TIME COST AND FARES FOR TRAVEL ON URBAN HIGHWAYS

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ABSTRACT

Public funds and resources are insufficient for development of a country's road network. In this regard, the idea of attracting private investment for the construction (including through public-private partnerships) and further exploitation of automobile and road infrastructure for a fee has got significant popularity. However, business is interested not only in covering vested assets, but also in getting a certain rate of return, so road toll, set by investors on a particular route, may exceed the expectations of potential users. As a result, the highway would be attractive only for those who highly appreciate own time, the others will prefer a free travel. The question of the real cost of time for Russian motorist has not been till now object to consistent sociological study. Accordingly, traffic risks of investor increase. Using statistical material the author provides recommendations for determining the amount of the fare and draws a conclusion on the possibility of using toll roads.

ENGLISH SUMMARY

Background. World Bank experts who had studied participation of the private sector in infrastructure projects, reached common opinion that in an environment where public-private partnership is just beginning to develop or when private markets are still poorly developed, only a few such projects can be profitable in the absence of financial support from the state.

Not overemphasizing such opinions, it is worth noting that more reasons appear to talk about the cost of the roads and the costs of their use. And we should start talking about investments, considering cost of travel, self repayment of traffic services, ability of a car owner to support transport demand.

Objective. The objective of the author is to investigate advantages and disadvantages of toll roads and to provide recommendations for determining the amount of the fare.

Methods. The author uses statistical analysis, economic evaluation and comparative method.

Results.

Component of cost of travel

Generalized Cost of Travel (hereinafter-GCT) of any car owner is made up of direct user costs of driving and time spent on the travel:

$$GCT_i = DC_i + VT(n) \cdot TT_i,$$

where $VT(n)$ is time cost of n-th user on an ordinal scale;

DC_i are direct costs of a travel by a variant i;

TT_i is travel time by a variant i.

Direct user costs related to driving include payment for gasoline, parking (if it is payable) and charges levied on toll roads. They are current, direct costs, sometimes referred to as «out-of-pocket costs». They have the greatest influence on the behavior of users. Most drivers think carefully about these costs, however, as a rule, do not pay attention to relatively fixed costs (those are costs which are independent of the number and distance of travel and include depreciation, repairs, insurance, costs incurred in the accident and uncovered by insurance, registration and taxes), even though these components often significantly exceed «out-of-pocket costs».

In the case where a motorist should not pay for the use of road network of the city (hereinafter-RNC), direct user costs are usually do not exceed 10–20% of the total cost of a car trip. In these circumstances, the use of a personal car is incredibly cheap in the eyes of most people, which is an important factor in promoting the daily pendulum transport demand within the metropolitan area (Pic. 1).

If there is a paid mode of travel then urban road will be attractive to fewer vehicle owners – mainly for those who appreciate own time, convenience and comfort of movement.

In other words, if the user selects a route, including a toll section of the road, it means he is willing to pay real money for time savings. In this case, the cost of his time will be:

$$VT(n) \geq \frac{DC_1 - DC_2}{TT_2 - TT_1}.$$

Value of Travel Time (hereinafter – VOTT) for users is not a constant; it varies depending on the duration / distance of travel. The function of changes in value of time of a motorist depending on travel time is S-shaped curve [1] (Pic. 2) and shows a close to zero value of the first few minutes of travel. The value of time increases dramatically with increasing duration of the trip in the first 15 minutes; after that the rate of
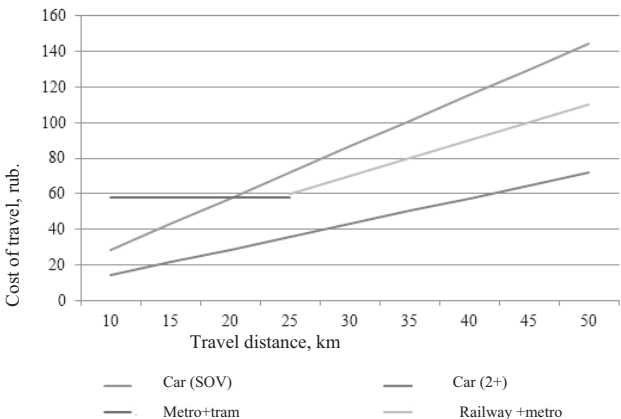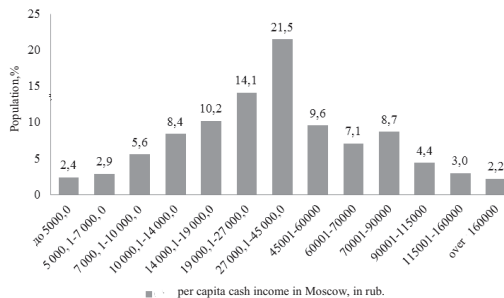

Pic. 1. Cost of travel within Moscow agglomeration.

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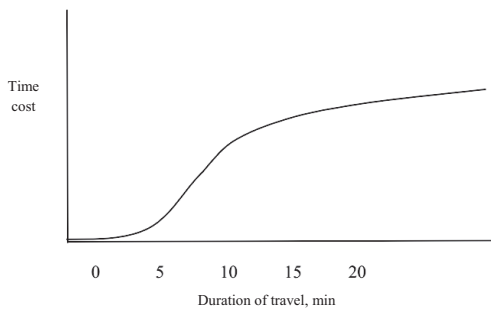
Pic. 2. Dependence diagram of time cost of a car owner from duration of travel.

Pic. 4. Distribution of per capita income of car owners, rub., Moscow, 2012

Pic. 3. Distribution of per capita income, Moscow, 2012

Pic. 5. Distribution of average hourly cash income of car owners, depending on the cost of time, Moscow, 2012.

