“Assessing the development of transport and logistics sector in Azerbaijan and the impact of transport investment: cross-country analysis”


| | |
|---|---|
| AUTHORS | Mehriban Samadova<br>Nazira Huseynova<br>Aliya Hajigayibova |



| | |
|---|---|
| ARTICLE INFO | Mehriban Samadova, Nazira Huseynova and Aliya Hajigayibova (2025). Assessing the development of transport and logistics sector in Azerbaijan and the impact of transport investment: cross-country analysis. *Problems and Perspectives in Management*, *23*(1), 597-619. doi:10.21511/ppm.23(1).2025.45 |
| DOI | http://dx.doi.org/10.21511/ppm.23(1).2025.45 |
| RELEASED ON | Wednesday, 26 March 2025 |
| RECEIVED ON | Tuesday, 19 November 2024 |
| ACCEPTED ON | Tuesday, 11 February 2025 |
| LICENSE | This work is licensed under a Creative Commons Attribution 4.0 International License |
| JOURNAL | "Problems and Perspectives in Management" |
| ISSN PRINT | 1727-7051 |
| ISSN ONLINE | 1810-5467 |
| PUBLISHER | LLC “Consulting Publishing Company “Business Perspectives” |
| FOUNDER | LLC “Consulting Publishing Company “Business Perspectives” |


| NUMBER OF REFERENCES | NUMBER OF FIGURES | NUMBER OF TABLES |
|---|---|---|
| 60 | 3 | 9 |

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

**Mehriban Samadova** (Azerbaijan), **Nazira Huseynova** (Azerbaijan), **Aliya Hajigayibova** (Azerbaijan)

# ASSESSING THE DEVELOPMENT OF TRANSPORT AND LOGISTICS SECTOR IN AZERBAIJAN AND THE IMPACT OF TRANSPORT INVESTMENT: CROSS-COUNTRY ANALYSIS

**Received on:** 19th of November, 2024
**Accepted on:** 11th of February, 2025
**Published on:** 26th of March, 2025



Mehriban Samadova, Ph.D. in Economics, Associate Professor, Department of Applied Economics, Azerbaijan State University of Economics (UNEC), Azerbaijan. (Corresponding author)

Nazira Huseynova, Ph.D. in Economics, Lector, Department of Applied Economics, Azerbaijan State University of Economics (UNEC), Azerbaijan.

Aliya Hajigayibova, Lector, Department of Applied Economics, Azerbaijan State University of Economics (UNEC), Azerbaijan.

## Abstract

The study aims to analyze the transport and logistics sector development in Azerbaijan compared with International Transport Forum (ITF) countries and assess investment impact on it. The research base consists of OECD and World Bank data for the sample of 41 ITF countries for 2010–2022 regarding 19 indicators that characterize the level of transport and logistics sector's development, investment, and maintenance spending. Based on Ward's clustering, Sturges rule, and normalization, sample countries were divided into six clusters depending on the transport and logistics sector development in 2010, 2015, and 2022 (using STATA and Statgraphics Centurion). In 2022, Azerbaijan remained part of Cluster 1 (mostly European countries), just as in 2015 and 2010. Pearson correlations were applied to prove the relationships between 19 indicators in this field. Arellano–Bond dynamic panel-data estimation was made for Cluster 1, including Azerbaijan (32 countries for 2010–2022). Based on the constructed dynamic regression models for panel data, it was confirmed that with every 1% increase in road/rail investment, the length of roads/rail tracks/electrified rail tracks will increase by 0.03% with 2-year lag, 0.03% with a 1-year lag, and 0.06% with a 1-year lag. A 1% increase in value added by machinery and transport equipment will lead to a 0.03% increase in the length of electrified rail tracks with 2-year lag and an increase in rail investment by an average of 0.1% without lag.

**Keywords** airways, infrastructure, investment, freight, passenger, railway, road, value added

**JEL Classification** O18, R49

## INTRODUCTION

The transport and logistics sector is a strategic component of a country's economy. Its efficiency and effectiveness directly influence the overall economic growth, trade competitiveness, and development of industries.

The transport and logistics sector refers to the industries and services that are involved in the movement, storage, and distribution of goods and people. It includes a variety of services and operations that support the flow of goods and people from one location to another. One of the main components of this sector is transportation which includes various modes of transport, such as road transport (trucks, vans, and other vehicles that carry goods or passengers by road), rail transport (trains used for transporting goods and people over long distances), and air transport (airlines and cargo carriers that move people and goods via airplanes). Another main component is logistics, which involves industries and services that facilitate transportation, particu-



**Conflict of interest statement:**
Author(s) reported no conflict of interest

larly freight transportation, of goods across different modes of transport, planning, coordination, and supply chain management.

Insufficient or outdated infrastructure – such as poor road conditions, inadequate ports, and aging railway systems – hinders the efficient movement of goods. This leads to increased transportation costs, delays, and inefficiencies that affect businesses and consumers. Modernizing transport infrastructure can lead to more efficient logistics networks, reduce transportation costs, and improve the overall competitiveness of the economy. Investments in smart infrastructure can significantly boost productivity in this sector.

Azerbaijan's location as a key transit point between Europe and Asia offers a natural advantage for freight transport and logistics hubs, with increasing opportunities for trade, especially as part of international supply chains. Expanding the rail network and increasing road density improves accessibility and connectivity, creating a more efficient transport system for both passenger and freight transport. A substantial increase in investment in transport infrastructure (e.g., upgrading rail tracks, roads, and air transport facilities) could serve as an incentive for future growth. Investment in electrified rail networks and road upgrades would reduce operational costs, improve efficiency, and contribute to environmental sustainability.

At the same time, the insufficient level of development of transport infrastructure compared to other countries is an obstacle to increasing passenger and freight transport volumes. Limited electrified railway tracks cause higher costs and less energy-efficient transport systems compared to International Transport Forum (ITF) countries. Insufficient investment in supporting transport infrastructure leads to a deterioration of the condition of roads, outdated railway systems, and a lack of modernization of airports and ports, which negatively affects competitiveness among ITF member countries.

That is why a comprehensive analysis of the factors impacting this sector plays a crucial role in state management.

## 1. LITERATURE REVIEW

Traditionally, transportation policies focused largely on the infrastructure and development of specific transportation modes (road, rail, air, sea) and terminals (ports, airports, intermodal hubs). However, logistics policies now recognize that transportation is just one element of the entire supply chain (Rodrigue, 2017; Bookbinder, 2012).

The large-scale Russian–Ukrainian war, initiated in February 2022, has had profound and extensive impacts, particularly on supply chains (Zozulinskyy, 2024). Kuzior et al. (2022) and Shaon et al. (2024) focus on the role of management support, effective communication, and a resilient organizational culture as key factors in managing supply chain disruptions in response to crises like COVID-19. Lima (2024) presents a framework for improving supply chain flexibility, responsiveness, and preparedness, emphasizing the importance of effective logistics, resource allocation, and disaster planning.

Wright (2023) discusses vulnerabilities in supply chains, the increasing threat of crime, and strategies for mitigating these risks. Therefore, a global supply chain refers to an interconnected network, including the transport and logistics sectors. This system relies heavily on efficient transport infrastructure.

The concept of the global supply chain is also interconnected with blockchain and digital technologies in various ways, especially when it comes to improving efficiency, transparency, and security in business transactions. Mouna and Yassine (2024) investigate how blockchain technology influences e-commerce leadership, its efficiency within operations, and how these advancements affect leadership strategies and competitive advantages. Oualid et al. (2024) provide insights into how e-stores can strategically use personalization to boost engagement while managing associated risks, e.g., logistics ones. Valentinas et al. (2021) assessed ride-sharing services, discussing their influence on consumer behavior and the economic landscape.


http://dx.doi.org/10.21511/ppm.23(1).2025.45

Chohra (2024) explores strategies for enhancing decision-making in the management of infrastructure projects within developing countries. Kobiyh and Amri (2024), Subedi and Bhandari (2024), and Pathak and Thapa (2024) highlight that cognitive biases, ethical considerations, and situational influences impact decision-making processes. Guemidi et al. (2024) present the design and implementation of a decision support information system aimed to improve the regulation and assist policymakers and regulatory bodies in monitoring, analyzing, and managing the supply and demand more effectively.

Bian and Wang (2024) and Rekunenko et al. (2025) examine how the integration of artificial intelligence affects ethical decision-making in the public sector and the relationship between AI usage, moral identity, and service motivation, providing insights into how these factors shape ethical behavior. Starchenko et al. (2021) and Ziabina et al. (2023) examine how efficient management systems contribute to environmental sustainability, reduce pollution, and support energy transition initiatives.

Doroshenko et al. (2023) discuss strategies for optimizing supply chains to improve efficiency, reduce costs, and address challenges unique to construction projects. Zamkova et al. (2023) focus on developing essential skills and competencies required in modern logistics and supply chain management, discussing curriculum design, practical training, and skill development to better prepare graduates for industry demands.

Effective regulation and connectivity are essential for a well-functioning, competitive economy. Effective transport policies enable countries to work together and remove barriers to trade (OECD, 2024; Mishrif et al., 2024; Berg et al., 2016). Savy (2016) highlighted an important shift in government policy, where transport and logistics sectors are becoming a central concern for national and regional development.

Samusevych et al. (2023) explore how transport tax policies can be designed to enhance national security by balancing environmental impact, energy efficiency, and economic growth. The study discusses tax structures that reduce the environmental footprint and promote energy-saving practices within the transportation sector, supporting sustainable development and national security goals.

One of the relevant research objectives is the volume of transport services exported. It refers to the act of providing transportation services to customers or businesses in other countries involving moving goods, people, or both across international borders, and typically involves logistics companies specializing in various forms of transport, including air, sea, rail, and road. Habenko (2023) identifies key factors that influence the export of high-tech goods and highlights how these exports contribute to economic growth, competitiveness, and technological advancement. Kherbash and Mocan (2015) showed that developing countries must invest in improving their transportation infrastructure and foster closer collaboration between public authorities and private enterprises to increase exports and improve imports. By doing so, they can enhance their logistics capabilities, reduce costs, and improve service quality, ultimately boosting their economic competitiveness.

Bîzoi et al. (2015) analyzed the relationship between transportation and logistics performance and social development using three indicators: LPI (Logistics Performance Index), HDI (Human Development Index), and IHDI (Inequality-adjusted Human Development Index). Liashenko and Trushkina (2021) analyzed the Logistics Performance Index, export of transport services, import of transport services, logistics costs, volumes of cargo transportation, volume of direct investments, and their influence.

Candemir and Çelebi (2017), Yusifov et al. (2019), Rustamova (2022), Sumbal et al. (2023), Melnyk et al. (2024), and Izteleuova et al. (2024) also studied transport and logistics sectors' impact on economic development, possibilities of development and growth based on SWOT-analysis, interviews and other methods, especially qualitative.

Halaszovich and Kinra (2020) investigated the influence of national transportation systems on foreign direct investments based on elements of national transportation systems as key drivers of FDI – land-based transportation infrastructure and logistics and supply chain efficiency. The determinants of investments in transport infrastructure projects in developing countries were assessed by Percoco (2014).

Yusifov et al. (2019) identified the possibilities of transport and logistics areas in Azerbaijan. The findings proposed strategic considerations and targets for the development of the logistics sector by 2020, 2025, and after 2025 but based mostly on the SWOT analysis and other qualitative methods.

Ibrahimov (2016) is confident that Azerbaijan's strategic position between Europe and Asia places it at the crossroads of major international trade routes, offering substantial potential for developing transportation infrastructure and logistics networks that can enhance its role in global trade and regional cooperation. Museyibov and Satiji (2024) studied the financial basis of the logistics sector in Azerbaijan and positioned financial and banking indicators as one of the drivers of the country's logistics development.

The purpose of this study is to analyze the state of transport and logistics sector's development in Azerbaijan compared with ITF countries and to assess how investment impact this development.

## 2. METHODS

To achieve the set goal, a complex of general scientific methods and methods of economic, mathematical, and statistical analysis and modeling was used, based on modern software in this field of research – STATA 18, Statgraphics Centurion 19, and MS Excel (Stata, n.d.c; Polhemus, n.d.).

Cluster analysis was based on hierarchical Ward's method (Ward, 1963) with the squared Euclidean distance as the distance metric. It is a specific technique for hierarchical clustering that aims to minimize the variance within each cluster. At each step, instead of simply merging the two closest clusters (as in other methods), Ward's method merges the two clusters, which results in the least increase in the total within-cluster variance. In simpler terms, it minimizes the sum of squared deviations from the cluster means (centroids). This is why squared Euclidean distance is particularly appropriate, as Ward's method is based on variance and squared differences. The squared Euclidean distance is calculated as the square of the straight-line distance between two points in a multidimensional space, and it is used both to compute the distance between individual observations and to calculate the distance between clusters at each step (Kaufman & Rousseeuw, 1990).

The optimal number of clusters was determined by Sturges' rule using the following equation (Scott, 2009):

$$n = 1 + 3.322 \cdot lgN, \tag{1}$$

where $n$ is the number of clusters, $N$ is the number of observations (countries).

