ствительна к колебаниям цены. Объяснение такого явления аналогично высказанному в п. 3 о нечувствительности части грузовладельцев к колебаниям уровня качества.

5. Предложенная методика и результаты расчетов эластичности спроса относительно качества транспортного обслуживания могут быть использованы для оценки эффективности мероприятий, стимулирующих качество, а также при прогнозировании реакции рынка на повышение уровня транспортного обслуживания грузовладельцев.

ЛИТЕРАТУРА

1. Васнев, С. А. Статистика: Учеб. пособие. – М.: МГУП, 2001. – 170 с.

2. Иловайский Н. Д., Киселёв А. Н. Сервис на транспорте (железнодорожном): Учебник для вузов. – М.: Маршрут, 2003. – 585 с.

3. Соколов Ю. И. Экономика качества транспортного обслуживания грузовладельцев: Монография. – М.: Учебно-методический центр по образованию на железнодорожном транспорте, 2011. – 184 с.

4. Соколов Ю. И. Методологические особенности управления качеством транспортного обслуживания грузовладельцев // Экономика железных дорог. – 2008. – № 7 – С. 24–33.

5. Соколов Ю. И. Методология управления качеством транспортного обслуживания грузовладельцев в условиях развития конкуренции на рынке железнодорожных перевозок/ Дис... док. экон. наук: – М., 2007. – 314 с.

6. Исследование в сфере оценки потребителями качества услуг на рынке грузоперевозок железнодорожным транспортом. – М.: Гудок, 2012. – 25 с.

7. HELPSTAT [Электронный ресурс]: Сайт помощи по общей теории статистики, статистике АПК, эконометрике. Электронные текстовые данные. http://www.helpstat.ru (Доступ 10.12.2013).

8. Проект Cleverstudents [Электронный ресурс]: Статьи по математической теории. Электронные текстовые данные. 2010. http://www.cleverstudents.ru/mnk.html#beginning (Доступ 10.12.2013).

APPLIED METHODS AND RESULTS OF COMPUTATION OF ELASTICITY OF DEMAND RELATIVE TO TRANSPORTATION QUALITY

Lavrov, Ilya M. *– Ph.D. student at the department of transport economics and management of Moscow State University of Railway Engineering (MIIT), Moscow, Russia.*

ABSTRACT

Market demand for carriage depends on a variety of factors which can be divided into two groups: controlled factors (freight tariff, quality of transportation service) and uncontrolled factors (emergencies, accidents, fluctuations of market conditions).The objective of the present article is to assess the impact of quality on demand for transportation. The system of quality indices establishes balance of interests of operators and customers of transport services. This balance permits operators to raise quality of their services in advance, and allows customers to protect their rights on the basis of the rules established by contracts and standards. But in order to determine the impact of a single factor it is necessary to eliminate other factors, which are relevant and admissible for forecasting.

ENGLISH SUMMARY

Background. *Market demand for carriage depends on a variety of factors which can be divided into two groups: controlled factors (freight tariff, quality of transportation service) and uncontrolled factors (emergencies, accidents, fluctuations of market conditions). There are also some factors which are of seasonal origin (they influence transport, demand for some goods and services). Season fluctuations affect national economics.*

Objectives. *The objective of the present article is to assess the impact of quality on demand for transportation. But in order to determine the impact of a single factor it is necessary to eliminate other factors, which are relevant and admissible for forecasting.*

To do so it is necessary to deeply study the seasonal effects on transportation demand, then to determine intensity of influence of quality factor on demand changes, to find common complex index of quality of transportation service for every month of the studied year. The obtained values of deseasonalized values of demand, compared to smoothed values of general complex index of quality for relevant periods, Can be used to compute approximate function.

Methods. *The author of the research uses statistical methods of time series (revealing of the trend), analytic method of fitting constants (smoothing of random fluctuations), extrapolation, moving average method, method of linear approximate, least-squares method etc., which are explained in the text in a detailed manner.*

Results. *Analysis of time series supposes study of seasonal fluctuations (stable fluctuations during the year which are caused by a set of factors including those of natural and climate origin). Seasonal fluctuations are measured with the help of seasonal indices, by two techniques whose choice depends on character of dynamic development. When yearly level changes, seasonal index is determined by (1), where $\bar{Q}_t$ is an average level of freight traffic for every month t; $\bar{\bar{Q}}$ is a common average value for all studied period [1].*

During the study of fluctuations of dynamic series it is necessary to choose random fluctuations, as well as periodical fluctuations. The study of periodical fluctuations is necessary to eliminate their influence on general dynamics while revealing random fluctuations. Seasonal fluctuations are those that reveal clear laws of changing during the year. In order to eliminate random fluctuations the researchers take average deviation rates for some years [7].

Average level for each month is calculated by formula

$$\bar{Q}_t = \frac{\sum Q_t}{n}, \quad (2)$$

where $\bar{Q}_t$ *is an average level of freight traffic in every month t;*

$\sum Q_t$ *is the sum of same freight traffic during a month t during analyzed years;*

n – number of analyzed years.

