

To Own or Not to Own: Costs for Car Ownership in Sharing Economy

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Abstract. The article is devoted to issues related to comparing the costs of owning a car and using a taxi in sharing economy. The article provides a methodological approach related to the full accounting of costs and the calculation of costs per kilometre with the corresponding microeconomic model building. The authors considered a case of Ekaterinburg city, one of the leading industrial Russian cities with a high number of cars per 1000 people. The calculations made it possible to identify the equilibrium point – the annual mileage, at which the unit cost of owning a car is equal to the cost of using a taxi. According to the presented model, if a citizen passes less than 5,000 km a year – it's more profitable to do this by taxi. For longer annual kilometres driven, the total costs of a taxi will be higher than the total costs of owning a car. The obtained results contribute to a better understanding of citizens' travelling behavior and helps to form a transport policy that helps to reduce the number of private cars in big cities and makes cities more sustainable.

1. Introduction

Increasing urbanization, corresponding negative impact on the environment and quality of life reduction raised an issue of cities sustainable development. Thus, one of the UN sustainable development goals is "Make cities and human settlements inclusive, safe, resilient and sustainable" [1].

There are many models and visions of a sustainable city. For example, model for sustainable urban development [2] and eco-cities [3], extended metabolism model [4], smart cities [5] and others.

But nearly all of them include the need for revising transportation priorities in favor of foot, bicycle and stress the importance of reducing the number of vehicles in the streets.

According to the World Bank, in many world cities, a number of cars per 1000 people is close to 1000¹. As for Russia – in 2017 it was 305 cars per 1000 people, but it differs a lot among regions, and it was up by 18 percent since 2012².

¹ <https://datacatalog.worldbank.org/passenger-cars-1000-people>

² www.gks.ru/free_doc/new_site/business/trans-sv/t3-4.xls

Along with the increase in the number of cars, emission of pollutants from automobile transport remains quite high in Russia, it's share in total emissions for 2015 was 44.7% or 13 937 thousand tonnes³. In addition, an increase in the number of cars in cities leads to various negative effects such as a decrease in pedestrian zones due to parked cars, an increase in the number of traffic jams and an increase in travel time, noise pollution, etc. These effects, altogether, certainly affect the quality of life in cities, significantly reducing it. Therefore, today one of the main city challenge, meeting of which leads to sustainable development, is the formation of a transport policy aimed at reducing the number of personal cars.

2. Theory

The reduction in the number of cars on the roads can be achieved as a whole in two ways – by creating convenient public transport or by using measures restricting the use of private cars. The second group of measures should also include the creation of conditions promoting refusal of personal transport in favor of alternative means of transportation, such as taxi and car sharing. In this paper, authors propose a detailed discussion of the last group of measures, since the transformation of the public transport system requires a sufficiently large amount of time and high investment, while the problem of congestion is already quite acute for many cities and requires a speedy solution.

The system of measures aimed at restricting the use of personal cars is presented in table 2.

Table 1. World experience of implementing measures that discourage the use of personal cars [6].

Measures	Description
Introduction of parking mode	<ul style="list-style-type: none"> • introduction of parking tariffs, including those with a progressive hourly rate on the central streets of the city, aimed at a significant increase in fees for long-term parking; • introduction of norms obliging each car owner to acquire a legalized parking lot at the place of residence
Prioritizing public transport	<ul style="list-style-type: none"> • separate driving lane; • providing a priority green phase for public transport
Introduction of toll roads	<ul style="list-style-type: none"> • payment for the use of high-speed sections of the road network; • road use charges during peak hours (peak-period road pricing); • payment for the use of congested sections of the road network; • Pay-as-You-Go Tax. The fee is a universal payment for the use of the road network per kilometer, charged at a differentiated rate according to the GPS tracks of each car

In Russia, the indicated restrictive measures that discourage the use of personal cars also find their application, which leads to a decrease in the attractiveness of personal cars ownership, stimulating the search for alternative solutions in the urban environment. The closest solution in terms of comfort in this regard is a taxi, as well as car sharing – short-term car rental. In economic terms, both of these options are identical and refer to the sharing economy, which is an interaction between two sides, when the first side has certain resources and does not use them, and the second side is ready to rent them for a certain time to meet their own needs (Yandex. Taxi, Uber, Delimobile and others).

