Change in Accessibility of Transport Services for the Population of the Far East of Russia

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Change in Accessibility of Transport Services for the Population of the Far East of Russia

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Abstract. The paper analyzes the change in accessibility of transportation services according to the methodology developed by the author. Two blocks are included in the review. The first block characterizes the change in the physical accessibility of transport. The indices obtained for individual modes of transport are normalized and aggregated taking into account the weights of various types of transport in the process of passenger transportation, which allowed us to analyze the dynamics of the overall index of changes in the physical accessibility of transport services. The second block characterizes the change in the economic accessibility of transport. The change in the purchasing power of per capita incomes of the population in relation to the tariffs for various types of passenger traffic is estimated. The methodology was tested on the basis of statistical data in the context of subjects of the Russian Federation in the Far East for the period 1990-2015 (according to the available indicators). The results of the calculations make it possible to trace the change in the state policy over the Eastern regions of Russia (regarding the development of the transport infrastructure) in different years, as well as the changing priorities of the transport policy in the context of administrative subjects of the Russian Federation.

1. Introduction
The accessibility of transport services for the population is an assessment of the possibility to use transport system. Unlike estimates of transport availability of the territory [1-5] accessibility of transport services places emphasis on the consumer but not the territory.

Accessibility of transport services for the population is one of the factors of the comfort of living in this territory. The Russian Far East has some specific features. There are: large territory, remoteness from the central and western regions of the country, cross-border location with large Northeast Asia countries. These regional features make extremely important for the population to have access to quality transport services.

Transport accessibility varies with time; its dynamics can be multidirectional. In east regions of Russia there were considerable transformations of a transport complex since the beginning of a large-scale economic reform of 1992 [6]. As a result accessibility of transport services to the population has significantly changed.

2. Literature review and research problem
This thematic area is presented in scientific publications mainly by micro-level research (urban systems). The publications discuss: the methods for optimizing urban transport systems, factors and methods for assessing the mobility of the urban population; the approaches to assessing the level of “transport discrimination of the population”; the models for the transport systems of urban agglomerations; the impact of transport accessibility indicators on the price of land resources [7-10]. These works are performed on a joint of economic geography, economy and sociology. They focused at micro (city systems) and meso - (administrative-territorial education) levels and in the majority have pronounced applied aspect. A separate area is to study the opportunities and conditions for increasing transport mobility for people with disabilities and the elderly people [11-16].
Transport system is one of the factors that form the level of comfort for living at this territory. The assessment of transport accessibility for the people may include the following aspects [17-19]:

- **Physical accessibility** - implies an assessment of the actual availability of the transport network on the territory (using network density indicators, Engel coefficient, Uspensky coefficient, transport performance, etc.).
- **Transport accessibility in space** - characterizes the localization of the elements of the transport network in the territory.
- **Transport accessibility on time** - implies an estimate of the time required for the movement.
- **Transport accessibility in time** - considers the change in availability in a certain period due to the dynamics of key parameters of the transport network.
- **Economic accessibility of transport** - is associated with the assessment of the availability of transport services taking into account the transportation tariffs.
- **Social transport accessibility** - the possibility of using transportation services for people with disabilities.
- **Transport discrimination** - assessment of transport services that are not received by the population etc.

Research problem is assessment of change of physical and economic accessibility of transport services to the population of the Far East of Russia during 1990-2016 in time.

### 3. Research methods

Changes of two components of accessibility of transport services to the population of the region were considered: physical and economic. The first component was estimated by means of calculation “the index of physical availability of transport infrastructure”. The aggregated indicator was calculated on the basis of statistical data about elements of transport infrastructure for the territorial subjects of the Russian Federation in the Far East during 1990-2016.

The following indicators of official statistics of "Rosstat" were used for calculation: extent of public highways with a hard coating (km); extent of the public railroads; number of the airports of civil aviation (unit); extent of internal water navigable ways (km); number of cars (piece); number of public buses (piece).

Normalization of particular indexes on each indicator from the minimum estimate of this indicator to scope of a variation of the corresponding indicator in the studied set of subjects is made.

\[
K_i = \frac{X_i_{\text{quan}} - X_i_{\text{min}}}{X_i_{\text{max}} - X_i_{\text{min}}} \quad (1)
\]

Need of the transfer the absolute values of indicators into relative values are defined by use of various scales of measurement that results in incomparability of indicators of initial data array.

The aggregated index of physical accessibility is received in an additive form taking into account weight coefficients of each component.

\[
l_{\text{assec}} = \frac{\sum_{i=1}^{n} K_i \cdot p_i}{n} \quad (2)
\]

\(K_i\) – the particular index; \(p_i\) – weight coefficient of this index; \(n\) – total number of the private indicators used for the calculation; \(t\) – time period.

Weight coefficients of indicators were set based on the importance of modes of transport in the structure of passenger turnover during a certain period. These coefficients were evenly distributed between indexes within one type of transport.

For assessment of economic accessibility the indicators of relative dynamics of the average per capita income of the population of the Far East in comparison to dynamics of average tariffs on separate passenger transport types have been calculated. The following data in a section of territorial subjects of the Russian Federation in the Far East were used during calculating: average fare for a compartment car of the fast non-brand long distance train, per 100 km of a way (rub); average fare in a compartment car of the fast brand long distance train, per 100 km of a way (rub); average fare in the interurban bus, per 50 km of a way (rub); average fare in a couchette car of the fast non-brand long
distance train, per 100 km of a way (rub); average fare in a couchette car of the fast brand long
distance train, per 100 km of a way (rub); the average cost of a trip in the suburban train (rub).