Sturges' rule provides a quick, easy way to estimate the number of clusters, especially for smaller datasets, as it is based purely on the number of data points. It is also necessary to round the result to the nearest integer, as the number of clusters should be a whole number.

Hierarchical clustering is sensitive to the scale of the data. Without normalization, the algorithm may place disproportionate weight on the variables with larger ranges, which can distort the clustering results. That is why, before conducting cluster analysis, a normalization procedure was applied, taking into account the different dimensions of the input data. A min-max normalization (or feature scaling) was made according to the following formula:

$$nI = \frac{I - \min I}{\max I - \min I}, \tag{2}$$

where $nI$ – normalized value of the indicator '$I$', $I$ – an indicator's value to be normalized, $\min I/\max I$ – minimum and maximum values of indicator '$I$'.

The equation adjusts the original values (I) to fall between 0 and 1. The $\min I$ is subtracted from each observation's value of $I$, and then divided by the range of the data ($\max I - \min I$). After normalization, each indicator will have a value between 0 and 1, where the smallest value of $I$ becomes 0 and the largest becomes 1. The other values will be scaled accordingly within this range. So, a


http://dx.doi.org/10.21511/ppm.23(1).2025.45

min-max normalization transforms each indicator (variable) into a value between 0 and 1, which makes the data more comparable across different scales.

To analyze the potential impact of indicators of the transport and logistics sector's development, Pearson product-moment correlations and regression analysis (panel data estimation) were applied. The Pearson product-moment correlation coefficient (or Pearson correlation) is a statistical measure that quantifies the strength and direction of a linear relationship between two continuous variables (Pearson, 1896). The value of the Pearson correlation coefficient ($r$) ranges from –1 to 1 and indicates the direction and strength of the linear relationship between the two variables:

- $r$ = 1 (Perfect positive linear relationship. As one variable increases, the other also increases in a perfectly straight-line relationship);
- $r$ = –1 (Perfect negative linear relationship. As one variable increases, the other decreases in a perfectly straight-line relationship);
- $r$ = 0 (No linear relationship between the variables. There may still be some kind of relationship (e.g., nonlinear), but no linear pattern is evident);
- $r$ > 0 (Positive correlation. As one variable increases, the other variable tends to increase as well);
- $r$ < 0 (Negative correlation. As one variable increases, the other tends to decrease).

The closer the absolute value of $r$ is to 1, the stronger the linear relationship between the two variables. A value closer to 0 indicates a weaker or no linear relationship. Therefore, it is a useful tool for understanding the degree of linear association between two variables.

In order to quantitatively assess the impact of these identified relationships between indicators, regression analysis was applied. Regression models for evaluating panel data were constructed using Arellano–Bond dynamic panel-data estimation, because the data contained time-series and cross-sectional dimensions and included lagged dependent variables as regressors, which introduces potential endogeneity. The estimator is part of the Generalized Method of Moments (GMM) family of estimators (Stata, n.d.a; Arellano & Bond, 1991). Typical dynamic model is a following:

$$Y_{it} = \alpha + \beta Y_{it-1} + \gamma X_{it} + \varepsilon_{it}, \qquad (3)$$

where $Y_{it}$ is the dependent variable for individual $i$ at time $t$, $X_{it}$ is a vector of independent variables for individual $i$ at time $t$, $Y_{it-1}$ is the lag of the dependent variable, $\alpha$ is the individual-specific intercept (fixed effect), $\varepsilon_{it}$ is the error term.

So, variable depends on its own past values (lags). Lagged values of the dependent variable and the independent variables are used as instruments.

The research sample covers 41 ITF countries. Generally, there are 69 ITF member countries (ITF, n.d.). However, Armenia and Russia are not included due to the authors' beliefs, and some ITF member countries are excluded from the sample due to the lack of data on many of the 19 indicators selected for the analysis (Chile, Iceland, Ukraine, Malta, Greece, Israel, Kazakhstan, Belarus, etc.). Therefore, the sample ultimately consisted of 41 countries-ITF members (Appendix A).

Informational bases are OECD (in particular, ITF as an intergovernmental organization at the OECD) and World Bank statistical databases, including 19 indicators for 2010–2022 within the following groups:

- Transport infrastructure investment (rail, road, air) and maintenance spending (rail, road) (OECD, n.d.c).
- Transport measurement indicators (freight and passenger transport by mode: rail, road, air) (OECD, n.d.b).
- Annual transport trends indicators (length of transport infrastructure (roads, roads outside urban areas, rails, electrified rail tracks) (OECD, n.d.a).
- Transport performance indicators (rail and road density) (OECD, n.d.d).

- Transport services commercial export (World Bank, n.d.b).
- Machinery and transport equipment value added (World Bank, n.d.a).

The normalized input data for the cluster analysis (for 2010, 2015, and 2022) are given in Appendix A.

# 3. RESULTS AND DISCUSSION

To identify countries with which Azerbaijan has explicit and implicit links, similar features in research economic field cluster analysis were applied. It also allows for monitoring Azerbaijan's cluster membership in the dynamics.

**Table 1.** Ward's clustering of ITF countries based on 19 indicators of transport and logistics sector development in 2010

| Cluster Summary | | |
|---|---|---|
| **Cluster** | **Members** | **Percent** |
| 1 | 22 | 53.66 |
| 2 | 8 | 19.51 |
| 3 | 5 | 12.20 |
| 4 | 4 | 9.76 |
| 5 | 1 | 2.44 |
| 6 | 1 | 2.44 |

| Centroids | | | | | | |
|---|---|---|---|---|---|---|
| **Cluster** | **nLR** | **nLeR** | **nLRd** | **nLrRd** | **nRD** | **nRdD** |
| 1 | 0.0418958 | 0.0707046 | 0.0316997 | 0.0202087 | 0.270284 | 0.0892936 |
| 2 | 0.0420111 | 0.137792 | 0.0149522 | 0.016613 | 0.633536 | 0.424356 |
| 3 | 0.010453 | 0.0190452 | 0.0119207 | 0.00130114 | 0.190679 | 0.153108 |
| 4 | 0.171543 | 0.642318 | 0.0658601 | 0.0872447 | 0.549036 | 0.2535 |
| 5 | 0.0023561 | 0.0134586 | 0.0568247 | 0.0015353 | 0.210596 | 0.294622 |
| 6 | 1.0 | 0.0 | 1.0 | 1.0 | 0.156626 | 0.140168 |
| **Cluster** | **nRP** | **nRdP** | **nAP** | **nRF** | **nRdF** | **nAF** |
| 1 | 0.290209 | 0.147725 | 0.154565 | 0.0897227 | 0.296489 | 0.00977884 |
| 2 | 0.584195 | 0.235833 | 0.0802383 | 0.0641068 | 0.320476 | 0.0362163 |
| 3 | 0.535277 | 0.417826 | 0.111468 | 0.624774 | 0.531999 | 0.0047619 |
| 4 | 0.468218 | 0.234962 | 0.0704524 | 0.020032 | 0.0957011 | 0.0213018 |
| 5 | 0.0936593 | 0.0 | 0.03664 | 0.0070937 | 0.254551 | 1.0 |
| 6 | 0.0230133 | 0.305096 | 0.125312 | 0.227254 | 0.29754 | 0.0321445 |
| **Cluster** | **nRI** | **nRDI** | **nAI** | **nRM** | **nRdM** | **nTSE** |
| 1 | 0.0464858 | 0.0166991 | 0.0100087 | 0.0165958 | 0.0140927 | 0.316613 |
| 2 | 0.135596 | 0.0288023 | 0.0102522 | 0.0588184 | 0.0135163 | 0.40609 |
| 3 | 0.0145722 | 0.0026563 | 0.00060344 | 0.00915154 | 0.00392992 | 0.80371 |
| 4 | 0.674413 | 0.151261 | 0.0708964 | 0.538201 | 0.12605 | 0.286876 |
| 5 | 0.005983 | 0.0028247 | 0.0002217 | 0.0164024 | 0.0007771 | 0.0920286 |
| 6 | 1.0 | 1.0 | 1.0 | 0.0 | 1.0 | 0.21966 |
| **Cluster** | **nMTV** | | | | | |
| 1 | 0.346935 | | | | | |
| 2 | 0.646965 | | | | | |
| 3 | 0.210402 | | | | | |
| 4 | 0.629683 | | | | | |
| 5 | 9.27E-10 | | | | | |
| 6 | 0.554976 | | | | | |

*Note*: The 'n' sign before the indicator abbreviation means its normalized value; LR – Length of rail tracks; LeR – Length of electrified rail tracks; LRd – Length of roads; LrRd – Length of rural roads; RD - Rail density; RdD – Road density; RP – Rail passenger transport; RdP – Road passenger transport; AP – Air passenger transport; RF – Rail freight transport; RdF – Road freight transport; AF – Air freight transport; RI Rail investment spending; RdI – Road investment spending; AI – Air investment spending; RM – Rail maintenance spending; RdM – Road maintenance spending; TSE – Transport services export; MTV – Machinery and transport equipment value added.


http://dx.doi.org/10.21511/ppm.23(1).2025.45

The number of sample countries is 41; therefore, according to Sturges' rule (equation 1), the optimal number of clusters is six. As a result of hierarchical clustering using Ward's method with the squared Euclidean distance as the distance metric, the study created six clusters from the 41 observations supplied (Cluster 1 – 22 countries / 53.66%; Cluster 2 – eight countries / 19.51%; Cluster 3 – five countries / 12.20%; Cluster 4 – four countries / 9.76%; Cluster 5 – one country / 2.44%; Cluster 6 – one country / 2.44%) (Table 1).

The clusters are groups of observations with similar characteristics. The procedure began with each observation in a separate group to form the clusters. It then combined the two observations which were closest together to form a new group. After recomputing the distance between the groups, the two groups then closest together were combined. This process was repeated until only six groups remained.

Table 2 presents an agglomeration schedule that shows the hierarchical process of clustering, where

**Table 2.** Agglomeration schedule of clustering 41 ITF countries based on 19 indicators of transport and logistics sector development in 2010

| Stage | Combined Cluster 1 | Combined Cluster 2 | Distance | Previous Stage Cluster 1 | Previous Stage Cluster 2 | Next Stage |
|---|---|---|---|---|---|---|
| 1 | 30 | 32 | 0.991812 | 0 | 0 | 5 |
| 2 | 11 | 36 | 2.02658 | 0 | 0 | 12 |
| 3 | 3 | 31 | 3.39376 | 0 | 0 | 14 |
| 4 | 8 | 34 | 4.79419 | 0 | 0 | 16 |
| 5 | 4 | 30 | 6.23321 | 0 | 1 | 11 |
| 6 | 9 | 33 | 7.98177 | 0 | 0 | 17 |
| 7 | 1 | 27 | 9.78543 | 0 | 0 | 30 |
| 8 | 22 | 26 | 11.6365 | 0 | 0 | 26 |
| 9 | 2 | 7 | 13.5596 | 0 | 0 | 23 |
| 10 | 6 | 23 | 15.8676 | 0 | 0 | 30 |
| 11 | 4 | 38 | 18.3407 | 5 | 0 | 15 |
| 12 | 11 | 35 | 20.9611 | 2 | 0 | 14 |
| 13 | 17 | 39 | 23.6491 | 0 | 0 | 32 |
| 14 | 3 | 11 | 27.613 | 3 | 12 | 16 |
| 15 | 4 | 24 | 32.1511 | 11 | 0 | 23 |
| 16 | 3 | 8 | 37.2006 | 14 | 4 | 20 |
| 17 | 9 | 37 | 42.354 | 6 | 0 | 18 |
| 18 | 9 | 15 | 47.896 | 17 | 0 | 25 |
| 19 | 10 | 19 | 53.9142 | 0 | 0 | 27 |
| 20 | 3 | 28 | 60.0577 | 16 | 0 | 28 |
| 21 | 13 | 41 | 66.3337 | 0 | 0 | 31 |
| 22 | 5 | 25 | 73.6181 | 0 | 0 | 34 |
| 23 | 2 | 4 | 81.2877 | 9 | 15 | 26 |
| 24 | 12 | 14 | 89.2816 | 0 | 0 | 32 |
| 25 | 9 | 29 | 98.2463 | 18 | 0 | 29 |
| 26 | 2 | 22 | 108.075 | 23 | 8 | 28 |
| 27 | 10 | 20 | 118.947 | 19 | 0 | 31 |
| 28 | 2 | 3 | 130.117 | 26 | 20 | 33 |
| 29 | 9 | 18 | 141.747 | 25 | 0 | 34 |
| 30 | 1 | 6 | 156.996 | 7 | 10 | 33 |
| 31 | 10 | 13 | 175.922 | 27 | 21 | 0 |
| 32 | 12 | 17 | 196.076 | 24 | 13 | 0 |
| 33 | 1 | 2 | 220.142 | 30 | 28 | 35 |
| 34 | 5 | 9 | 245.062 | 22 | 29 | 0 |
| 35 | 1 | 16 | 276.651 | 33 | 0 | 0 |

| Cluster Number | Smallest Row |
|---|---|
| 1 | 1 |
| 2 | 5 |
| 3 | 10 |
| 4 | 12 |
| 5 | 21 |
| 6 | 40 |

each row corresponds to a step of the clustering process. It illustrates how clusters are formed at each stage of the hierarchical agglomerative clustering process, starting with individual observations (each as a cluster) and eventually merging them into larger groups.