The variation factor is calculated on the basis of formulas (3), (4), (5), as explained in the text.

After the values of variation factor have been found, they are shown graphically or in a diagram with a relevant time scale. Then an amplitude of fluctuations is studied.

The next step concerns determining of intensity of quality impact on demand change. To do so it is necessary to find integral index of quality of transport services for every month of the studied year. When all the values of quality indices will have been found, common integral index for a certain month $K^t_{ОБ}$ *could be calculated as the sum of product of each quality index and relative weight of such index [4]:*

$$K^t_{ОБ} = \sum K_i * \alpha_i, \quad (6),$$

where K_i *is value of quality index;* α_i *is factor of relative weight of quality index in general level of quality, considered to be equal to 1 (or 100%). We prefer 5 main quality indices which reflect at most interests of freight owners (in-time delivery, safety of freight, full satisfaction of demand, regularity of delivery, possibility to deliver different kinds of goods) [5].*

Then it is necessary to smooth general integral quality indices and freight volume index for studied year following the character of lag impact on their changes during certain time period. The researcher uses moving average method (7). Finally it is necessary to build dependency, which would be close to experimental points, being insensible to random variations of measured value. The researcher uses method of linear approximate and least-squares method (8–14).

Using the described method and the algorithm, the researcher makes a detailed step-by-step computation of the impact of quality of transportation on the demand for carriage for the year 2012 using the statistical data of Russian railways for 5 years.

Conclusions.

1. After analyzing month-long time series a linear dependency of demand and quality level was revealed: Q=K+62,2.

2. The factor of elasticity of demand (which doesn't account for tariffs) in 2012 was of 1. The factor of tariff-related elasticity demand was 0,53.

3. It has been found that the important part of demand (more than half of a monthly volume) is insensible to quality level fluctuations. Such profile of demand is characteristic of enterprises bent for railways because of specific goods (mass goods) or because of lack of other reliable mode of transportation. It is to suppose that the similar analysis relative to operating company will show lower percentage of demand insensible to quality level.

4. The same method has shown the dependency of demand on the level of satisfaction of goods owners with transportation rate. Dependency is described as Q=0,53P+97,22. Analysis has shown that price elasticity is two times lower than non-price elasticity, and it confirms the thesis that quality factor is of great importance for operators and serves to attract clients to transportation market. It has also been revealed that an important part of demand is insensible to price fluctuation. It can be explained similarly to explanation, proposed in paragraph 3 above on the insensibility of some goods owners to quality fluctuations.

5. The proposed methods and the results of computation of elasticity of demand relative to quality of carriage services can be used to assess measures intended for quality enhancement, as well as for forecasting market's reaction to better transportation services.

Key words: railways, economics, freight traffic, demand, quality, variation, deseasonalization, approximation.

REFERENCES

1. Vasnev, S. A. Statistics. Manual. [*Statistika: Ucheb. Posobie*]. Moscow, MGUP, 2001, 170 p.

2. Ilovayskiy N. D., Kiselev A. N. Service at railways [*Servis na transporte (zheleznodorozhnom)].* University textbook. Moscow, Marshrut publ., 2003, 585 p.

3. Sokolov Yu.I. Economics of quality of transport services to cargo owners [*Ekonomika kachestva transportnogo obsluzhivaniya gruzovladel'tsev: Monografiya].* Moscow, Uchebno-metodicheskiy tsentr po obrazovaniyu na zheleznodorozhnom transporte, 2011, 184 p.

4. Sokolov Yu.I. Methodological features of quality management of transport services to cargo owners [*Metodologicheskie osobennosti upravleniya kachestvom transportnogo obsluzhivaniya gruzovladel'tsev]. Ekonomika zheleznyh dorog,* 2008, № 7, pp. 24–33.

5. Sokolov Yu.I. Methodology of quality management of transport services to cargo owners under the conditions of competition development in the market of rail carriage [*Metodologiya upravleniya kachestvom transportnogo obsluzhivaniya gruzovladel'tsev v usloviyah razvitiya konkurentsii na rynke zheleznodorozhnyh perevozok*]. Thesis of D. Sc. (Econ) candidate. Moscow, 2007, 314 p.

6. Study in the sphere of assessment by clients of service quality in the market of rail freightage [*Issledovanie v sfere otsenki potrebitelyami kachestva uslug na rynke gruzoperevozok zheleznodorozhnym transportom].* Moscow, Gudok publ., 2012, 25 p.

7. HELPSTAT: http://www.helpstat.ru (Last accessed 20.12.2013).

8. Cleverstudents. http://www.cleverstudents.ru/mnk.html#beginning (Last accessed 20.12.2013).

Координаты автора (contact information): Лавров И. М. (Lavrov I. M.) – ilya02lavrov10@yandex.ru.

Статья поступила в редакцию / article received 23.10.2013
Принята к публикации / article accepted 13.12.2013