4. Results

Over the past twenty-five years there have been changes in the transport services of the population
of the Far East which have a largely negative character [20].

In the region the system of regular sea passenger traffic has been lost. So far there is no full-fledged
basic network of highways. Many settlements of the Far East have no year-round land transport
connection with the central settlements and main transport routes and among themselves.

A difficult situation has developed with the air transport of the region. Since 1990, the number of
airfields of civil aviation in the Far East has decreased 3.6 times. The State Program for the creation of
federal state enterprises based on regional and local airports has been implemented since 2006. The
purpose of this program is to preserve and develop the ground infrastructure of regional airports that
can’t make a profit. Five federal state-owned enterprises were created.

Support for air passenger transportation is also provided through tariff subsidies. Since 2009,
subsidies have been granted to air carriers from the state budget for transporting young people under
the age of 23 and people of retirement age on certain routes.

The change in the system of rail suburban passenger transport did not have a significant positive
effect. Currently, two companies “Express Primorye” and “Passenger company Sakhalin” operate in
the Far East. The number of routes in recent years has decreased. Transportation by rail in the far
direction is carried out by JSC “Federal Passenger Company”.

The results of calculating the aggregated index of physical accessibility of transport infrastructure
for the Russian Far East are presented below (see Fig. 1).

![Fig. 1. Dynamics of the aggregated index of physical accessibility of transport for the population in the Far East.](image_url)

Calculation was made according to the methods given above. For the most of territorial subjects of
the Far East significant increase in accessibility of transport isn’t observed. It is possible to sort out the
general tendencies of indicator’s dynamic. There are three main stages: the first in 1990-1999
stabilization or reduction of availability; the second in 1999-2005 – essential reduction and the third in
2006-2016 growth of an indicator of availability. Observed changes are accurately connected with state policy concerning a transport complex during certain periods.

The assessment of changes in the economic accessibility of transport services for the population of the region was carried out through the relative dynamics of average per capita incomes in comparison with the dynamics of the average tariffs for passenger transport by certain modes of transport. The cost of transport services is second only to the cost of housing and communal services of the population. At the end of 2016, 11.7% of the Far Eastern population’s expenditures accounted for the payment of transportation services (with an average Russian rate of 8.6%).

The parameters of air transport, rail transportation in long-distance trains (coupe and reserved seat), suburban rail transport, intercity bus transport, transportation in the urban transport system (commercial and municipal buses) were considered. For example, consider the results obtained in analyzing changes in the economic accessibility of air transport and rail transport (see Table 1).

Table 1. Economic accessibility of transport services for the population of the Far East of Russia (per 1000 km).

| Territorial subject of the Russian Federation | Air Transport 2003 | Air Transport 2016 | Rail Transport 2003 | Rail Transport 2016 |
|---------------------------------------------|---------------------|---------------------|---------------------|---------------------|
| The Republic of Sakha (Yakutia)             | 5.2                 | 6.6                 | 31.9                | 35.3                |
| Kamchatka Krai                              | 8.3                 | 18.3                | -                   | -                   |
| Primorsky Krai                              | 3.9                 | 18.8                | 17.7                | 36.5                |
| Khabarovsk Krai                             | 4.8                 | 9.2                 | 22.9                | 47.4                |
| Amur region                                 | 3.2                 | 10.5                | 14.4                | 35.6                |
| Magadan region                              | 5.0                 | 7.1                 | -                   | -                   |
| Sakhalin region                             | 7.1                 | 31.5                | no data             | no data             |
| Jewish Autonomous Region                    | 3.4                 | 8.5                 | 15.6                | 26.5                |
| Chukotka Autonomous Okrug                   | 9.3                 | 8.4                 | -                   | -                   |

In 2016 the purchasing power of the average per capita income of the population of the region has increased. During this period the population of the majority of territorial subjects of the Russian Federation in the Far East (except residents of Khabarovsk Krai, the Magadan region and Chukotka Autonomous Okrug) already had sufficient income for flight to the capital of Russia and back. At the same time change of purchasing power of income of the population on average in Russia has increased by 2.9 times during 2003-2016 while in most of subjects of the Far East increase in purchasing power has happened in a smaller size.

More positive changes of economic availability of transport have happened rather railway transport. The purchasing power of the average per capita income of the population practically in all territorial subjects of the Russian Federation in the Far East (except for Yakutia) exceeds or is at the level of the average Russian indicators.

5. Conclusions and discussion
Since 1990 the economic accessibility of transport for the population of the Far East has increased. The main factors are: growth of incomes; growth of competition between modes of transport (rail and air, rail and motor); state support (subsidizing of air passenger transportation).

However the physical accessibility of transport characterizing density of transport network, it’s branching and existence of vehicles to some territorial subjects of the Far East has decreased.

The offered approaches have in many respects debatable character. Beyond the scope of work there are such important aspects as degree of satisfaction of the population with transport services; influence of transport services on the solution of social problems of regional development, structure of use of working hours and so forth.
Our estimates can be a basis for the further analysis and development of a calculation procedure. The received estimates can be used by public authorities for justification of the directions of social and economic development of the Russian Far East.

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