The agglomeration schedule shows which observations were combined at each stage of the clustering process. For example, in the first stage, observation 30 (the 30$^{th}$ country of the sample is Portugal) was combined with observation 32 (the 32$^{nd}$ country of the sample is Serbia). The distance between the groups when combined was 0.991812. It also shows that the next stage at which this combined group was further combined with another cluster was stage 5. As a result, six clusters with similar characteristics were formed from the 41 countries of the sample that were the objects of observations. For this, the procedure involved an initial observation in a separate group, after which the two observations that were closest to each other were combined, and thus a new group was formed. Then, after recalculating the distance between the groups, the two closest groups were again combined with each other, and so on; this procedure was repeated until there were actually six groups left. The described algorithm is well-traced on the constructed dendrogram (Figure 1).

A dendrogram is a tree-like diagram that visually represents the results of hierarchical cluster analysis. It shows how individual data points (clusters) are merged step-by-step into larger clusters based on their similarity (or dissimilarity), and it helps to understand the hierarchy of clusters. The dendrogram represents the successive merging of clusters that minimizes the within-cluster variance at each step. The leaves of the dendrogram represent the individual data points or observations. In the initial stages of clustering, each data point is its own cluster. As the algorithm progresses, these leaves are grouped into clusters. The height of the branches indicates the distance (dissimilarity) at which two clusters are merged, and the width of the branches typically represents the clusters being merged (Stata, n.d.b).

In turn, the agglomeration distance graph shows the distances at which clusters are merged (Figure 2).

The graph does not show any sharp jumps between the steps of the merging procedure, which confirms the validity of the clustering outcome.

As a result, Table 3 demonstrates cluster membership, i.e., which cluster each observation belongs to (the row number is equal to the country's number in the sample).

A similar procedure was applied to cluster the sample of countries for two more study periods – 2015 and 2022. Accordingly, the summarized results are presented in Table 4.

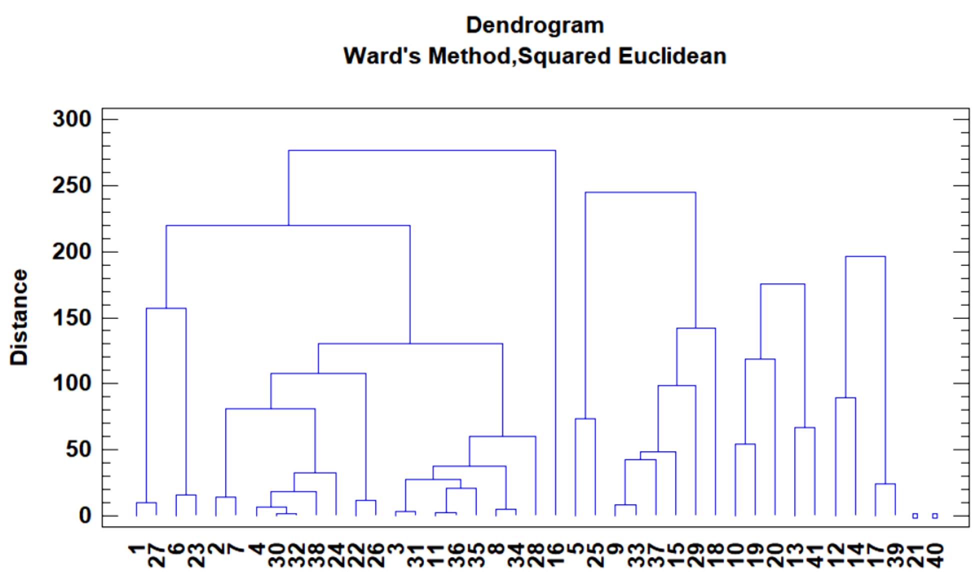


**Figure 1.** Dendrogram of clustering 41 ITF countries based on 19 indicators of transport and logistics sector development in 2010


http://dx.doi.org/10.21511/ppm.23(1).2025.45

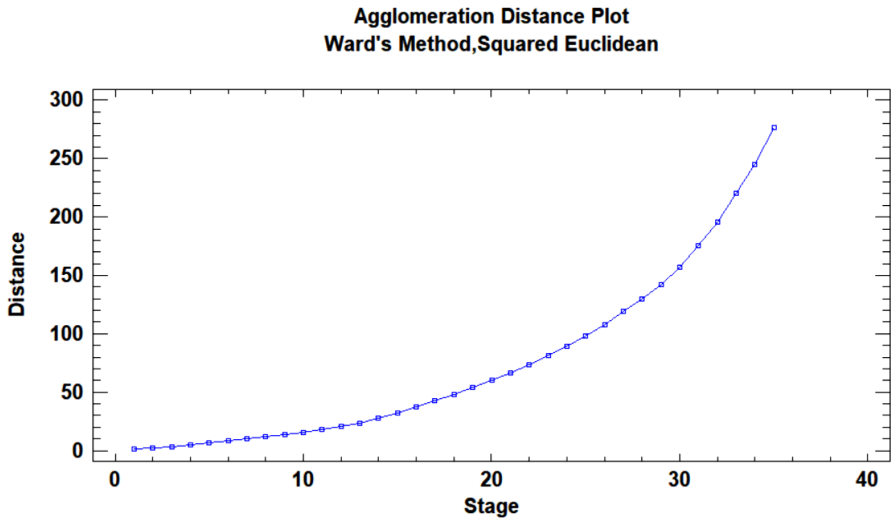


**Figure 2.** Agglomeration distance graph of clustering 41 ITF countries based on 19 indicators of transport and logistics sector development in 2010

**Table 3.** Cluster membership of 41 ITF countries based on 19 indicators of transport and logistics sector development in 2010

| Row | Cluster | Row | Cluster | Row | Cluster | Row | Cluster | Row | Cluster |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 10 | 3 | 18 | 2 | 26 | 1 | 34 | 1 |
| 2 | 1 | 11 | 1 | 19 | 3 | 27 | 1 | 35 | 1 |
| 3 | 1 | 12 | 4 | 20 | 3 | 28 | 1 | 36 | 1 |
| 4 | 1 | 13 | 3 | 21 | 5 | 29 | 2 | 37 | 2 |
| 5 | 2 | 14 | 4 | 22 | 1 | 30 | 1 | 38 | 1 |
| 6 | 1 | 15 | 2 | 23 | 1 | 31 | 1 | 39 | 4 |
| 7 | 1 | 16 | 1 | 24 | 1 | 32 | 1 | 40 | 6 |
| 8 | 1 | 17 | 4 | 25 | 2 | 33 | 2 | 41 | 3 |
| 9 | 2 | | | | | | | | |

In 2010, Cluster 1 consisted of European and non-European countries. Cluster 2 included several countries from Europe, Asia, and Latin America. Cluster 3 consisted of smaller European and post-Soviet countries. Cluster 4 was a group of major Western European countries. Cluster 5 was a small cluster with just one country, Luxembourg. The United States was another single country in its own Cluster 6. The clusters might reflect similarities in transport infrastructure, geographical regions, and economic development levels, among other investigated variables.

In 2015, the ITF member countries' cluster analysis results were updated, and some changes in the groupings were observed compared to 2010. Cluster 1 has expanded significantly since 2010, with more countries, including many of the Eastern European and some new ones like Azerbaijan, Mexico, and New Zealand. Cluster 2 has remained fairly consistent, including the major European economies (Austria, France, Germany, and the UK), plus South Korea. Cluster 3 remained mostly the same, with a few small countries from the Baltic region and Central Asia. Cluster 4 has seen the inclusion of North Macedonia. Cluster 5 still contained only one country, but Norway instead of Luxembourg. Cluster 6 remained the same – the United States – similar to the previous year. The changes in the clusters might reflect adjustments in the transport or economic profiles of these countries.

In 2022, the ITF member countries' cluster analysis results show further refinements and changes compared to the previous years. Cluster 1 has become more focused, including several European countries and a few from outside

**Table 4.** The summarized results of clustering 41 ITF countries based on 19 indicators of transport and logistics sector development in 2010, 2015, and 2022

| Cluster membership | Countries | Number | Percent |
|---|---|---|---|
| | **2010** | | |
| Cluster 1 | Albania, Australia, Austria, ***Azerbaijan,*** Bulgaria, Canada, Croatia, Finland, Ireland, New Zealand, North Macedonia, Norway, Portugal, Romania, Serbia, Slovenia, Türkiye, Spain, Sweden | 22 | 53.66 |
| Cluster 2 | Belgium, Czechia, Hungary, South Korea, Mexico, Moldova, Montenegro, the Netherlands, Poland, the Slovak Republic, Switzerland | 8 | 19.51 |
| Cluster 3 | Estonia, Georgia, Latvia, Lithuania, Uzbekistan | 5 | 12.20 |
| Cluster 4 | France, Germany, Italy, the United Kingdom | 4 | 9.76 |
| Cluster 5 | Luxembourg | 1 | 2.44 |
| Cluster 6 | The United States | 1 | 2.44 |
| | **2015** | | |
| Cluster 1 | Albania, Australia, ***Azerbaijan***, Belgium, Bulgaria, Canada, Croatia, Czechia, Estonia, Finland, Georgia, Hungary, Ireland, Italy, Luxembourg, Mexico, Moldova, Montenegro, the Netherlands, New Zealand, Poland, Portugal, Romania, Serbia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye | 30 | 73.17 |
| Cluster 2 | Austria, France, Germany, South Korea, the United Kingdom | 5 | 12.20 |
| Cluster 3 | Latvia, Lithuania, Uzbekistan | 3 | 7.32 |
| Cluster 4 | North Macedonia | 1 | 2.44 |
| Cluster 5 | Norway | 1 | 2.44 |
| Cluster 6 | The United States | 1 | 2.44 |
| | **2022** | | |
| Cluster 1 | Albania, Australia, ***Azerbaijan,*** Belgium, Bulgaria, Canada, Croatia, Czechia, Estonia, Finland, Georgia, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Mexico, Moldova, Montenegro, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Serbia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye | 32 | 77.50 |
| Cluster 2 | Austria, South Korea | 2 | 5.00 |
| Cluster 3 | France, Germany, Italy, the United Kingdom | 4 | 10.00 |
| Cluster 4 | North Macedonia | 1 | 2.50 |
| Cluster 5 | The United States | 1 | 2.50 |
| Cluster 6 | Uzbekistan | 1 | 2.50 |

Europe. It remained the largest and most diverse, with a mix of European countries and a few from outside Europe, including New Zealand, Mexico, and Australia. Norway was a notable inclusion in Cluster 5 in 2015. Cluster 2 had two countries from Europe and Asia: Austria and South Korea. This may reflect specific economic or transport similarities between these two countries, possibly related to their transport policies or infrastructure. Cluster 3 included the major Western European countries (France, Germany, Italy, and the United Kingdom). Cluster 4 had North Macedonia, similar to 2015. Cluster 5 still only included the United States, similar to 2010 and 2015. Cluster 6 contained Uzbekistan, a new addition compared to previous years. This suggests a shift in similarities between Uzbekistan and other countries, particularly regarding transport systems or policies.

Overall, the structure of the clusters has remained relatively stable over the years, with only slight shifts in groupings, reflecting changes in transport systems, infrastructure, or other relevant factors within these countries.

