

## ANALYSIS OF IMPACT OF REGISTRATION FEE IN THE CZECH REPUBLIC

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**Abstract.** Transport contributes significantly to economic growth, globalization, raising the living standards of all the population, and contributing to a particular country's development. At the same time, however, it accounts for about one fifth of the total carbon dioxide emissions, causing external effects due to transport, which raises the need to address this issue. It can be said that the older the car is, the more emissions it produces. A tax on motor vehicles can be used to reduce the harmful effects of transport. The Czech Republic has a fairly old fleet, which contributes to a great extent to the deterioration of the environment. In this context, a registration fee was introduced in the Czech Republic based on the vehicle emission parameters. The aim of the fee was to change the fleet structure, in particular to promote new registrations of new passenger cars with better environmental performance, reduce the share of new registrations of used passenger cars and increase the disposal of old cars. This paper focuses on the analysis of the impact of the registration fee on the fleet structure in the Czech Republic. The case study is based on a multinomial regression analysis and statistical analysis of official sources in the Czech Republic. The impact of the registration fee on cars is significant. The number of new registrations of used vehicles is decreasing and the number of discarded old cars is increasing. Despite the positive year-on-year changes, the average age of the fleet remains unfavorable and well above the European average.

**Keywords:** car fleet structure, emissions, taxation, registration fee.

### Introduction

Transport contributes significantly to economic growth and raising of living standards. On the other hand, transport is also the cause of numerous undesirable effects – externalities. One of them is climate change, which is mainly due to greenhouse gas emissions of carbon dioxide [1]. One of the instruments to encourage the purchase of environmentally friendly vehicles is the taxes levied on motor vehicles. The level of taxation is one of the major factors influencing both the consumer behavior and the behavior of the car manufacturers. Within the EU member states, there has been some convergence in the recent years towards CO<sub>2</sub>-based passenger car taxation systems.

Taxes levied on road motor vehicles in individual member states of the European Union can be divided into three major groups. The first group is closely related to certain consumption – excise duty on fuel, the second group includes taxes related to the moment of acquisition or purchase of the vehicle – it is a registration tax, the third group can include the annual taxation of passenger cars.

Excise duty is considered to be the best available tool for reducing CO<sub>2</sub> emissions, as there is a direct correlation between the fuel consumption and emissions and it is also easily implemented in the tax system [1]. This tax induces a change in the behavior of both the motor vehicle manufacturers and the users and underestimates consumers in buying more fuel-efficient vehicles [2]. Other benefits of this tax can be seen in indirect distance travel taxation, and consumers have more opportunities to minimize this tax, for example by switching to a different mode of transport, a more economical driving style, or reduced mileage [3]. The excise tax increases are politically very sensitive, so other tools are also used.

Other instruments include taxes that are related to the moment of purchase of the vehicle, respectively the purchase or the moment of purchase of the vehicle, respectively the purchase or the moment of initial entry into service – this is a registration tax. The purpose of taxation is to influence the consumer's decision to buy a lower CO<sub>2</sub> vehicle. Although empirical evidence of purchasers' responses to various forms of taxation is very feeble, the common view is that car buyers are more likely to be affected by car retail prices than lifetime costs of ownership, and therefore registration taxes have a greater direct impact on lower-priced cars [4]. The reason is that this one-off tax is able to limit the effect of consumers' short-sightedness due to the fact that consumers may not always be able to fully assess or estimate the value of future cost savings at the time of purchase and therefore often prefer short-term savings over long-term ones [3;5]. Moreover, registration taxes are effective in reducing the number of cars and switching to another mode of transport. In order for the registration tax to have a sufficient effect on emission reductions, it is necessary that the tax is sufficiently high. It

follows that one of the main drawbacks of introducing a registration tax is that it can cause a slowdown in vehicle fleet renewal as the high cost of automobiles on the feet of the consumer discourages the purchase of new and more fuel-efficient cars, and on the contrary, the average age of the fleet may increase.

