

# *Carsharing Market Analysis and the Substantiation of Its Efficiency*

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**Abstract:** The article analyzes the markets of car sharing services and taxis in the PRC, Japan and India. The problems of the development of these markets in China, Japan, India are revealed. The efficiency of using car sharing services in comparison with personal vehicles has been substantiated. Within this rationale, mathematical models for calculating the efficiency of carsharing services are presented, including taking into account the synergistic effect of the interaction of factors determining the effectiveness of these services. Recommendations for the development of car sharing services and areas for further research in this area are offered. The conclusion is drawn that Russians do not hurry to leave the yet the car therefore the karsheringovy companies in Russia will have some difficulties with the development in the near future.

## **1. Introduction**

Carsharing is a form of joint consumption of goods as a type of car use with payment, when no one of the parties is its owner [1]. Carsharing appeared as an alternative to owning a car, the cost of which is constantly increasing as a result of traffic density, traffic jams, limited availability and high parking prices in large cities [2-4]. The leader in this area is the United States with a leading company ZipCar, which has more than 800 million customers and a fleet of approximately 10 thousand cars. Next come Germany, Great Britain, France with the popular operators DriveNow and Car2Go. CarGuru and CityBee companies operate in Lithuania, Latvia and Estonia.

## **2. Analysis of the Car Sharing Service Market in Russia**

In Russia, the development of such a service as car sharing began in 2012 in Moscow (at any time) and in 2013 in St. Petersburg (StreetCar). The Russian car-sharing services market is also represented in Anapa, Grozny, Yekaterinburg, Kaliningrad, Krasnodar, Krasnoyarsk, Nizhny Novgorod, Novosibirsk, Rostov-on-Don, Samara, Sochi, Tuapse, Ufa, Chelyabinsk. The largest services by the number of machines were Delimobil (2,200 units), BelkaCar (1,750 units) and YouDrive (1,150 units). This market of services is growing at a high rate: the revenue of the car sharing market in 2018 was 7 billion rubles; the number of companies providing car sharing services increased by 2 from 2 to 28 by 2018. The number of cars currently offered for rent in

Moscow is about 17.6 thousand<sup>4</sup> (for comparison, about 20 thousand are registered in Tokyo<sup>5</sup>), which is 80% in Russia. Although 76% of respondents on PwC agree that car sharing helps to avoid difficulties with maintaining a personal car, 70% prefer personal transport (owning a vehicle in Russia is a reflection of social status, so part of the affluent population cannot abandon the element of comfort and image) [5, 6].

Enjoy the greatest popularity (25% of users) of service of carsharing at youth at the age of 20-34 years that first of all is connected with ease of development of technologies in the field of mobile applications and navigation systems. According to poll of users of carsharing in 2017 of contact center "Moscow transport" 90% of respondents - consumers of these services are men, at 57% from them - own car. From them 47% are ready to refuse at trips around the city the individual transport and 10% - completely to refuse it. That is existence of the privately owned vehicle does not assume refusal of their owners of car-sharing services, and movement around the city on the leased car is represented more favorable to most of owners of the motor transport.

### 3. Analysis of the Car Sharing Service Market in China, Japan and India

Let us analyze the features (problems) of the development of car sharing services in the PRC, Japan and India. Their comparative characteristics in these countries are presented in Table 1 [7].

Table 1: Comparative characteristics of car sharing services in China, Japan and India.