In the 2022 cluster analysis, Azerbaijan remained part of Cluster 1, just as it was in 2015 and 2010. This continued grouping suggests that Azerbaijan shared key similarities with these countries in terms of transport systems, policies, or other factors that are relevant to the ITF analysis. Azerbaijan's position in Cluster 1 (mostly European countries) is thus a reflection of its continued alignment with countries that share similarities in transportation or economic profiles, particularly in comparison with countries in Cluster 2, Cluster 3, and others that have more distinct economic or infrastructure traits.



http://dx.doi.org/10.21511/ppm.23(1).2025.45

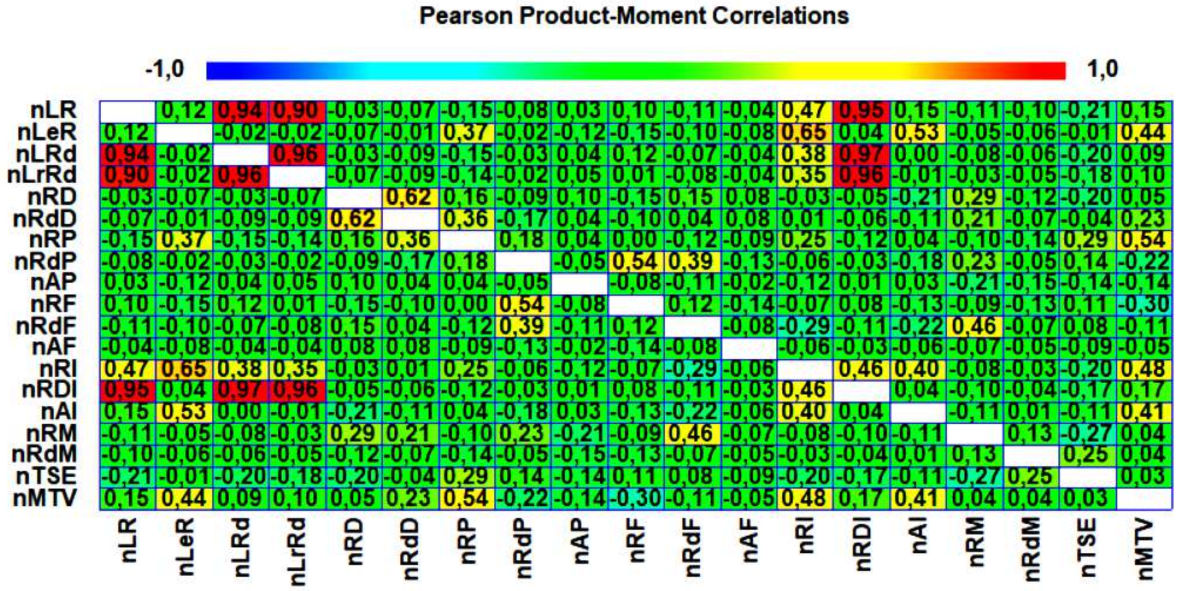


**Figure 3.** Pearson product-moment correlations to prove the relationships between 19 indicators of transport and logistics development

Then, to prove the relationships between 19 indicators of the transport and logistics sector's development, Pearson product-moment correlations between each pair of variables were applied (Figure 3).

These correlation coefficients range between –1 and +1 and measure the strength of the linear relationship between the variables. In addition, the statistical significance of the estimated correlations was tested using the *P*-value. *P*-values below 0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level. The following pairs of variables have *P*-values below 0.05: *nLR* and *nLRd*, *nLR* and *nLrRd*, *nLR* and *nRI*, *nLR* and *nRDI*, *nLeR* and *nRP*, *nLeR* and *nRI*, *nLeR* and *nAI*, *nLeR* and *nMTV*, *nLRd* and *nLrRd*, *nLRd* and *nRI*, *nLRd* and *nRDI*, *nLrRd* and *nRI*, *nLrRd* and *nRDI*, *nRD* and *nRdD*, *nRdD* and *nRP*, *nRP* and *nMTV*, *nRdP* and *nRF*, *nRdP* and *nRdF*, *nRdF* and *nRM*, *nRI* and *nRDI*, *nRI* and *nAI*, *nRI* and *nMTV*, *nAI* and *nMTV* (abbreviations are listed under the tables in Appendix A).

There is a direct relationship between such transport and logistics sector's development indicators as the length of rail tracks, electrified rail tracks, and rail investment spending, length of electrified rail tracks and machinery and transport equipment value added, length of roads, rural roads and road investment spending, rail investment spending and machinery and transport equipment value added, etc. To quantitatively assess the impact of these identified relationships, regression analysis was applied for a panel of the Cluster 1 countries, including Azerbaijan (cluster membership is taken into account for 2022). This sample consists of 31 countries of ITF, and the time period is 2010–2022 (13 years). The number of observations is 416. The data were normalized previously according to the procedure described above.

Table 5 presents the results of Arellano–Bond dynamic panel-data estimation to test the impact of rail investment spending (*nRI*) on the length of rail tracks (*nLR*).

For Lag 1 of *nLR* (L1.), the coefficient is 1.049599, with a *z*-statistic of 16.18, which is statistically significant at the 1% level (*P*-value = 0.000). This suggests a positive relationship between the current value of *nLR* and its lagged value (L1). For Lag 2 of nLR (L2.), the coefficient is –0.2481723, with a *z*-statistic of –3.03, which is significant at the 1% level (*P*-value = 0.002). This indicates a negative relationship between *nLR* and its second lag. And for Lag 3 of *nLR* the coefficient is –0.0048872, with a *z*-statistic of –0.07, which is not significant (*P*-value = 0.943). This suggests that the third lag does not have a significant effect on *nLR*.

**Table 5.** Arellano–Bond dynamic panel-data estimation to test the impact of rail investment spending on the length of rail tracks

| nLR | Coefficient | Std. err. | z | P>\|z\| | [95% conf. interval] | |
|---|---|---|---|---|---|---|
| nLR L1 | 1.049599 | .0648823 | 16.18 | 0.000 | .9222432 | 1.176766 |
| nLR L2 | –.2481723 | .0819396 | –3.03 | 0.002 | –.4087711 | –.0875736 |
| nLR L3 | –.0048872 | .0686577 | –0.07 | 0.943 | –.1394538 | .1296795 |
| nRI | –.0132381 | .0078021 | –1.70 | 0.090 | –.0285299 | .0020537 |
| nRI L1 | .0285863 | .0124259 | 2.30 | 0.021 | .004232 | .0529405 |
| nRI L2 | –.0065411 | .0125491 | –0.52 | 0.602 | –.03111369 | .0180547 |
| nRI L3 | –.0077411 | .0083771 | –0.92 | 0.355 | –.0241599 | .0086776 |
| Constant | .030909 | .0098364 | 3.14 | 0.002 | .0116299 | .050188 |

The coefficient for *nRI* is –0.0132381, with a *z*-statistic of –1.70, which is marginally significant at the 10% level (*P*-value = 0.090). This suggests a small negative effect of *nRI* on *nLR*. With Lag 1 of *nRI* the coefficient is 0.0285863, with a *z*-statistic of 2.30, which is significant at the 5% level (*P*-value = 0.021). This suggests a positive relationship between *nLR* and the first lag of *nRI*. With Lag 2 of *nRI*, the coefficient is –0.0065411, with a *z*-statistic of –0.52, which is not significant (*P*-value = 0.602). This suggests that the second lag of *nRI* does not significantly affect *nLR*. And with Lag 3 of *nRI* the coefficient is –0.0077411, with a *z*-statistic of –0.92, which is also not significant (*P*-value = 0.355).

The constant term is 0.030909, with a *z*-statistic of 3.14, which is significant at the 1% level (*P*-value = 0.002). This represents the baseline level of *nLR* when the explanatory variables are zero.

A high value of Wald test (Wald chi2(7) = 429.46) indicates the joint significance of the model coefficients – the model is statistically significant. The *p*-value for the Wald test (Prob > chi2 = 0.0000) is less than 0.05 suggesting that the model is statistically significant.

Therefore, a 1% increase in rail investment spending will increase the length of rail tracks by an average of 0.03% with a lag of 1 year.

Similarly, the regression modelling procedure was applied to other pairs of indicators. Table 6 summarizes the results.

The infrastructure investments in roads, rail tracks, and electrified rail tracks have varying response times to changes in economic variables, with 1-year or 2-year being common lags. For every 1% increase in road investment spending, the length of roads will increase by 0.03%, but this effect takes 2 years to materialize. As for the length of rural roads, the impact of road investment spending is not statistically significant, so it is not confirmed (*P*>|z| = 0.111, which is more than 0.05).

**Table 6.** Summarized results of panel data regression estimation of the impact of transport and logistics sector's indicators

| Indicators | Model | Coefficient | z | P>\|z\| | Statistical significance |
|---|---|---|---|---|---|
| *nLR*<br>*nRI* | $1.05nLR_{t-1} = 0.03 + 0.03nRI_{t-1}$ | 0.0285863 | 2.3 | 0.021 | Wald chi2(7) = 429.46<br>Prob > chi2 = 0.0000 |
| *nLeR*<br>*nRI* | $0.73nLeR_{t-1} = 0.04 + 0.06nRI_{t-1}$ | 0.0601007 | 4.64 | 0.000 | Wald chi2(7) = 724.26<br>Prob > chi2 = 0.0000 |
| *nLRd*<br>*nRdI* | $0.51nLRd_{t-1} = 0.08 + 0.03nRdI_{t-2}$ | 0.0311683 | 2.28 | 0.023 | Wald chi2(7) = 99.77<br>Prob > chi2 = 0.0000 |
| *nLrRd*<br>*nRdI* | $0.71nLrRd_{t-1} = 0.02 - 0.1nRdI_{t-1}$ | –0.097702 | –1.59 | 0.111* | Wald chi2(7) = 2276.53<br>Prob > chi2 = 0.0000 |
| *nLeR*<br>*nMTV* | $0.66nLeR_{t-1} = 0.02 + 0.03nMTV_{t-2}$ | 0.0255187 | 1.8 | 0.051 | Wald chi2(7) = 749.67<br>Prob > chi2 = 0.0000 |
| *nRI*<br>*nMTV* | $0.84nRI_{t-1} = 0.05 + 0.1nMTV$ | 0.1048626 | 1.73 | 0.033 | Wald chi2(7) = 184.91<br>Prob > chi2 = 0.0000 |

*Note*: * is not statistically significant (*P*>|*z*| > 0.05); the 'n' sign before the indicator abbreviation means its normalized value; *LR* – Length of rail tracks; *LeR* – Length of electrified rail tracks; *LRd* – Length of roads; *LrRd* – Length of rural roads; *RI* – Rail investment spending; *RdI* – Road investment spending; *MTV* – Machinery and transport equipment value added.


http://dx.doi.org/10.21511/ppm.23(1).2025.45

A 1% increase in rail investment spending will increase the length of rail tracks by an average of 0.03% with a lag of 1 year. Rail investments are reflected relatively quickly in terms of infrastructure growth compared to road investments. An increase in rail investment spending by 1% results in a larger effect on electrified rail tracks (0.06% increase), with the effect observed after 1 year. This indicates that rail investment spending has a greater impact on electrified rail tracks compared to regular rail tracks, and the response time is still short (1 year).

A 1% increase in the value added by the machinery and transport equipment sector will lead to a 0.03% increase in the length of electrified rail tracks, but the effect will be seen after 2 years. This suggests that the machinery sector plays a role in rail infrastructure, but the impact takes time to materialize. A 1% increase in machinery and transport equipment value added will contribute to an increase in rail investment spending by an average of 0.1% without time lag. This indicates a direct and prompt influence of the machinery sector on investment in rail infrastructure.

There are also indirect effects, such as how the value added in machinery and transport equipment influences both rail investment spending and electrified rail track length. These effects underscore the interconnected nature of sectors in driving infrastructure development. Besides, rail investment spending appears to have a larger impact on electrified rail tracks compared to regular rail tracks, showing a stronger effect on more specialized infrastructure.

Liashenko and Trushkina (2021) and Liashenko et al. (2023) provided a comprehensive framework for assessing the current conditions of the transport logistics system, focusing on infrastructural support and the impact of logistics performance on economic indicators. They analyzed such indicators as he Logistics Performance Index, logistics costs, export of transport services, import of transport services, volumes of cargo transportation, volume of direct investments, etc. Liashenko et al. (2021) paid great attention to the outcomes of forming a transport and logistics cluster at the regional level, taking into account innovative infrastructure. That is, the list of indicators is completely different, and the study did not aim for empirical confirmation based on regression panel data analysis nor for clustering countries in particular on the basis of the proposed indicators framework and on the world level.

Yusifov et al. (2019) explored the potential of transport and logistics sectors in Azerbaijan. Their findings outlined strategic recommendations and objectives for the development of this sector but primarily relying on qualitative methods, including SWOT analysis and others. In comparison, this study offers empirical confirmations.

The results of cluster analysis of transport and logistics potential were presented by Satybaldin et al. (2022) on the case of regions in Kazakhstan. The analysis took into account 11 economic indicators for transport, logistics, and transport infrastructure for 2021. Instead, this current study presents the outcomes of cluster analysis over three periods. Kumar et al. (2017) applied spatial clustering and econometric techniques to examine the characteristics of transportation and logistics cluster regions throughout the continental US, with an emphasis on employment, clustering trends, and distribution patterns. In comparison, this study covers a sample of countries worldwide, and it is based on more indicators, in particular indicators in the transport and logistics sectors.

This study has some limitations. They refer to the constraints or factors that may affect the scope, validity, or generalizability of the study's findings. Firstly, some countries' exclusion may limit the representativeness of the sample, and the findings may not be fully generalizable to the entire group of 69 ITF member countries. Data for certain indicators were missing for some countries, so the final analysis is based on available data from 41 countries only. Secondly, the study relies heavily on secondary data from the OECD and World Bank statistical databases. While these sources are authoritative, they may also have limitations in terms of data accuracy, consistency across countries, or timeliness of data collection. Thirdly, the chosen set of indicators may not fully capture all relevant aspects of transport and infrastructure development. The study focuses on 19 indicators related to transport infrastructure and performance, which may not capture the full complexity of transport systems across different countries. The selection of these indicators may be influenced by the availability of data, and there may be other important factors that are not included in the analysis. Finally, the study spans the period 2010–2022, which may be subject to variations in data reporting and the impact of specific events, such as economic crises or the COVID-19 pandemic, that may have affected transport and infrastructure development in certain countries. The findings might not account for significant shifts or emerging trends that occur beyond this timeframe. All the above should be taken into account in further research.