On the other hand, in the case of the road tax, it emphasizes its ability to encourage consumers to replace the vehicle earlier, thereby contributing to a reduction in the age of the fleet [6]. Consideration should be given to the different price elasticity of demand in relation to the proposal for a road tax based on CO<sub>2</sub> emissions as the effects of changes in the cost of operating the vehicle will be treated differently by business entities, otherwise by high or low income households [7]. Some authors view the road tax as a complementary registration tax because it has elements that have the ability to eliminate the main disadvantage of the registration tax, that is, the risk of extending the age of the fleet [8]. Taxation of vehicle ownership plays a major role, as it affects purchasing behavior and use of vehicles. The factors influencing consumer behavior are listed [9].

The composition of the fleet and its gradual aging also have significant impacts on environmental pollution. The fleet age in the Czech Republic is one of the oldest fleets in Europe. The average age of passenger cars in the Czech Republic was 14.6 years at the end of 2017 and was well above the European average, which was 9.7 years for 2014 [10]. For this reason, a legal standard was introduced in the Czech Republic in 2009, which addresses the issue in relation to the compliance with the emission limits in the exhaust gases. This fee, also referred to as the ecological tax, applies to vehicles meeting the maximum EURO 2 emission standard. If the EURO 2 emission standard is met, the fee is CZK 3 000, CZK 5 000 if the EURO 1 emission standard is met, if no emission limits are met at the time of registration it is CZK 10 000. The fee income is the income of the State Environmental Fund. The evolution of the car registration fee income is shown in Fig. 1.

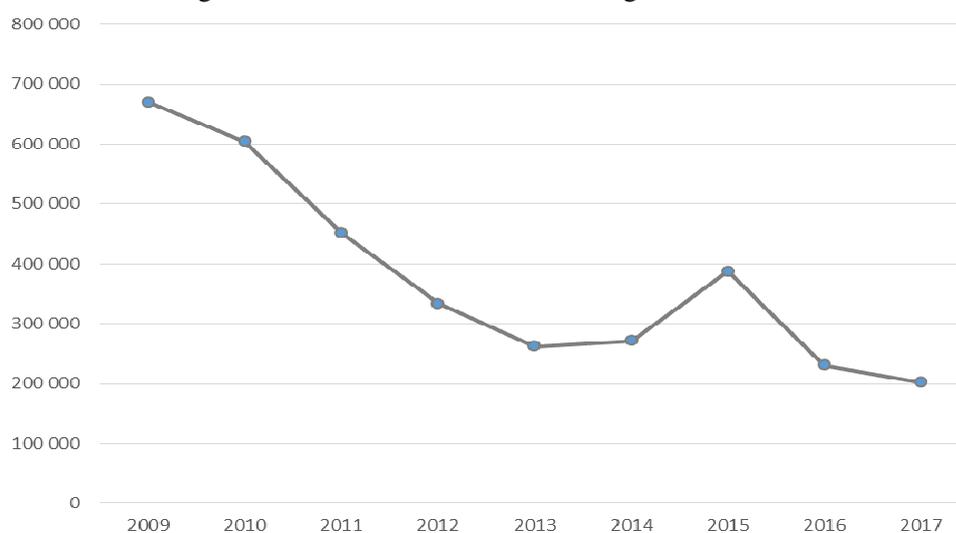


Fig. 1. Evolution of revenues from registration fee for vehicles not meeting emission standards (CZK thousand)

The main objective of the article is to describe the development of the impact of the registration fee on the registration of used vehicles and the decommissioning of vehicles in the Czech Republic for the period 2006-2016.

### Materials and methods

Modeling of the impact of the registration fee on the registration of used cars and the decommissioning of passenger cars from registration is made on the basis of a multinomial regression.

The explained variable is considered to be three categorical. The first category is the first registration of second-hand vehicles; the second category is vehicles discarded. New vehicle registration has been selected for the reference category. The explanatory change was chosen as a calendar year of observation, which was considered a categorical variable. The first category is the year 2005, which is also the reference category. The last category is the year 2016.