Criteria	Japan	PRC	India
legal features of the agreement	18 +, documents: international passport, international law, pledge, driving experience > 1 year	Temporary Chinese driving license for 3 months, pledge (\$ 700–1500) and insurance premium (\$ 5–10 / day), medical board	Passport, international driving license, pledge (usually 100%), compulsory insurance policy
price	Toyota Corolla class car with standard insurance will cost about 100 dollars a day, an economy class \$ 70-80 a day.	Electromobil rent at a discount on the 1st day is 1 yuan (\$ 0.14), depending on the gearbox, engine power, year of production, etc. up to 43.5 dollars / day	On average, a budget car costs 10-15 dollars per day. for a short time or 180 dollars / month.
Agencies	Toyota Rentacar, Nissan Rentacar, Nippon Rentacar, Times Car Rental	Togo, Gofun	Savaari Car Rentals, Bharat Tours, State Express
Transport infrastructure	Left-hand traffic, a large number of toll roads, paid by the driver, many hours of traffic jams, road signs in Japanese, electronic system of payment for traffic	Right-hand traffic, toll roads, signs in Chinese	Left side traffic; a variety of vehicles, animals, pedestrians, impeding the observance of the rules of the road, the emergency condition of roads
Parking lots	City (municipal) limit the time 40 minutes - 1 hour for 1.3-3 dollars outside of active urban areas and about 7.6 dollars in the center. In many parking it is not allowed to leave the car at night. Private parking are underground or multi-storey complexes with a cost higher than urban. Free parking lots is only near shopping centers upon presentation of a purchase check.	The lack of parking spaces allows you to leave the vehicle on the street in the direction of travel, most of the parking lots are paid (depending on the area)	Many parking lots are free, the cost of paid parking is one of the lowest in the world - less than 2 dollars / day.
Car return	With a full tank of gasoline, without damage, otherwise fines are imposed; route to "one way" is agreed upon in advance	Without damage, otherwise a fine will be imposed.	Without damage
Payment	Credit cards, cash	Possible through a smartphone for long stays in the country (a set of documents is required)	Credit cards, cash

From the data of table 1 we can draw the following conclusions:

1) in the analyzed countries, the use of carsharing services involves the collection of a large number of documents that require the expenditure of money and time; Payment is made both in cash and by card in all three countries;

2) in India, car sharing is represented as a rental car with prices lower than in China and Japan;

3) traffic in Japan and India is left-hand, which creates an inconvenience in driving for tourists who are used to right-hand traffic. Also in Japan, an excessive number of toll roads that a tenant must pay for. In India — a variety of vehicles (including animals) without adhering to the rules of the road leads to chaotic traffic on the road;

4) in Japan there is the most difficult situation with parking (compared to China and India): time constraints that lead to the inconvenience of constantly reparking the driver's car of the day, problems with public parking at night and high rates in private parking lots, which are also equipped with systems sophisticated for tourists. In China, the parking problem is solved by legislative permission to leave transport in any place while driving. In India, most parking is free, and the price of paid is very low, due to the standard of living of citizens in the country;

5) general requirements for the return of a rented car [8]: without damage. In Japan, it is obligatory to return a full gas tank and pay extra for travel without putting the car in a specially designated place.

An analysis of taxi services in the PRC, Japan and India is presented in Table 2 [7].

Table 2: Comparative characteristic of taxi services in China, Japan and India.

Criteria	Japan	PRC	India
Types	State-owned and private	Controlled by the state	State-owned and private
Communication	Rarely used international language - English	Ignorance of the Chinese language causes difficulties when talking to a taxi driver	English
Price	Minimum - starting with 5.8 dollars. Further accrued 0.7 dollars for every 280 m. In a traffic jam for every 135 seconds idle counter charges 0,8 dollars, based on the rate of 1 dol. = 112.98 yen. Night tariff charges 30% extra		

The use of taxi services in the PRC and Japan implies knowledge of the national language, which causes certain difficulties for tourists. In India, English is used and the price of transportation is minimal from the countries analyzed. The most expensive taxi services are in Japan.

#### 4. The Economic Rationale of the Effectiveness of Car Sharing Services

Owning a car becomes economically disadvantageous when compared to a combination of car sharing and public transport. This is due to the following factors.

Personal car is not used most of the time. When this happens, it is passively depreciated, tax and insurance payments increase, the cost of maintenance and current repairs increases, the quality requirements of which increase over time. Due to the lack of parking facilities, its cost also increases.

In this case, the car owner bears the organizational costs associated with owning a technically complex product and a source of increased danger under state control. That is, the cost of owning a car is largely formed passively, i.e., regardless of the conditions of its operation and according to the economic category, they are constants. The intensity of the operation of a personal car is limited to the needs of a particular person and, in part, to his relatives.

Carsharing companies have a similar cost structure. Objectively, their economic advantage is that the cars they own are intensively exploited and the share of fixed costs in the cost of one hour

of operation is less, and consequently, the unit cost of operation is less. At the same time, both fixed and variable, the specific costs of karsheringovye companies are lower than those of a private car owner due to different scale effects. With the development of car sharing, this trend will only increase.

At the same time, car sharing companies often enjoy benefits provided by municipal authorities, in particular, for the purchase of fuel and parking. The effect of this factor is predicted for a long time due to the development trends of urbanized areas.