## CONCLUSION

The purpose of this paper was to analyze the state of the transport and logistics sector's development in Azerbaijan compared with ITF countries and to assess the impact of investments. In 2022 Azerbaijan continues to be classified within Cluster 1, alongside mostly European countries, consistent with its placement in 2015 and 2010. This persistent grouping indicates that Azerbaijan has notable similarities with these nations in aspects such as transport systems, policies, and other factors relevant to the ITF. Its position in Cluster 1 highlights its ongoing alignment with countries that share comparable transportation or economic characteristics, especially when compared to countries in Cluster 2, Cluster 3, and other groups with more distinct infrastructure or economic profiles.

Infrastructure investments in roads, railways, and electrified rail tracks exhibit different response times to changes in economic factors, with common delays of 1 to 2 years. Rail investments tend to show quicker results in infrastructure growth compared to road investments. Additionally, spending on rail infrastructure has a more significant effect on electrified rail tracks than on conventional ones, with a similarly short response time of around 1 year. The machinery sector is vital for the rail infrastructure: a direct and prompt influence is on investment in rail infrastructure. Indirect effects also play a role, such as how the value added in machinery and transport equipment impacts both rail investment spending and the expansion of electrified rail track. These effects highlight the interdependent relationship between sectors in fostering infrastructure growth. Furthermore, rail investment spending seems to have a greater influence on electrified rail tracks than on conventional ones, demonstrating a more significant effect on specialized infrastructure.

The obtained results can be useful in policy improvement and government decision-making for strengthening the development of the transport and logistics sector in Azerbaijan and prioritizing certain partnership relations in this area.

## AUTHOR CONTRIBUTIONS

Conceptualization: Mehriban Samadova, Nazira Huseynova.
Data curation: Aliya Hajigayibova.
Formal analysis: Mehriban Samadova, Nazira Huseynova, Aliya Hajigayibova.
Funding acquisition: Mehriban Samadova.
Investigation: Nazira Huseynova, Aliya Hajigayibova.
Methodology: Mehriban Samadova, Nazira Huseynova.
Project administration: Aliya Hajigayibova.
Resources: Mehriban Samadova, Nazira Huseynova, Aliya Hajigayibova.
Software: Nazira Huseynova, Aliya Hajigayibova.
Supervision: Mehriban Samadova.
Validation: Mehriban Samadova, Aliya Hajigayibova.
Visualization: Nazira Huseynova.
Writing – original draft: Nazira Huseynova, Aliya Hajigayibova.
Writing – review & editing: Mehriban Samadova.


http://dx.doi.org/10.21511/ppm.23(1).2025.45

## REFERENCES


1. Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies, 58*(2), 277-297. https://doi.org/10.2307/2297968
2. Berg, C. N., Deichmann, U., Liu, Y., & Selod, H. (2016). Transport policies and development. *The Journal of Development Studies, 53*(4), 465-480. https://doi.org/10.1080/00220388.2016.1199857
3. Bian, X., & Wang, B. (2024). Exploring the influence of artificial intelligence usage on ethical decision making among public sector employees: Insights into moral identity and service motivation. *Business Ethics and Leadership, 8*(3), 133-150. https://doi.org/10.61093/bel.8(3).133-150.2024
4. Bîzoi, G., Bîzoi, A.-C., Sipos G. L., & Sipos, C. (2015). The transport and logistics sector's performance and the social development – A comparison within the European Union. *Studia Universitatis Babeş-Bolyai. Oeconomica, 60*(1), 68-81. Retrieved from https://studia.reviste.ubbcluj.ro/index.php/subboeconomica/article/view/5229
5. Bookbinder, J. H. (Ed.). (2012). *Handbook of global logistics: Transportation in international supply chains.* New York: Springer. https://doi.org/10.1007/978-1-4419-6132-7
6. Candemir, Yu., & Çelebi, D. (2017). An inquiry into the analysis of the transport & logistics sectors' role in economic development. *Transportation Research Procedia, 25,* 4692-4707. https://doi.org/10.1016/j.trpro.2017.05.317
7. Chohra, M. (2024). Managing socio-economic infrastructure projects in developing countries: Improving decision-making through risk assessment. *Financial Markets, Institutions and Risks, 8*(3), 98-112. https://doi.org/10.61093/fmir.8(3).98-112.2024
8. Doroshenko, H., Biletskyi, I., & Prokopenko, V. (2023). Supply chain management in residential real estate construction. *Financial and Credit Activity Problems of Theory and Practice, 4*(51), 491-507. https://doi.org/10.55643/fcaptp.4.51.2023.4068
9. Guemidi, Y., Guemidi, L. B., Bouchetara, M., Boudedja, M., & Gahlam, N. (2024). Development of a decision support information system for the regulation of consumer goods in the agricultural sector. *SocioEconomic Challenges, 8*(3), 169-180. https://doi.org/10.61093/sec.8(3).169-180.2024
10. Habenko, M. (2023). Export of high-tech goods in the context of innovation transfer for social-economic development: Factor analysis. *SocioEconomic Challenges, 7*(2), 152-160. https://doi.org/10.21272/sec.7(2).152-160.2023
11. Halaszovich, T. F., & Kinra, A. (2020). The impact of distance, national transportation systems and logistics performance on FDI and international trade patterns: Results from Asian global value chains. *Transport Policy, 98,* 35-47. https://doi.org/10.1016/j.tranpol.2018.09.003
12. Ibrahimov, R. (2016). The development of the transport sector in Azerbaijan: The implementation and challenges. *Caucasus International, 6*(1), 101-115. Retrieved from https://www.researchgate.net/publication/349457212_The_Development_of_the_Transport_Sector_in_Azerbaijan_The_Implementation_and_Challenges
13. International Transport Forum (ITF). (n.d.). *Member countries.* Retrieved from https://www.itf-oecd.org/member-countries
14. Izteleuova, M., Arimbekova, P., Murzabekova, K., & Alik, A. (2024). Features of development and efficiency of transport logistics infrastructure. *Acta Commercii, 24*(1), Article a1235. https://doi.org/10.4102/ac.v24i1.1235
15. Kaufman, L., & Rousseeuw, P. J. (1990). *Finding groups in data: An introduction to cluster analysis.* New York: Wiley. Retrieved from https://onlinelibrary.wiley.com/doi/book/10.1002/9780470316801
16. Kherbash, O., & Mocan, M. L. (2015). A review of logistics and transport sector as a factor of globalization. *Procedia Economics and Finance, 27,* 42-47. https://doi.org/10.1016/S2212-5671(15)00969-7
17. Kobiyh, M., & Amri, A. E. (2024). Rational individual and managerial decision model: A critical review of the standard rationality hypothesis. *Business Ethics and Leadership, 8*(3), 120-132. https://doi.org/10.61093/bel.8(3).120-132.2024
18. Kumar, I., Zhalnin, A., Kim, A., & Beaulieu, L. J. (2017). Transportation and logistics cluster competitive advantages in the U.S. regions: A cross-sectional and spatio-temporal analysis. *Research in Transportation Economics, 61,* 25-36. https://doi.org/10.1016/j.retrec.2016.07.028
19. Kuzior, A., Krawczyk, D., Brożek, P., Pakhnenko, O., Vasylieva, T., & Lyeonov, S. (2022). Resilience of smart cities to the consequences of the COVID-19 pandemic in the context of sustainable development. *Sustainability, 14*(19), Article 12645. https://doi.org/10.3390/su141912645
20. Liashenko, V., & Trushkina, N. (2021). Cross-border transport and logistics cluster as an effective form of cooperation between the regions of Ukraine and Visegrad Four. In A. Krysovatyy & T. Shengelia (Eds.), *Visegrad Group: A form of establishment and development of European integration* (pp. 265-288). Publishing House "Universal". Retrieved from https://iie.org.ua/wp-content/uploads/application/pdf/monohrafiia_vyshehradska-chetvirka_compressed.pdf
21. Liashenko, V., Ivanov, S., & Trushkina, N. (2021). A conceptual approach to forming a transport and

logistics cluster as a component of the region's innovative infrastructure (on the example of Prydniprovsky Economic Region of Ukraine). *Virtual Economics, 4*(1), 19-53. https://doi.org/10.34021/ve.2021.04.01(2)

22. Liashenko, V., Khaustova, V., & Trushkina, N. (2023). Cross-border transport and logistics cluster as a tool for territorial development of Ukraine and Poland: Institutional basis. *Journal of European Economy, 21*(4), 503-521. https://doi.org/10.35774/jee2022.04.503

23. Lima, M. (2024). Strengthening healthcare supply chains: A comprehensive strategy for resilience in the face of natural disasters. *Health Economics and Management Review, 5*(2), 47-67. https://doi.org/10.61093/hem.2024.2-04

24. Melnyk, M., Leshchukh, I., Prytula, K., Ivaniuk, U., & Ohinok, S. (2024). Logistics potential to ensure the resilience of the Ukrainian economic system facing global challenges. *Problems and Perspectives in Management, 22*(2), 399-418. https://doi.org/10.21511/ppm.22(2).2024.31

25. Mishrif, A., Antimiani, A., & Khan, A. (2024). Examining the contribution of logistics and supply chain in boosting Oman's trade network. *Economies, 12*(3), Article 70. https://doi.org/10.3390/economies12030070

26. Mouna, B., & Yassine, M. (2024). Business leadership in e-commerce in the USA: The impact of blockchain technology. *Business Ethics and Leadership, 8*(1), 116-128. https://doi.org/10.61093/bel.8(1).116-128.2024

27. Museyibov, A., & Satiji, A. (2024). Financing trends of trade and logistics sector in developing countries: The case of Azerbaijan. *Economy and Sociology, 2,* 97-108. https://doi.org/10.36004/nier.es.2023.2-10

28. OECD. (2024). Transport policy. In *Western Balkans Competitiveness Outlook 2024*: *Kosovo*. Paris: OECD Publishing. https://doi.org/10.1787/cbdde6ac-en

29. OECD. (n.d.a). *Annual transport trends*. Retrieved from https://data-explorer.oecd.org/vis?fs[0]=Topic%2C0%7CTransport%23TRA%23&fs[1]=Reference%20area%2C1%7CNon-OECD%20economies%23WXOECD%23%7CAzerbaijan%23AZE%23&pg=0&fc=Reference%20area&snb=21&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_TRENDS%40DF_TRENDS&df[ag]=OECD.ITF&df[vs]=1.0&dq=.A.INFRASTRUCTURE..ROAD%2BRAIL..&pd=2010%2C2023&to[TIME_PERIOD]=false&vw=tb

30. OECD. (n.d.b). *Transport activity indicators*. Retrieved from https://data-explorer.oecd.org/vis?fs[0]=Topic%2C0%7CTransport%23TRA%23&pg=0&fc=Topic&bp=true&snb=22&vw=tb&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_INDICATORS%40DF_MEASUREMENT&df[ag]=OECD.ITF&df[vs]=1.0&dq=.A.PASSENGER%2BFREIGHT.PASKM_10-P3USD%2BTKM_10P3USD.AIR%2BRAIL%2BROAD...&pd=2000%2C2022&to[TIME_PERIOD]=false

31. OECD. (n.d.c). *Transport infrastructure investment and maintenance spending*. Retrieved from https://data-explorer.oecd.org/vis?df[ds]=DisseminateFinalDMZ&df[id]=DSD_INFRINV%40DF_INFRINV&df[ag]=OECD.ITF&dq=.A.INV%2BMNT.EUR.AIR%2BMAR%2BROAD%2BIWW%2BRAIL.V&pd=2000%2C2022&to[TIME_PERIOD]=false&vw=tb

32. OECD. (n.d.d). *Transport performance indicators*. Retrieved from https://data-explorer.oecd.org/vis?df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_INDICATORS%40DF_TRANSPORTINDICATORS&df[ag]=OECD.IT-F&df[vs]=1.0&dq=.A.DENSITY..AIR%2BRAIL%2BROAD...&pd=2000%2C2022&to[TIME_PERIOD]=false&ly[cl]=TIME_PERIOD&ly[rs]=TRANSPORT_MODE%2CCOMBINED_MEASURE%2CINFRASTRUCTURE_TYPE&ly[rw]=REF_AREA&vw=tb

33. Oualid, C., Selma, D., & Soufyane, B. (2024). The impact of content personalization on customer engagement and market risks of e-stores. *Financial Markets, Institutions and Risks, 8*(3), 37-56. https://doi.org/10.61093/fmir.8(3).37-56.2024

34. Pathak, D. D., & Thapa, B. S. (2024). Beyond market anomalies: How heuristics and perceived efficiency shape investor behavior in developing markets. *Investment Management and Financial Innovations, 21*(3), 1-14. https://doi.org/10.21511/imfi.21(3).2024.01

35. Pearson, K. (1896). Mathematical contributions to the theory of evolution – III. Regression, heredity, and panmixia. *Philosophical Transactions of the Royal Society of London, Series A, 187,* 253-318. https://doi.org/10.1098/rsta.1896.0007

