# DTCESI METHOD FOR ASSESSING COMPETITIVENESS IN THE TRANSPORT NETWORK

Independent researcher at Termez State University

**Aymatov Sirojiddin To‘raqul o‘g‘li**

E-mail: aymatovsirojiddin349@gmail.com

**Abstract:** This article develops the DTCESI method for assessing competitiveness in the transport network. The study introduces a dynamic component based on the TCESI static index and proposes a comprehensive approach to assessing the efficiency of the transport system. The min-max method is used to normalize indicators, the CRITIC method is used to determine weights, and the logarithmic difference approach is used to assess growth rates. As a result, it is possible to dynamically assess and group the transport competitiveness of regions.

**Keywords:** transport network, competitiveness, DTCESI, TCESI, composite index, CRITIC method, min-max normalization, logarithmic growth, panel data, efficiency analysis.

**Аннотация:** В данной статье разработан метод DTCESI для оценки конкурентоспособности транспортной сети. В исследовании вводится динамический компонент, основанный на статическом индексе TCESI, и предлагается комплексный подход к оценке эффективности транспортной системы. Для нормализации показателей используется метод min-max, для определения весов — метод CRITIC, а для оценки темпов роста — метод логарифмической разницы. В результате становится возможным динамически оценивать и группировать транспортную конкурентоспособность регионов.

**Ключевые слова:** транспортная сеть, конкурентоспособность, DTCESI, TCESI, составной индекс, метод CRITIC, нормализация min-max, логарифмический рост, панельные данные, анализ эффективности.

In recent years, the issues of ensuring the sustainable development of the transport network and increasing its competitiveness in the economy of Uzbekistan have become of strategic importance. Because transport not only performs the function of transporting goods and passengers, but is also one of the decisive factors in the economic integration of regions, their connection with domestic and foreign markets, and increasing the well-being of the population. Therefore, in the Resolution of the President of the Republic of Uzbekistan "On Approval of the Transport Strategy of the Republic of Uzbekistan until 2030" dated December 27, 2019, as well as in the "Strategy for Transition to a Green Economy", increasing the efficiency of transport services and strengthening their competitiveness are identified as one of the main tasks.

When applied to the transport network, the concept of competitiveness encompasses the efficiency of transport enterprises and regions in using available resources, the volume and quality of services, the level of infrastructure development, and their contribution to economic growth. However, in current practice, indices based on static indicators are used to assess the competitiveness of the transport network. This does not fully reflect the dynamic changes that occur over time.

From this point of view, it is urgent to develop approaches that take into account not only static, but also dynamic indicators in assessing transport competitiveness. The TCESI (Transport Competitiveness Efficiency Static Index) and its dynamic modification - DTCESI (Dynamic Transport Competitiveness Efficiency Index) used in the study are of significant scientific and practical importance in assessing the efficiency of regional transport networks. This model involves determining weights based on the CRITIC method, normalizing indicators and calculating a static index using the geometric mean, and then adding a dynamic effect through the growth rate $g_{it}$and the sensitivity coefficient δ. Although the issue of assessing competitiveness in the transport sector has been widely studied in the economic literature, the approaches are based on

different methodologies. In general, the use of static composite indices and dynamic efficiency models to determine competitiveness indicators has become a tradition.

The assessment of regional competitiveness using composite indices is widely covered in the OECD's "Handbook on Constructing Composite Indicators" methodology. According to it, normalization, weighting, and aggregation of indicators are the main stages of composite indices. Geometric mean and log-transformation methods are often used in this process. There are various methods for determining the weights of indicators: expert assessment, entropy method, and statistically based methods. One of them is the CRITIC (Criteria Importance Through Intercriteria Correlation) method, proposed by Diakoulaki et al. This method allows for objective weighting, taking into account the dispersion of the indicator and its correlation with other indicators. Dynamic models have been developed to take into account the time factor in assessing transport efficiency. The Malmquist Productivity Index developed by Caves, Christensen, and Diewert and the extended efficiency measures by Fare et al. are widely used in this direction. These methods are based on assessing the changes in resources and outputs over time. Log differences are also widely used to measure economic growth. This approach is also relevant in assessing transport competitiveness, allowing us to express the year-on-year growth of indices in percentages.

Panel data analysis is widely used in transport and regional economics. The methodological advantages of panel fixed effects and random effects models are discussed in detail in the works of Baltagi, Greene, and Wooldridge. Panel regressions are especially important for assessing competitiveness over time across regions.