Pic. 6. Cutoff border for car flow at fares of 100 and 150 rubles.

increase in the cost of time slows down. In any case, time saving of at least five minutes is estimated by users cheaper than the savings in excess of five minutes [2]. This fact is reflected in the recommendations of the American Association of State Highway and Transportation Officials, AASHTO) (Chui and McFarland, 1990) [3].

In 1999, the consulting agency Accent Marketing & Research and Hague Consulting Group [4] carried out a study for the British government about the dependence of the elasticity of travel on toll roads from a distance. The index value was 0,37, that is, increase in the travel distance by 1% leads to an increase in the cost of time by 0,37%.

Further analyses fixed similar values of the elasticity of demand, depending on the travel distance: from 0,26 to 0,3 [5–8].

Allocation of time cost among users corresponds to lognormal distribution with mathematical expectation m and square deviation σ. For a specific route a form of this distribution is fully consistent with the distribution of income.

Thus, value of travel time (hereinafter- VOTT) can be calculated by count up through the income level of a user, or by count down based on the option of the trip, which he chooses.

Foreign studies have shown a wide variation of the value of time, depending on the purpose of travel and the country for which the analysis is carried out. At the same time there is regularity: in high-income countries (Great Britain, France, and others.) the difference is not significant; in countries with relatively lower income (including Russia) cost of an hour of free time is always significantly lower than hourly labor compensation of a car-owner. This remark is true for the level of well-being, which is characteristic of an average resident of Moscow agglomeration.
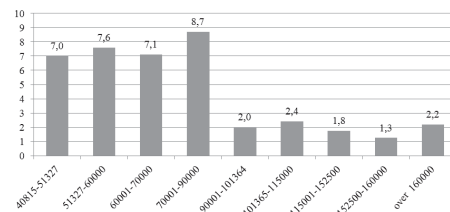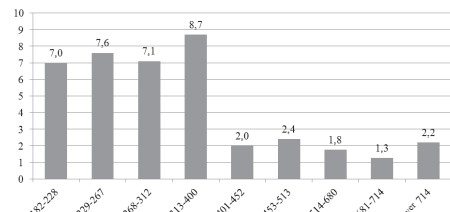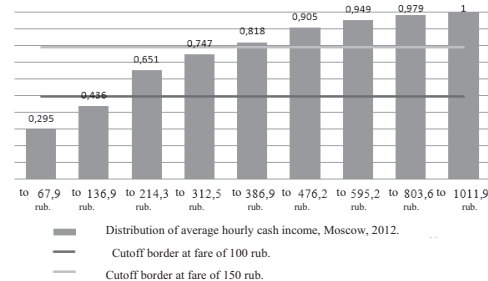
The question of the real time cost of an average Muscovite (or average Moscow car-owner) has not been investigated for the moment sociologically. But it is possible to calculate this cost using value of a monthly wage (Pic. 3) *.

The cost of time of a motorist – Muscovite

The average wage of a resident of the capital according to the year 2012 data amounted to 51 260 rubles.

We assume that car owners are upper 40% of the curve of wages distribution, and therefore we shall proceed with finding of the distribution of per capita income (Pic. 4).

Considering that there are 168 working hours in a month on average, we take decreasing coefficient with respect to hourly wage, equal to 0, 75. In these conditions, we obtain approximate distribution of the «cost of time» of Moscow car owners (Pic. 5).

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*Editorial note: Lack of relevant national surveys and studies doesn't permit to consider the application of the results of foreign studies to featured Russian practices as apriori grounded without appropriate adaptation. This theme should be subject to further research.

Valuation of 20-minute time saving for car owners

Cost of time rub. hour	The share of car owners, attributable to time cost range,%	The share of car owners, willing to pay for a 20-minute time saving,%	
		100 rub.	150 rub.
180–400	76	26,6	0
401–680	15,4	15,4	12,7
over 680	8,6	8,6	8,6
Total	100	50,6	21,3

The average speed of the traffic flow in the city during peak hours does not exceed, as a rule, 20 km / h (as of December 2013). At the same time, the 10-kilometer trip will last approximately 30 minutes. With the increase in the average speed to 80 km / h on urban road average travel time on a 10-km section could be reduced to 20–23 minutes. In this case, the willingness to pay a certain fee for travel corresponds to the real «cost of time» of car owners, including those, who are ready to pay 100 and 150 rubles for a 20-minute time saving (Table 1).

With such a distribution a half of potential users will not be willing to pay 100 rubles for travel on a 10-km section. And the increase in the cost of travel to over 100 rubles dramatically reduces the demand. This means that the demand for travel on a paid section at a cost of a travel of more than 150 rubles in all cases will be very low (Pic. 6).

Conclusion. *Surveys carried out in Western Europe, Canada, USA, Japan show that traffic on urban toll highways is highly elastic with respect to fare. In large settlements there is a much wider possibility to travel on an alternative «free routes», and therefore even a slight increase in the rate reduces the intensity of traffic as many persons refuse to use the route for daily trips, prefer free roads, or use other means of transport. Reduction in transport demand will lead to a new increase in the cost of travel in order to return to the investor the funds previously vested in construction. This, in turn, will cause a further reduction in demand, and accordingly in its elasticity. As a result of the increased cost, travel will be unavailable for the majority of consumers, and the transfer of the road to toll mode of operation will turn to have been economically inefficient measure.*

Those circumstances give rise to the conclusion that at the initial stage the upper limit of the size of the fare should be considered as 100 rubles, because it corresponds to the actual price of the 20-minute time-saving and paying capabilities of a «middle» Muscovite.

If the optimal level of payment income is not sufficient to cover investments for the construction and operation of the facility, it is necessary for a state to subsidize part of the investment, providing an acceptable level of profitability for a private partner.

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