36. Percoco, M. (2014). Quality of institutions and private participation in transport infrastructure investment: Evidence from developing countries. *Transportation Research Part A: Policy and Practice, 70,* 50-58. https://doi.org/10.1016/j.tra.2014.10.004

37. Polhemus, N. W. (n.d.). *Cluster Analysis using Statgraphics* [Presentation]. Retrieved from http://www.statvision.com/webinars/Cluster%20Analysis.pdf

38. Rekunenko, I., Kobushko, I., Dzydzyguri, O., Balahurovska, I., Yurynets, O., & Zhuk, O. (2025). The use of artificial intelligence in public administration: Bibliometric analysis. *Problems and Perspectives in Management, 23*(1), 209-224. https://doi.org/10.21511/ppm.23(1).2025.16

39. Rodrigue, J.-P. (2017). *Developing the logistics sector: The role of public policy*. OECD. http://dx.doi.org/10.13140/RG.2.2.20189.92645

40. Rustamova, N. F. (2022). The current state of logistics development in Azerbaijan. *International Journal of Innovative Technologies in Economy, 2*(38). https://doi.org/10.31435/rsglobal_ijite/30062022/7827

41. Samusevych, Y., Lyeonov, S., Artyukhov, A., Martyniuk, V., Tenytska, I., Wyrwisz, J., & Wojciechowska, K. (2023). Optimal design of transport tax on the way to national security: Balancing environmental footprint, energy efficiency and economic growth. *Sustainability, 15*(1), Article 831. https://doi.org/10.3390/su15010831

42. Satybaldin, A. A., Sadykov B. E., Moldabekova, A., & Akhmetova, Z. B. (2022). Cluster analysis of the transport and logistics potential of the regions of Kazakhstan. *The Economy Strategy and Practice, 17*(4), 41-57. https://doi.org/10.51176/1997-9967-2022-4-41-57

43. Savy, M. (2016). Logistics as a political issue. *Transport Reviews, 36*(4), 413-417. https://doi.org/10.1080/01441647.2016.1182793

44. Scott, D. W. (2009). Sturges' rule. *Wiley Interdisciplinary Reviews: Computational Statistics, 1*(3), 303-306. https://doi.org/10.1002/wics.35

45. Shaon, S., Rahman, M. S., Urmi, Z. N., Mia, M. S., & Hossen, M. A. (2024). COVID-19 lessons for the tourism sector: Role of top management support, communication, and organisational culture in supply chain resilience. *Health Economics and Management Review, 5*(2), 68-83. https://doi.org/10.61093/hem.2024.2-05

46. Starchenko, L., Lyeonov, S., Vasylieva, T., Pimonenko, T., & Lyulyov, O. (2021). Environmental management and green brand for sustainable entrepreneurship. *E3S Web of Conferences, 234*. https://doi.org/10.1051/e3sconf/202123400015

47. Stata. (n.d.a). *Arellano–Bond linear dynamic panel-data estimation*. Stata Manuals. Retrieved from https://www.stata.com/manuals13/xtxtabond.pdf

48. Stata. (n.d.b). *Dendrograms for hierarchical cluster analysis*. Stata Manuals. Retrieved from https://www.stata.com/manuals/mvclusterdendrogram.pdf

49. Stata. (n.d.c). *Hierarchical cluster analysis*. Stata Manuals. Retrieved from https://www.stata.com/manuals/mvclusterlinkage.pdf

50. Subedi, D. P., & Bhandari, D. R. (2024). Impact of psychological factors on investment decisions in Nepalese share market: A mediating role of financial literacy. *Investment Management and Financial Innovations, 21*(3), 317-329. https://doi.org/10.21511/imfi.21(3).2024.26

51. Sumbal, M. S., Ahmed, W., Shahzeb, H., & Chan, F. (2023). Sustainable technology strategies for transportation and logistics challenges: An implementation feasibility study. *Sustainability, 15*(21), Article 15224. https://doi.org/10.3390/su152115224

52. Valentinas, N., Petrokė, I., Bačiulienė, V., & Vasylieva, T. (2021). The impact of the sharing economy as an ecosystem on the tourism sector. *Journal of Tourism and Services, 12*(22), 66-88. https://doi.org/10.29036/jots.v12i22.241

53. Ward, J. H. Jr. (1963). Hierarchical grouping to optimize an objective function. *Journal of the American Statistical Association, 58*(301), 236-244. https://doi.org/10.1080/01621459.1963.10500845

54. World Bank. (n.d.a). *Machinery and transport equipment (% of value added in manufacturing)*. Retrieved from https://data.worldbank.org/indicator/NV.MNF.MTRN.ZS.UN

55. World Bank. (n.d.b). *Transport services (% of commercial service exports)*. Retrieved from https://data.worldbank.org/indicator/TX.VAL.TRAN.ZS.WT?end=2023&start=1960&view=chart

56. Wright, J. (2023). Healthcare cybersecurity and cybercrime supply chain risk management. *Health Economics and Management Review, 4*(4), 17-27. https://doi.org/10.61093/hem.2023.4-02

57. Yusifov, E. M., Kulu, T. K., & Mammadov, H. P. (2019). Logistics sector in Azerbaijan economy: structural improvements and orientations strategic development. *Eureka: Social and Humanities*, (2), 29-38. https://doi.org/10.21303/2504-5571.2019.00873

58. Zamkova, N., Polishchuk, I., Dovhan, Y., Dovhan, L., & Novytskyi, R. (2023). Training of future logistics and supply chain managers: A competency approach. *Financial and Credit Activity Problems of Theory and Practice, 1*(48), 427-440. https://doi.org/10.55643/fcaptp.1.48.2023.3946

59. Ziabina, Y., Iskakov, & Senyah, M.M. (2023). Waste management system: Key determinants of green development and energy balance transformation. *SocioEconomic Challenges, 7*(2), 161-172. https://doi.org/10.21272/sec.7(2).161-172.2023

60. Zozulinskyy, A. (2024). The financial, economic and social consequences of the Russo-Ukrainian war: Bibliometric analysis. *Financial Markets, Institutions and Risks, 8*(3), 134-162. https://doi.org/10.61093/fmir.8(3).134-162.2024

# APPENDIX A

**Table A1.** Normalized input data on transport and logistics development indicators in 2010

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 0.0013 | 0.0000 | 0.0006 | 0.0002 | 0.1046 | 0.0292 | 0.0139 | 0.5080 | 0.1687 | 0.0071 | 0.7279 | 0.0000 | 0.0003 | 0.0018 | 0.0001 | 0.0000 | 0.0001 | 0.1596 | 0.0035 |
| Australia | 0.1282 | 0.0744 | 0.1333 | 0.0262 | 0.0000 | 0.0259 | 0.1978 | 0.1805 | 0.1327 | 0.3012 | 0.2499 | 0.0302 | 0.0740 | 0.0681 | 0.0000 | 0.0000 | 0.0000 | 0.1866 | 0.3608 |
| Austria | 0.0373 | 0.1828 | 0.0175 | 0.0174 | 0.4957 | 0.2720 | 0.4630 | 0.0000 | 0.0900 | 0.0700 | 0.0282 | 0.0112 | 0.1829 | 0.0081 | 0.0062 | 0.0647 | 0.0153 | 0.4153 | 0.5283 |
| Azerbaijan | 0.0080 | 0.0289 | 0.0029 | 0.0468 | 0.1870 | 0.0450 | 0.2881 | 0.0000 | 0.0394 | 0.2171 | 0.3915 | 0.0018 | 0.0007 | 0.0005 | 0.0008 | 0.0005 | 0.0005 | 0.4353 | 0.0816 |
| Belgium | 0.0240 | 0.0000 | 0.0237 | 0.0178 | 0.9115 | 1.0000 | 0.3626 | 0.2019 | 0.0409 | 0.0176 | 0.0900 | 0.0273 | 0.1544 | 0.0025 | 0.0096 | 0.0550 | 0.0018 | 0.4496 | 0.3314 |
| Bulgaria | 0.0224 | 0.0876 | 0.0030 | 0.0044 | 0.2849 | 0.0351 | 0.7080 | 0.0000 | 0.0414 | 0.0838 | 0.7197 | 0.0005 | 0.0119 | 0.0046 | 0.0004 | 0.0026 | 0.0034 | 0.3197 | 0.2906 |
| Canada | 0.2464 | 0.0000 | 0.1736 | 0.0000 | 0.0460 | 0.0285 | 0.0012 | 0.0000 | 0.1024 | 0.2865 | 0.2204 | 0.0149 | 0.0928 | 0.0637 | 0.0588 | 0.0772 | 0.1775 | 0.2663 | 0.4790 |
| Croatia | 0.0157 | 0.0382 | 0.0045 | 0.0126 | 0.3696 | 0.1027 | 0.5032 | 0.3476 | 0.0680 | 0.0617 | 0.2456 | 0.0003 | 0.0030 | 0.0053 | 0.0004 | 0.0090 | 0.0097 | 0.1972 | 0.3755 |
| Czechia | 0.0601 | 0.1573 | 0.0200 | 0.0074 | 0.9451 | 0.1413 | 0.5354 | 0.2727 | 0.0644 | 0.0914 | 0.4446 | 0.0011 | 0.0566 | 0.0053 | 0.0021 | 0.0478 | 0.0061 | 0.3978 | 0.6262 |
| Estonia | 0.0083 | 0.0030 | 0.0089 | 0.0012 | 0.2108 | 0.2699 | 0.2073 | 0.0000 | 0.0780 | 0.4737 | 0.5242 | 0.0026 | 0.0029 | 0.0004 | 0.0001 | 0.0000 | 0.0004 | 0.6420 | 0.3317 |
| Finland | 0.0257 | 0.0938 | 0.0162 | 0.0079 | 0.1428 | 0.0504 | 0.2626 | 0.2221 | 0.0911 | 0.0540 | 0.1890 | 0.0359 | 0.0355 | 0.0083 | 0.0049 | 0.0214 | 0.0161 | 0.2524 | 0.6207 |
| France | 0.1930 | 0.8268 | 0.1604 | 0.1151 | 0.4165 | 0.3757 | 0.6590 | 0.2214 | 0.0602 | 0.0152 | 0.0763 | 0.0236 | 0.4508 | 0.1870 | 0.0593 | 0.4880 | 0.0069 | 0.3472 | 0.5828 |
| Georgia | 0.0093 | 0.0327 | 0.0032 | 0.0022 | 0.1666 | 0.0534 | 0.9168 | 0.3685 | 0.0352 | 0.7094 | 0.0454 | 0.0009 | 0.0063 | 0.0003 | 0.0000 | 0.0189 | 0.0002 | 0.7257 | 0.0792 |
| Germany | 0.2801 | 1.0000 | 0.0000 | 0.1295 | 0.8366 | 0.1297 | 0.4160 | 0.2171 | 0.0749 | 0.0435 | 0.1293 | 0.0271 | 0.8093 | 0.2045 | 0.1068 | 0.0000 | 0.0000 | 0.3989 | 0.7928 |
| Hungary | 0.0352 | 0.0929 | 0.0305 | 0.0149 | 0.6704 | 0.4318 | 1.0000 | 0.3993 | 0.2471 | 0.0924 | 0.4592 | 0.0005 | 0.0300 | 0.0030 | 0.0020 | 0.0147 | 0.0032 | 0.3241 | 0.8119 |
| Ireland | 0.0091 | 0.0025 | 0.0147 | 0.0091 | 0.2080 | 0.2730 | 0.1179 | 0.0000 | 1.0000 | 0.0000 | 0.0425 | 0.0077 | 0.0374 | 0.0153 | 0.0081 | 0.0214 | 0.0032 | 0.0875 | 0.2419 |
| Italy | 0.0929 | 0.4465 | 0.0389 | 0.0673 | 0.4307 | 0.1687 | 0.3709 | 0.2873 | 0.0400 | 0.0116 | 0.1094 | 0.0045 | 0.6940 | 0.1184 | 0.0269 | 1.0000 | 0.2932 | 0.2418 | 0.5520 |
| South Korea | 0.0323 | 0.0496 | 0.0161 | 0.0390 | 0.4211 | 0.2116 | 0.8755 | 0.2539 | 0.0847 | 0.0110 | 0.1248 | 0.1391 | 0.4740 | 0.1224 | 0.0232 | 0.1406 | 0.0426 | 0.7705 | 1.0000 |
| Latvia | 0.0084 | 0.0150 | 0.0090 | 0.0000 | 0.2809 | 0.1855 | 0.5306 | 0.0000 | 0.3449 | 1.0000 | 0.8373 | 0.0028 | 0.0037 | 0.0001 | 0.0009 | 0.0058 | 0.0009 | 0.7398 | 0.2424 |
| Lithuania | 0.0084 | 0.0056 | 0.0125 | 0.0031 | 0.2284 | 0.2567 | 0.1611 | 0.7207 | 0.0057 | 0.5042 | 1.0000 | 0.0009 | 0.0027 | 0.0019 | 0.0001 | 0.0090 | 0.0018 | 0.9111 | 0.2166 |
| Luxembourg | 0.0024 | 0.0135 | 0.0568 | 0.0015 | 0.2106 | 0.2946 | 0.0937 | 0.0000 | 0.0366 | 0.0071 | 0.2546 | 1.0000 | 0.0060 | 0.0028 | 0.0002 | 0.0164 | 0.0008 | 0.0920 | 0.0000 |
| Mexico | 0.1025 | 0.0000 | 0.0210 | 0.0848 | 0.8222 | 0.0326 | 0.0000 | 0.0000 | 0.0774 | 0.1034 | 0.3643 | 0.0106 | 0.0656 | 0.0223 | 0.0140 | 0.0000 | 0.0143 | 0.3060 | 0.4175 |
| Moldova | 0.0044 | 0.0000 | 0.0004 | 0.0000 | 0.2652 | 0.0557 | 0.9827 | 0.0000 | 0.1799 | 0.1913 | 0.8810 | 0.0018 | 0.0002 | 0.0000 | 0.0005 | 0.0000 | 0.0004 | 0.5601 | 0.0505 |
| Montenegro | 0.0013 | 0.0070 | 0.0014 | 0.0000 | 0.1391 | 0.1256 | 0.3688 | 0.0150 | 0.4166 | 0.0503 | 0.0244 | 0.0002 | 0.0000 | 0.0000 | 0.0010 | 0.0000 | 0.0000 | 0.2649 | 0.1961 |
| The Netherlands | 0.0196 | 0.0975 | 0.0144 | 0.0267 | 0.0380 | 0.8196 | 0.2863 | 0.0000 | 0.0833 | 0.0092 | 0.0395 | 0.0935 | 0.1083 | 0.0295 | 0.0083 | 0.1126 | 0.0158 | 0.2562 | 0.5445 |