Uzbek scientists are also studying the role of the transport network in the economy. In particular, the issues of increasing the efficiency of transport services and ensuring their sustainable development are emphasized in the republican-adopted "Transport Strategy of the Republic of Uzbekistan until 2030" and the "Strategy for

Transition to a Green Economy". Composite indices are widely used to assess the level of competitiveness of the transport network. The study first developed the Transport Competitiveness Efficiency Static Index (TCESI) to determine the efficiency of transport services. Later, its dynamic modification, the Dynamic Transport Competitiveness Efficiency Index (DTCESI), was used. Since transport sector indicators are expressed in different units of measurement, it is necessary to bring them into a common range. In this study, the min-max normalization method was used:

$$z_{k,it} = 0.1 + 0.9 \cdot \frac{X_{k,it} - \min(X_{k,i})}{\max(X_{k,i}) - \min(X_{k,i})}, \quad (1)$$

where, $X_{k,it}$ is the k-index value for district i, time t, $z_{k,it}$ is the normalized value, and the inclusion of 0.1 as an additional value eliminates the zero problem in logarithmization.

The relative importance of indicators was determined using the CRITIC method:

$$C_k = s_k \cdot \sum_{\ell \neq k}(1 - r_{k\ell}), w_k = \frac{C_k}{\sum_{h=1}^{K} C_h}, \quad (2)$$

where, $s_k$ is the standard deviation of the indicator (variation strength), $r_{k\ell}$ is the correlation between indicators k and $\ell$, $C_k$ is the informative value, and $w_k$ is the final weight.

The advantage of the CRITIC method is that it is based on statistical characteristics, not subjective expert assessments.

The index assessing the competitiveness of the transport network was calculated using the following formula:

$$TCESI_{it} = \exp\left(\sum_{k=1}^{K} w_k ln z_{k,it}\right), \quad (3)$$

where, $w_k$ are the weights determined by CRITIC, and $z_{k,it}$ are the normalized indicators.

This index, in the form of a geometric mean, is the most common approach to integrating composite indicators.

To account for changes in the regional transport network over time, the growth rate was taken in the form of a log difference:

$$g_{it} = \ln(TCESI_{it}) - \ln(TCESI_{i,t-1}), \quad (4)$$

where $g_{it}$ is the logarithmic growth rate of transport efficiency, and $g_{i1}$ is equal to zero. In the theory of economic growth, the log difference allows us to express growth in percentage terms.

The effect of the growth rate was added to the static index, forming a dynamic index:

$$DTCESI_{it} = TCESI_{it} \times (1 + \delta g_{it}), \quad (5)$$

where δ is the sensitivity coefficient of the growth rate, estimated based on panel data.

The sensitivity coefficient δ was estimated using the following regression model:

$$\ln(TCESI_{it}) = \alpha_i + \delta g_{it} + \varepsilon_{it}, \quad (6)$$

where $\alpha_i$ is the individual effects for the regions, $\varepsilon_{it}$ is the random error.

Initially, the indicators are selected in terms of regions, these values given in terms of regions and years are normalized using formula (1), weight coefficients are found using formula (2). Using formulas (3) and (4), the values of $\text{TCESI}_{it}$ and $g_{it}$ are found, and then using formula (6), the value of δ is found. First, TCESI is formed, then the growth rate $g_{it}$ is added, and DTCESI is determined. After that, the regions are divided into groups according to the results of the dynamic index. The method of the magnitude of change of the dynamic index is used

The method of grouping based on the magnitude of change of the dynamic index is based on determining the difference between the largest and smallest values of the DTCESI indicator of each region for a certain period of time. This approach allows us to assess the real amplitude of the competitiveness of transport services and the degree

of growth across regions. The advantage of this method is its simplicity and its ability to clearly reveal dynamic differences in the transport sector.

$$\Delta_i = \max(DTCESI_i) - \min(DTCESI_i) \quad (7)$$

Using formula (7), the amplitude of change of the dynamic index of each region was found and expressed in percentages.

$$Z_i = \frac{\Delta_i}{\Delta_{\max}} \times 100 \quad (8)$$

The method of equal intervals was additionally used to group the results. In this method, the normalized value range was divided into three equal intervals, and the districts were divided into "low–medium–high" groups. The advantage of this method is that it is simple, visually understandable, and convenient for comparing indicators.

$$Interval = \frac{\max(x) - \min(x)}{3}$$

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