The decision to use a personal car or a combination of car sharing and public transport, as well as any consumer decision, is made not only and not so much under the influence of the results of cost calculations, but, nevertheless, the factor of a lower cost of car sharing services compared to the cost of owning a personal car has a significant impact on consumer decision making. This premise allows you to objectively simulate the difference between the cost of operating a personal car and the use of car sharing services:

$$\Delta Z = L^C (X^C_1 + X^C_2) + X^C_3 + X^C_4 - L^K (X^K_1 + X^K_2) + X^K_3 + X^K_4 \quad , \quad (1)$$

where  $\Delta Z$  is the difference in the annual costs of operating a car company and car-sharing company, monetary units;  $L^C, L^K$  - annual runs of own and car-sharing company of cars, respectively, km;  $X^C_1, X^K_1$  - expenses for fuel and lubricants for own and car-sharing company of cars, respectively, monetary units / km;  $X^C_2, X^K_2$  - the cost of maintenance and repair, including parts of their own and carshare company cars, respectively, monetary units / km;  $X^C_3, X^K_3$  - the cost of the full restoration of their own and carshare companies cars, respectively, monetary units. The structure of these costs is different. For an individual, this is a reservation of consumer expenses of the future periods, for an enterprise - depreciation. In both cases, these costs may include a loan fee;  $X^C_4, X^K_4$  - parking expenses (car storage), organizational expenses and insurance costs of own and car-sharing company of cars, respectively, of monetary units. The structure of these costs is different. For an individual, this is the cost of their time;  $\alpha$  is a reduction factor taking into account the effect of scale.

To take into account the synergistic effect of the interaction of these factors, you can use the neoclassical production function, for example, the Cobb-Douglas function (F), interpreted as follows:

$$Y = F(K, M) = A K^\lambda \cdot M^{(1-\lambda)} \quad , \quad (2)$$

where Y is the income from car sharing services; M is the attractiveness of car sharing for using this service as an economically effective lifestyle attribute, the change in the annual growth rate of which is defined as:  $M = M_0 e^{vt}$ , km of run; v is the annual growth rate of the attractiveness of car sharing (M);  $\lambda$  - the maximum value of the share ( $\rho$ ) of investments (I); K (capital) - fixed assets (cars) and fixed assets, the change of which (decrease due to retirement or increase due to investments (I) over time (dt) is defined as:

$$dK/dt = -\mu K + I \quad , \quad (3)$$

where  $\mu$  is the share of fixed assets retired in a year, with:  $(0 < \rho < 1, 0 < \mu < 1, -1 < v < 1)$ , which are constant in time;  $I = \rho Y$ .

At the same time,  $\rho$  is a control parameter set at the initial moment of time at any level from the region of permissible values.

Further analysis of the factors in expressions (1 and 2) will allow us to obtain their quantitative influence on the change in the growth of the volume of car sharing services provided through the use of statistical methods [9] and marketing research. The level of service for car owners by the criterion of minimizing their organizational expenses should be evaluated.

## 5. Conclusions

Now car-sharing was widely adopted worldwide including in Russia where the positive prerequisites promoting growth in the new direction of business of economy of joint consumption are formed. In Russia the post-industrial economy of municipal level and households assuming emphasis on use of technical devices and other benefits without possession of them is formed.

Automakers should think about integration into the car-sharing business, as did the companies of the PRC - Chery and Lifan. It is obvious that in modern conditions the car market is close to the saturation point and the issues of product sales in the short and medium term will be increasingly acute. One of the potential solutions to this problem may be targeted cooperation with major players in the car sharing service or the integration of automakers into this market. The first will allow establishing specialized production of cars equipped for working in car sharing, which will make it easier to enter the market - now entrepreneurs buy cars and spend additional funds to install necessary equipment. Obviously, in the case of centralized production, this process can be made more efficient and inexpensive by optimizing and carrying out all the work in one place. The integration entry of car manufacturers into the car sharing market seems more risky due to the fact that the marginality of such a step requires careful analysis [10].

The analyzed trends in the development of the carsharing services industry are of interest from the point of view of further research, in particular: a) it is advisable to follow the market formation dynamics that currently follow the classical laws of modernity: low margins due to the mass of the client base, leadership of large participants, government involvement as business partner; b) it is necessary to assess risks for businesses of this type, formalize the mathematical model and describe ways to reduce the risk component.

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