http://dx.doi.org/10.21511/ppm.23(1).2025.45

http://dx.doi.org/10.21511/ppm.23(1).2025.45

**Table A1 (cont.).** Normalized input data on transport and logistics development indicators in 2010

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand | 0.0153 | 0.0180 | 0.0143 | 0.0018 | 0.6862 | 0.0700 | 0.0320 | 0.2459 | 0.2375 | 0.0368 | 0.2366 | 0.0393 | 0.0091 | 0.0036 | 0.0075 | 0.0055 | 0.0098 | 0.2568 | 0.3120 |
| North Macedonia | 0.0036 | 0.0075 | 0.0013 | 0.0025 | 0.2091 | 0.1102 | 0.2732 | 0.5433 | 0.0000 | 0.0773 | 0.8540 | 0.0000 | 0.0015 | 0.0012 | 0.0011 | 0.0002 | 0.0002 | 0.0000 | 0.1790 |
| Norway | 0.0161 | 0.0638 | 0.0622 | 0.0038 | 0.0756 | 0.0504 | 0.1099 | 0.1115 | 0.0000 | 0.0107 | 0.0243 | 0.0000 | 0.0553 | 0.0155 | 0.0055 | 0.0627 | 0.0167 | 0.7176 | 0.6933 |
| Poland | 0.1452 | 0.5825 | 0.0020 | 0.0087 | 0.5050 | 0.2597 | 0.6425 | 0.3714 | 0.0226 | 0.1426 | 0.8542 | 0.0020 | 0.0302 | 0.0174 | 0.0053 | 0.0111 | 0.0135 | 0.3878 | 0.4691 |
| Portugal | 0.0136 | 0.0502 | 0.0066 | 0.0276 | 0.2327 | 0.0281 | 0.2869 | 0.0000 | 0.1146 | 0.0130 | 0.2373 | 0.0188 | 0.0612 | 0.0164 | 0.0114 | 0.0097 | 0.0039 | 0.4162 | 0.2751 |
| Romania | 0.0786 | 0.1978 | 0.0022 | 0.0034 | 0.3557 | 0.0702 | 0.5433 | 0.0000 | 0.0575 | 0.1010 | 0.2510 | 0.0004 | 0.0066 | 0.0108 | 0.0005 | 0.0024 | 0.0005 | 0.4037 | 0.5242 |
| Serbia | 0.0146 | 0.0295 | 0.1016 | 0.0050 | 0.3301 | 0.0980 | 0.2036 | 0.0000 | 0.0616 | 0.1170 | 0.0246 | 0.0006 | 0.0004 | 0.0010 | 0.0000 | 0.0016 | 0.0103 | 0.3631 | 0.1692 |
| The Slovak Republic | 0.0000 | 0.0000 | 0.0000 | 0.0042 | 0.5772 | 0.1765 | 0.4274 | 0.2692 | 0.0021 | 0.1235 | 0.5514 | 0.0000 | 0.0081 | 0.0039 | 0.0003 | 0.0015 | 0.0020 | 0.4737 | 0.7456 |
| Slovenia | 0.0084 | 0.0296 | 0.0059 | 0.0061 | 0.4655 | 0.2005 | 0.2799 | 0.4582 | 0.0532 | 0.0985 | 0.0390 | 0.0004 | 0.0024 | 0.0063 | 0.0002 | 0.0013 | 0.0024 | 0.4163 | 0.3908 |
| Spain | 0.0728 | 0.3135 | 0.0253 | 0.1441 | 0.2338 | 0.0650 | 0.2612 | 0.2116 | 0.0973 | 0.0078 | 0.2418 | 0.0107 | 0.2807 | 0.0819 | 0.0421 | 0.0000 | 0.0000 | 0.1892 | 0.4049 |
| Sweden | 0.0595 | 0.2658 | 0.0327 | 0.0199 | 0.2044 | 0.1031 | 0.3781 | 0.1823 | 0.2172 | 0.0655 | 0.0909 | 0.0117 | 0.0900 | 0.0156 | 0.0238 | 0.0569 | 0.0225 | 0.3277 | 0.7105 |
| Switzerland | 0.0196 | 0.1225 | 0.0129 | 0.0142 | 1.0000 | 0.3542 | 0.5440 | 0.1183 | 0.0968 | 0.0252 | 0.0000 | 0.0263 | 0.2232 | 0.0464 | 0.0311 | 0.0873 | 0.0231 | 0.1891 | 0.6471 |
| Türkiye | 0.0368 | 0.0644 | 0.0561 | 0.0210 | 0.0882 | 0.0935 | 0.1092 | 0.2239 | 0.1538 | 0.0200 | 0.4388 | 0.0182 | 0.0111 | 0.0171 | 0.0327 | 0.0279 | 0.0034 | 0.4239 | 0.3277 |
| The United Kingdom | 0.1202 | 0.2960 | 0.0641 | 0.0371 | 0.5124 | 0.3399 | 0.4270 | 0.2141 | 0.1066 | 0.0098 | 0.0678 | 0.0300 | 0.7436 | 0.0951 | 0.0906 | 0.6648 | 0.2042 | 0.1596 | 0.5911 |
| The United States | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 0.1566 | 0.1402 | 0.0230 | 0.3051 | 0.1253 | 0.2273 | 0.2975 | 0.0321 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 0.2197 | 0.5550 |
| Uzbekistan | 0.0178 | 0.0389 | 0.0259 | 0.0000 | 0.0667 | 0.0000 | 0.8606 | 1.0000 | 0.0935 | 0.4365 | 0.2532 | 0.0166 | 0.0572 | 0.0107 | 0.0020 | 0.0121 | 0.0163 | 1.0000 | 0.1822 |

*Note*: the 'n' sign before the indicator abbreviation means its normalized value; LR – Length of rail tracks; LeR – Length of electrified rail tracks; LRd – Length of roads; LrRd – Length of rural roads; RD - Rail density; RdD – Road density; RP – Rail passenger transport; RdP – Road passenger transport; AP – Air passenger transport; RF – Rail freight transport; RdF – Road freight transport; AF – Air freight transport; RI Rail investment spending; RdI – Road investment spending; AI – Air investment spending; RM – Rail maintenance spending; RdM – Road maintenance spending; TSE – Transport services export; MTV – Machinery and transport equipment value added.

**Table A2.** Normalized input data on transport and logistics development indicators in 2015

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 0.0002 | 0.0000 | 0.0006 | 0.0002 | 0.0000 | 0.0260 | 0.0000 | 0.5348 | 0.0000 | 0.0025 | 0.2520 | 0.0000 | 0.0000 | 0.0022 | 0.0000 | 0.0000 | 0.0000 | 0.1343 | 0.0466 |
| Australia | 0.1278 | 0.0806 | 0.1307 | 0.0273 | 0.4485 | 0.3171 | 0.2003 | 0.1948 | 0.1440 | 0.4746 | 0.1430 | 0.0149 | 0.2263 | 0.1285 | 0.0000 | 0.0919 | 0.0148 | 0.1586 | 0.3398 |
| Austria | 0.0361 | 0.1924 | 0.0189 | 0.0162 | 0.9018 | 1.0000 | 0.5209 | 0.0000 | 0.0970 | 0.0781 | 0.0204 | 0.0088 | 0.0987 | 0.0057 | 0.1210 | 0.0572 | 0.0098 | 0.4107 | 0.5944 |
| Azerbaijan | 0.0067 | 0.0294 | 0.0028 | 0.0438 | 0.0453 | 0.0285 | 0.1448 | 0.3546 | 0.0855 | 0.1683 | 0.2808 | 0.1232 | 0.0001 | 0.0109 | 0.2432 | 0.1750 | 0.1147 | 0.5812 | 0.2993 |
| Belgium | 0.0230 | 0.0000 | 0.0228 | 0.0166 | 0.9285 | 0.1414 | 0.3612 | 0.2089 | 0.0625 | 0.0180 | 0.0539 | 0.0305 | 0.0641 | 0.0097 | 0.0883 | 0.1208 | 0.0147 | 0.3588 | 0.3223 |
| Bulgaria | 0.0200 | 0.0888 | 0.0030 | 0.0069 | 0.1959 | 0.2658 | 0.4977 | 0.0000 | 0.0527 | 0.1032 | 0.6198 | 0.0003 | 0.0192 | 0.0105 | 0.0032 | 0.0000 | 0.0010 | 0.3551 | 0.3554 |
| Canada | 0.2445 | 0.0000 | 0.1700 | 0.0073 | 0.1402 | 0.0503 | 0.0042 | 0.0000 | 0.1297 | 0.3823 | 0.1554 | 0.0127 | 0.0679 | 0.0899 | 0.7325 | 0.0387 | 0.0064 | 0.2459 | 0.5465 |
| Croatia | 0.0141 | 0.0394 | 0.0040 | 0.0123 | 0.3942 | 0.3895 | 0.3013 | 0.4635 | 0.0893 | 0.0616 | 0.1832 | 0.0001 | 0.0039 | 0.0030 | 0.0982 | 0.5933 | 0.0557 | 0.1636 | 0.3518 |
| Czechia | 0.0590 | 0.1655 | 0.0195 | 0.0014 | 0.8341 | 0.1292 | 0.7232 | 0.3348 | 0.0452 | 0.1166 | 0.2910 | 0.0014 | 0.0743 | 0.0110 | 0.0253 | 0.0865 | 0.0060 | 0.4024 | 0.7998 |
| Estonia | 0.0070 | 0.0031 | 0.0088 | 0.0083 | 0.6526 | 0.4398 | 0.1996 | 0.0000 | 0.0563 | 0.1958 | 0.2517 | 0.0004 | 0.0008 | 0.0023 | 0.0000 | 0.0251 | 0.0018 | 0.5424 | 0.3741 |
| Finland | 0.0247 | 0.0969 | 0.0159 | 0.1091 | 0.1530 | 0.2812 | 0.2812 | 0.2487 | 0.1399 | 0.0516 | 0.0806 | 0.0290 | 0.0365 | 0.0181 | 0.0549 | 0.3182 | 0.1943 | 0.2455 | 0.5489 |
| France | 0.1934 | 0.8542 | 0.1625 | 0.1223 | 0.4235 | 0.1716 | 0.7041 | 0.2837 | 0.0671 | 0.0210 | 0.0374 | 0.0160 | 0.5608 | 0.1247 | 0.3561 | 0.2660 | 0.0473 | 0.2805 | 0.6864 |
| Georgia | 0.0081 | 0.0338 | 0.0031 | 0.0021 | 0.3006 | 0.2124 | 0.5061 | 0.3569 | 0.0391 | 0.4106 | 0.0199 | 0.0001 | 0.0056 | 0.0024 | 0.0076 | 0.0214 | 0.0037 | 0.5376 | 0.0709 |
| Germany | 0.2693 | 1.0000 | 0.0000 | 0.0000 | 0.2196 | 0.1834 | 0.4432 | 0.2373 | 0.0879 | 0.0496 | 0.0699 | 0.0198 | 0.4371 | 0.1424 | 0.5912 | 0.0294 | 0.0034 | 0.3471 | 0.9052 |
| Hungary | 0.0094 | 0.0978 | 0.0306 | 0.0177 | 0.2202 | 0.2656 | 1.0000 | 0.4558 | 0.4030 | 0.1149 | 0.2851 | 0.0000 | 0.0447 | 0.0155 | 0.0071 | 0.0279 | 0.0007 | 0.4095 | 0.8960 |
| Ireland | 0.0350 | 0.0035 | 0.0148 | 0.0086 | 0.8077 | 0.2206 | 0.0990 | 0.0000 | 1.0000 | 0.0000 | 0.0091 | 0.0045 | 0.0041 | 0.0076 | 0.0737 | 0.0000 | 0.0234 | 0.0926 | 0.0000 |
| Italy | 0.0081 | 0.4625 | 0.0387 | 0.0653 | 0.0380 | 0.0331 | 0.4622 | 0.3350 | 0.0392 | 0.0158 | 0.0393 | 0.0049 | 0.1824 | 0.0642 | 0.1029 | 0.1750 | 0.0273 | 0.2464 | 0.6036 |
| South Korea | 0.0928 | 0.0650 | 0.0161 | 0.0395 | 0.6793 | 0.8082 | 0.7648 | 0.2037 | 0.1135 | 0.0089 | 0.0664 | 0.0733 | 0.5476 | 0.1642 | 0.0577 | 0.0128 | 0.0204 | 0.5994 | 1.0000 |
| Latvia | 0.0336 | 0.0120 | 0.0087 | 0.0000 | 0.0000 | 0.0705 | 0.3500 | 0.0000 | 0.2333 | 1.0000 | 0.5204 | 0.0008 | 0.0133 | 0.0025 | 0.0292 | 0.1530 | 0.0418 | 0.7554 | 0.3317 |
| Lithuania | 0.0073 | 0.0058 | 0.0127 | 0.0029 | 0.0728 | 0.0507 | 0.1346 | 0.5209 | 0.0828 | 0.4882 | 0.6220 | 0.0001 | 0.0115 | 0.0032 | 0.0042 | 0.1058 | 0.0089 | 1.0000 | 0.2473 |
| Luxembourg | 0.0078 | 0.0141 | 0.0005 | 0.0015 | 0.4713 | 0.2685 | 0.1054 | 0.0000 | 0.0767 | 0.0045 | 0.0945 | 1.0000 | 0.0177 | 0.0028 | 0.0013 | 0.0247 | 0.0037 | 0.0913 | 0.3414 |
| Mexico | 0.0011 | 0.0000 | 0.0584 | 0.0909 | 0.2037 | 0.0306 | 0.0098 | 0.0000 | 0.1009 | 0.1014 | 0.1867 | 0.0058 | 0.0733 | 0.0535 | 0.3774 | 0.0019 | 0.0043 | 0.2813 | 0.6055 |
| Moldova | 0.1022 | 0.0000 | 0.0014 | 0.0000 | 0.5677 | 0.2319 | 0.3755 | 0.0000 | 0.3247 | 0.1777 | 0.5224 | 0.0006 | 0.0003 | 0.0006 | 0.0141 | 0.0201 | 0.0021 | 0.5745 | 0.1316 |
| Montenegro | 0.0032 | 0.0072 | 0.0013 | 0.0000 | 0.4500 | 0.1955 | 0.3218 | 0.0214 | 0.3271 | 0.0394 | 0.0099 | 0.0001 | 0.0000 | 0.0000 | 0.0021 | 0.1221 | 0.0254 | 0.2990 | 0.2486 |
| The Netherlands | 0.0000 | 0.1026 | 0.0204 | 0.0257 | 0.2316 | 0.0651 | 0.3328 | 0.0000 | 0.1173 | 0.0119 | 0.0300 | 0.0658 | 0.0897 | 0.0604 | 0.1017 | 0.1005 | 0.0582 | 0.3118 | 0.5990 |
| New Zealand | 0.0187 | 0.0190 | 0.0142 | 0.0019 | 0.1959 | 0.1034 | 0.0336 | 0.2027 | 0.2033 | 0.0348 | 0.1061 | 0.0618 | 0.0195 | 0.0129 | 0.0797 | 0.0318 | 0.0051 | 0.2172 | 0.3071 |