The maximum likelihood method has been used for parameter estimation. Interpreting of the regression coefficients is: when  $\beta > 0$  ( $e^\beta > 1$ )  $\rightarrow$  the probability of occurrence of the character increases with the increasing  $x$ ; when  $\beta < 0$  ( $e^\beta < 1$ )  $\rightarrow$  the probability of occurrence of the character decreases with increasing  $x$ . The odds ratio  $e^\beta$  tells you how many times the chances of a positive result change.

Wald’s test was used to verify the significance of the variable calendar year. To verify the model as a whole, a deviance was used and it can be said that the model as a whole has a meaning to consider.

The main source of data used to quantify the impact of the registration fee on a fleet is the statistics of the Automobile Importers Association.

**Results and discussion**

In Figures 2 and 3, the parameter values can be observed for the two groups of explanatory variables considered – first registration of used vehicles and discarded vehicles. Full gray columns show the parameters, which  $p$ -value is less than five percent (based on the Wald test); on the contrary, the white ones are marked with the parameters, which are statistically insignificant.

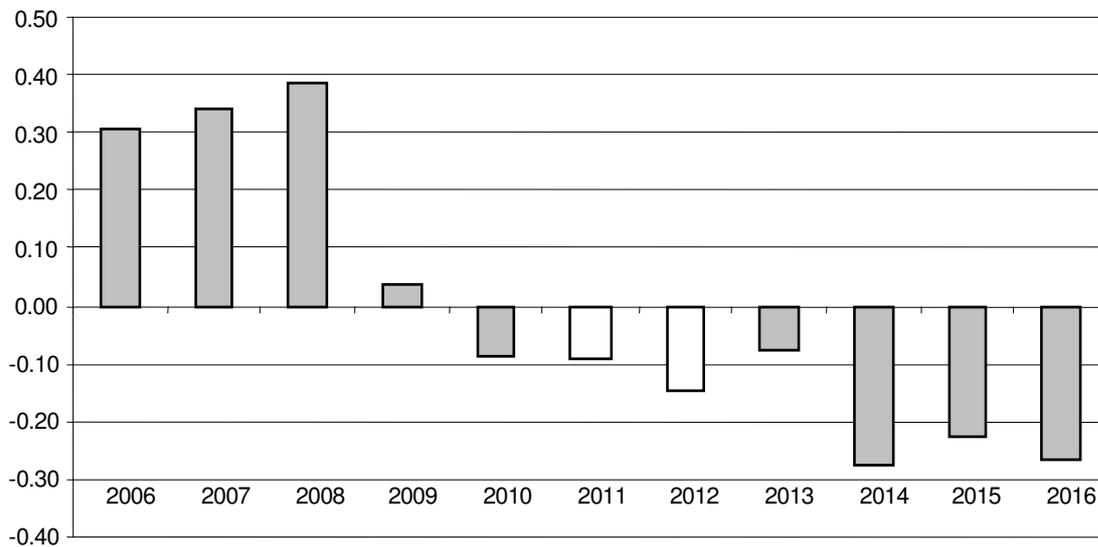


Fig. 2. Estimates of calendar years parameters for used vehicle category

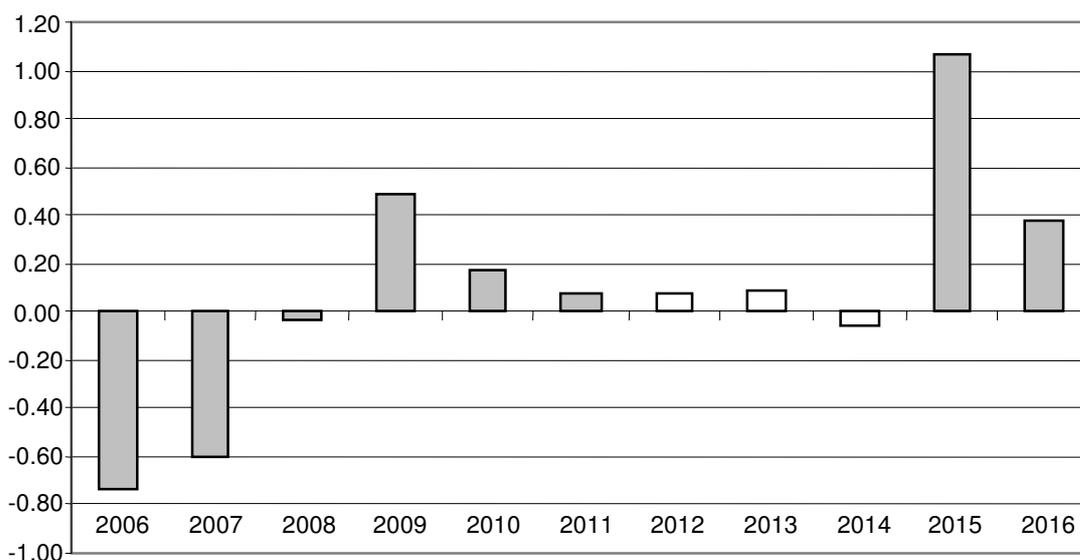


Fig. 3. Estimates of calendar years parameters for excluded vehicle category

Figure 2 shows that between 2006 and 2008 the values of the registration parameters of used vehicles are increasing. Since 2009, when the registration fee was introduced, there is a clearly visible (almost linear) decrease in the parameter estimates.

Also, estimates of the discarded vehicle parameters indicate the positive effect of the registration fee, when the number of discarded vehicles increases. For each vehicle category, the interpretation of the individual parameter estimates is analogous. For example, an estimate of the 2009 parameter for the used vehicle category of 0.03812 means that compared with 2005, there is a chance that a used car will be registered, compared to the lower car registration, i.e. the odds  $e^{0.03812} = 1.04$ . Similarly, an estimate of the 2009 parameter for the de-classed vehicle category of 0.487 means that compared with 2005, there is a chance that the vehicle will be eliminated as opposed to registering a new car higher, i.e. given the estimated parameter, the chance is  $e^{0.487} = 1.63$ . The development of the estimated parameters therefore confirms the hypothesis on the positive effect of the registration fee over time, whether it is a decline in the registration of used vehicles or an increase in the number of discarded vehicles compared to the period without a charge.

