cars using specification (2). We use 2019's prices and taxes and the social cost of carbon dioxide emissions to be €0.15.

The estimated decrease in carbon emissions per results in a decrease in external costs of €820 per car. The increase in consumer surplus from the lower fuel costs from the company cars being more fuel efficient and using less-expensive fuels amounts to €2471 while the government reduce their tax revenues by €1818, yielding a gain of €653. Combined the welfare losses amount to €1122 per company car over its lifetime.

4. Conclusion

We have applied a matching model on micro panel registry data to estimate the effect of company car possession on car choice. Our matching model combines exact and Mahalanobis distance matching to control for selection into company car possession. Using the estimated effect of company car possession on car fossil fuel consumption per kilometre, the probability that the car is an alternative fuelled vehicle, and other car characteristics.

We find that new company cars consume 0.12 litres less fossil fuel per kilometre than new private cars and are more likely to be an alternative fuelled vehicle. However, welfare gains from the car being more environmentally friendly and fuel-efficient, are smaller than the losses induced by increased car consumption, yielding a net negative effect. For the welfare effect we only use observations from 2019 and 2020. However, using a sample from 2000 to 2020 we find that the effect of company cars on the probability that the car is an alternative fuelled vehicle is lower. Moreover, new company cars are also larger, heavier, and more powerful compared to new private cars, reflecting the lower capital cost. This suggests that company cars may lead to a renewal of the car fleet using the latest technologies, but that then whether the renewal leads to less polluting cars depends on the year.

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