The main factor stimulating the development of the sharing economy is the accumulation of a huge number of personal items, including cars, among economic entities. As a result, the implementation of this economic model leads to an increase in the efficiency of resource consumption, and the negative

³ http://www.gks.ru/free_doc/doc_2018/ohrana_2018.pdf

environmental and social consequences of mass motorization are reduced. The latest scientific studies also prove the possibilities for owners to generate income from their property, however, the key role of digital platforms in the feasibility of these potentials is highlighted [7,8,9].

Indeed, the development of a sharing economy would not be possible without the digitalization of operations, the widespread dissemination of digital technologies that provide equal access to resources for all economic entities. Internet connectivity in Russia over the past five years is growing at an accelerated pace (figure 1), which proves the active involvement of Russia in the processes of global digitalization.

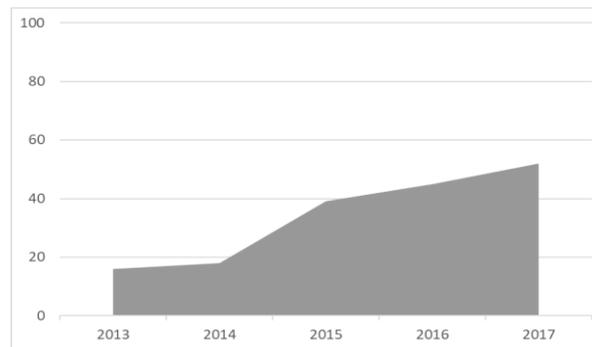


Figure 1. Internet connectivity in Russia, % of Internet users⁴.

In Russia, digital technologies expansion is also reflected in the field of car sharing and taxi. Mobile applications are constantly being improved: there are opportunities to track the delivered car, get more specific information about an order, view the driver profile, and others. In addition, taxi aggregators take significant steps in the field of improving travel safety – rating systems, photo, and video control, passenger and driver insurance provision, tracking of driver fatigue and remote vehicle diagnostics. The convenience of taxi services is also improving, so in Moscow at the end of 2017 the taxi waiting time was only 4-5 minutes. All these factors contribute to considering taxis as an alternative to owning a car.

In this context, the issue of comparing the cost of owning a personal car and the cost of taxi/car sharing services when making a choice becomes relevant for a city dweller. And here certain methodological difficulties arise, since, as a rule, a city dweller takes into account only direct costs for one trip in a personal car, which makes up a small part of the total costs. This fact makes driving a personal car cheap for most people, and, of course, more profitable compared to taxi/car sharing services. Authors suggest the methodological approach that allows to calculate and compare the costs of owning and sharing cars for making more objective choices.

3. Materials and methods

Studies of car user's behavior and factors determining their choice have been carried out by many authors [10,11,12,13]. It should be noted that it is important to take into account country specific in determining the cost of car ownership and the cost of a taxi/car sharing.

As for Russia, authors suggest the following set of costs of car ownership (table 2).

Among the listed costs, the authors do not indicate so called "external effects" from owning a personal car (externalities), such as damage to pedestrian traffic, loss of uniqueness of the urban environment because of parking lots, roads construction; damage from congestion; damage from noise pollution; damage to health from air pollution; damage to health due to a decrease in physical activity with constant use of a car, etc. because there are certain methodological difficulties in calculating the listed effects.

⁴ <http://ac.gov.ru/files/content/15801/issledovanie-taksi-2018-pdf.pdf> (дата обращения: 01.11.18).

Table 2. The cost structure for car ownership.

Direct costs	Constant costs
<ul style="list-style-type: none"> ○ gasoline ○ parking ○ toll roads 	<ul style="list-style-type: none"> ○ depreciation (loss of car value) ○ car repair (if a new car – maintenance costs according to the producer’s standards) ○ registration costs ○ the risk of damage during an accident (taken as a cost of hull insurance) ○ third party only car insurance ○ night parking ○ loss of profit (at an average interest rate on a deposit) when buying a car on your own funds/payments on a car loan, when buying a car on credit funds ○ transport tax

As for the cost of sharing cars (taxi/car sharing) – in this case, the costs are made up of the cost of the trip according to the tariff.

After determining the costs of car ownership and car sharing, the authors propose to calculate the costs per kilometer, after which it will be possible to compare these two types of traveling.

4. Results and discussion

To compare the costs of owning a car and the costs of using a taxi, authors choose Ekaterinburg – one of the leading industrial cities of Russia. The population of Ekaterinburg is 1,48 million people, average monthly salary in 2018 was 860 USD⁵. The number of cars per 1000 people is one of the biggest among Russian cities and higher than Russian average – 306 cars per1000.