Also, foreign empirical studies show a positive impact on the fleet. Research focuses mainly on effectiveness of alternate policy tools, such as regulations, taxes, and various types of incentives towards the purchase of clean vehicles and the retirement of more polluting ones. The authors [11] examined annual vehicle registration tax and the vehicle excise duty. The authors indicate that the measure increased the adoption of low-emission vehicles and discouraged the purchase of very polluting vehicles. The authors [12] investigated in particular, how people reacted to two French environmental policies that aimed at mitigating CO<sub>2</sub> emissions from automobiles. The authors state that, consumers choices were bent towards low CO<sub>2</sub> emitting cars. The authors [13] examined greening of the vehicle fleet in Norway. They found that CO<sub>2</sub> differentiated registration tax contributes significantly to shifting purchase towards low – emitting cars. The authors [14] analysed the impact of different bonus/malus annual registration fee in Switzerland. The authors suggest that retirement of old cars can be reached through a bonus/malus scheme.

Despite the slightly positive year-on-year changes, the age structure and average fleet age in the Czech Republic remain unfavorable. At the end of 2017, 5.59 million passenger cars were registered in the Czech Republic, of which 41.5 % were 15 years old. The Czech Republic is one of the few EU countries, where the road tax is levied only on vehicles designed for business. At present, there is also a debate on the introduction of a road tax for private cars with a link to CO<sub>2</sub> emissions. A CO<sub>2</sub>-based tax would be able to motivate consumers to exchange their old non-organic vehicles for more environmentally friendly vehicles.

## Conclusions

1. A multinomial regression was used to model the development of the impact of the registration fee on registration of used vehicles and decommissioning of vehicles from the register.
2. Estimates of the parameters for discarded vehicles indicate a positive effect, when at the time of charging and later the chances of vehicle retirement from the registry are greater than the pre-charging period.
3. Estimates of the parameters for used vehicles also indicate a positive effect, when the chance that a used vehicle will be registered due to the introduction of the fee has decreased.

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