Authors compare the costs of owning a car with the costs of sharing for Ekaterinburg using the following assumptions: a new Renault Logan car is considered as a personal car, the car costs 10 585 USD and is purchased at own expense, the cost of city parking in Ekaterinburg is not taken into account, the cost of taxi rides were analyzed according to Yandex.Taxi data, economy tariff, two rides per day during peak hours (morning and evening) from the faraway district to the city center.

The data on the annual total cost of owning a car and using a taxi is shown in table 3.

Table 3. Annual total cost of car ownership and using a taxi.

Type of costs	Amount, USD
Car ownership costs	
1. Direct costs	
1.1. Gasoline, RUR	0,61 USD/liter
1.2. City parking	n/a
1.3. Toll roads	n/a
2. Constant costs	

⁵ <https://екатеринбург.рф/file/d24ca3fc2ce687381483a16214110d93>

2.1. Depreciation (loss of car value, 11% per year)	1164
2.2. Car repair (if a new car – maintenance costs according to the producer’s standards)	92
2.3. Registration costs	47
2.4. The risk of damage during an accident (taken as a cost of hull insurance)	333
2.5. Third party only car insurance	137
2.6. Night parking	332
2.7. Loss of profit (at an average interest rate on a deposit – 8,5% per year)	900
2.8. Transport tax	15
Total Constant costs	3020
Using a taxi costs	0,67 USD/km

In table 4 authors analyze the costs of car ownership and car sharing per kilometer.

Table 4. Car ownership costs and using a taxi costs in dependence to annual kilometers driven.

Annual kilometers driven	3 000	5 000	7 000	10 000
Car ownership costs, USD/km	1,06	0,65	0,48	0,35
Using a taxi costs, USD/km	0,67	0,67	0,67	0,67

The microeconomic model is presented in figure 2.

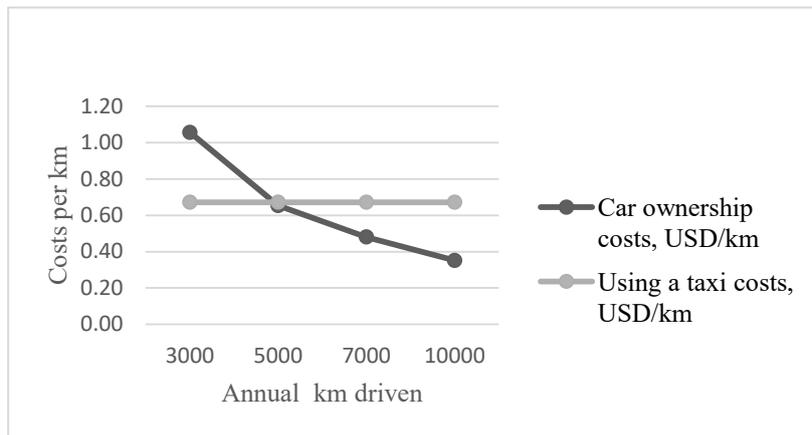


Figure 2. Microeconomic model of car ownership costs and using a taxi costs in dependence to annual kilometers driven.

Obviously, the total cost of using a taxi increases in proportion to the distance traveled during the year. As for the costs of owning a car, the “scale effect” plays a role – with an increase in the distance traveled during the year, total costs grow, but at a slower pace, so costs per km decrease.

Summing up, authors note the following:

(1) according to the presented model, if a citizen passes less than 5,000 km a year – it’s more profitable to do this by taxi, for longer annual kilometers driven, the total costs of using a taxi will be higher than the total costs of owning a car;

(2) if a private car is more expensive (in the paper authors considered a new Renault Logan), the line of car ownership costs per km on figure 2 will move to the right and this will make using a taxi preferable in terms of costs for even more number of citizens;

(3) the same change in citizens' traveling behavior may occur in case of introduction transport policy measures restricting use of personal cars (city parking, congestion charging, etc.), as well as if the cost of a taxi decreases and the quality and reliability of this service improves.

A study conducted by the authors, due to the full accounting of the costs of owning a car, and the microeconomic model that compares the unit costs of owning a car and using a taxi, allows, for given conditions, to establish an equilibrium point (the annual kilometers driven), when unit costs are equal.

This information contributes to a better understanding of citizens' travelling behavior and helps to form a transport policy aimed at reducing the number of private cars in big cities and making cities more sustainable.

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