Problems and Perspectives in Management, Volume 23, Issue 1, 2025

http://dx.doi.org/10.21511/ppm.23(1).2025.45

http://dx.doi.org/10.15511/ppm.23(1).2025.45

**Table A2 (cont.).** Normalized input data on transport and logistics development indicators in 2015

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North Macedonia | 0.0136 | 0.0078 | 0.0022 | 0.0024 | 1.0000 | 0.3547 | 0.2837 | 0.7271 | 0.0000 | 0.0394 | 1.0000 | 0.0000 | 0.0004 | 0.0021 | 0.0004 | 1.0000 | 0.1655 | 0.0000 | 0.4062 |
| Norway | 0.0023 | 0.0648 | 0.0143 | 0.0045 | 0.0918 | 0.0608 | 0.1400 | 0.1399 | 0.0000 | 0.0130 | 0.0264 | 0.0000 | 0.0817 | 0.0443 | 0.1845 | 0.0000 | 1.0000 | 0.7367 | 0.7096 |
| Poland | 0.0148 | 0.5941 | 0.0630 | 0.0147 | 0.5045 | 0.3414 | 0.5947 | 0.3943 | 0.0235 | 0.1525 | 0.5544 | 0.0023 | 0.0217 | 0.0270 | 0.2104 | 0.0000 | 0.0002 | 0.4363 | 0.4731 |
| Portugal | 0.1442 | 0.0557 | 0.0021 | 0.0289 | 0.1180 | 0.1432 | 0.3196 | 0.0000 | 0.1604 | 0.0188 | 0.1401 | 0.0164 | 0.0113 | 0.0026 | 0.0556 | 0.0061 | 0.0007 | 0.3892 | 0.3184 |
| Romania | 0.0113 | 0.2033 | 0.0129 | 0.0070 | 0.0969 | 0.0292 | 0.4708 | 0.0000 | 0.0514 | 0.1104 | 0.1970 | 0.0003 | 0.0205 | 0.0358 | 0.0269 | 0.0060 | 0.0030 | 0.5332 | 0.6800 |
| Serbia | 0.0768 | 0.0572 | 0.0068 | 0.0065 | 0.1824 | 0.0451 | 0.2031 | 0.0000 | 0.1540 | 0.1177 | 0.0508 | 0.0008 | 0.0053 | 0.0063 | 0.0001 | 0.0186 | 0.0053 | 0.4004 | 0.2924 |
| The Slovak Republic | 0.0196 | 0.0000 | 0.0066 | 0.0044 | 0.2742 | 0.0358 | 0.6274 | 0.2915 | 0.0003 | 0.1365 | 0.3567 | 0.0000 | 0.0188 | 0.0141 | 0.0029 | 0.0040 | 0.0003 | 0.4879 | 0.8293 |
| Slovenia | 0.0072 | 0.0307 | 0.0058 | 0.0057 | 0.3469 | 0.0935 | 0.2631 | 0.4722 | 0.0610 | 0.1393 | 0.0235 | 0.0002 | 0.0240 | 0.0018 | 0.0007 | 0.0000 | 0.0009 | 0.4720 | 0.3959 |
| Spain | 0.0805 | 0.3681 | 0.0248 | 0.1443 | 0.1552 | 0.0548 | 0.3530 | 0.2404 | 0.1274 | 0.0126 | 0.1521 | 0.0082 | 0.1798 | 0.0531 | 0.2038 | 0.0000 | 0.0000 | 0.1943 | 0.4892 |
| Sweden | 0.0584 | 0.2896 | 0.0322 | 0.0199 | 0.2588 | 0.0558 | 0.4060 | 0.1914 | 0.2922 | 0.0586 | 0.0581 | 0.0112 | 0.1039 | 0.0232 | 0.0913 | 0.0010 | 0.0002 | 0.2923 | 0.7161 |
| Switzerland | 0.0189 | 0.1265 | 0.0127 | 0.0135 | 0.1327 | 0.1256 | 0.4779 | 0.1129 | 0.0979 | 0.0254 | 0.0000 | 0.0193 | 0.2673 | 0.0532 | 0.1485 | 0.0000 | 0.0000 | 0.1801 | 0.6638 |
| Türkiye | 0.0380 | 0.0816 | 0.0357 | 0.0215 | 0.1982 | 0.1127 | 0.1499 | 0.2657 | 0.2813 | 0.0170 | 0.2611 | 0.0317 | 0.0783 | 0.1129 | 1.0000 | 0.0016 | 0.0035 | 0.5457 | 0.3802 |
| The United Kingdom | 0.1222 | 0.3168 | 0.0630 | 0.0355 | 0.3490 | 0.0732 | 0.4205 | 0.1942 | 0.1128 | 0.0090 | 0.0273 | 0.0176 | 0.9349 | 0.1130 | 0.0000 | 0.0119 | 0.0116 | 0.1615 | 0.6739 |
| The United States | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 0.3241 | 0.1023 | 0.0228 | 0.2774 | 0.1103 | 0.2017 | 0.1362 | 0.0198 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.1908 | 0.5918 |
| Uzbekistan | 0.0167 | 0.0402 | 0.0000 | 0.0000 | 0.0647 | 0.0000 | 0.7143 | 1.0000 | 0.0726 | 0.3834 | 0.1247 | 0.0126 | 0.0239 | 0.0078 | 0.0180 | 0.0000 | 0.0000 | 0.9900 | 0.1772 |

*Note*: the 'n' sign before the indicator abbreviation means its normalized value; LR – Length of rail tracks; LeR – Length of electrified rail tracks; LRd – Length of roads; LrRd – Length of rural roads; RD - Rail density; RdD – Road density; RP – Rail passenger transport; RdP – Road passenger transport; AP – Air passenger transport; RF – Rail freight transport; RdF – Road freight transport; AF – Air freight transport; RI Rail investment spending; RdI – Road investment spending; AI – Air investment spending; RM – Rail maintenance spending; RdM – Road maintenance spending; TSE – Transport services export; MTV – Machinery and transport equipment value added.

**Table A3.** Normalized input data on transport and logistics development indicators in 2022

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 0.0000 | 0.0000 | 0.0005 | 0.0002 | 0.0000 | 0.0262 | 0.0000 | 0.3602 | 0.0734 | 0.0027 | 0.2389 | 0.0000 | 0.0013 | 0.0018 | 0.0005 | 0.0000 | 0.0000 | 0.1941 | 0.0570 |
| Australia | 0.1282 | 0.0829 | 0.1297 | 0.0268 | 0.4301 | 0.3046 | 0.0837 | 0.0878 | 0.1070 | 0.7324 | 0.1186 | 0.0079 | 0.5839 | 0.1456 | 0.0000 | 0.0855 | 0.0194 | 0.1328 | 0.4063 |
| Austria | 0.0376 | 0.1793 | 0.0190 | 0.0162 | 0.8873 | 1.0000 | 0.4511 | 0.0000 | 0.2678 | 0.1198 | 0.0184 | 0.0026 | 0.1903 | 0.0041 | 0.1475 | 0.0437 | 0.0096 | 0.4849 | 0.6184 |
| Azerbaijan | 0.0076 | 0.0267 | 0.0028 | 0.0444 | 0.0472 | 0.0285 | 0.0402 | 0.1427 | 0.1369 | 0.2298 | 0.1234 | 0.0093 | 0.0000 | 0.0210 | 0.0421 | 0.1223 | 0.0846 | 1.0000 | 0.1255 |
| Belgium | 0.0240 | 0.0000 | 0.0226 | 0.0163 | 0.8997 | 0.1417 | 0.2751 | 0.1335 | 0.0619 | 0.0326 | 0.0376 | 0.0306 | 0.0855 | 0.0117 | 0.0814 | 0.1016 | 0.0185 | 0.4132 | 0.3124 |
| Bulgaria | 0.0206 | 0.0890 | 0.0030 | 0.0076 | 0.1958 | 0.4095 | 0.2963 | 0.0000 | 0.0033 | 0.1499 | 0.3539 | 0.0000 | 0.0165 | 0.0036 | 0.0000 | 0.0000 | 0.0008 | 0.3632 | 0.4577 |
| Canada | 0.2621 | 0.0000 | 0.1686 | 0.0126 | 0.1372 | 0.0502 | 0.0089 | 0.0000 | 0.0849 | 0.4839 | 0.1275 | 0.0161 | 0.1027 | 0.0674 | 0.9982 | 0.0418 | 0.0073 | 0.2002 | 0.4355 |
| Croatia | 0.0146 | 0.0378 | 0.0039 | 0.0124 | 0.3691 | 0.3930 | 0.1886 | 0.2028 | 0.0758 | 0.1267 | 0.1621 | 0.0000 | 0.0106 | 0.0042 | 0.0067 | 0.5484 | 0.0504 | 0.1371 | 0.2687 |
| Czechia | 0.0592 | 0.1597 | 0.0194 | 0.0021 | 0.8151 | 0.1288 | 0.5380 | 0.1837 | 0.0343 | 0.1434 | 0.1939 | 0.0000 | 0.1307 | 0.0174 | 0.0296 | 0.1149 | 0.0083 | 0.4629 | 0.7298 |
| Estonia | 0.0077 | 0.0054 | 0.0133 | 0.0088 | 0.6139 | 0.4686 | 0.1646 | 0.0000 | 0.0002 | 0.0861 | 0.0927 | 0.0000 | 0.0075 | 0.0022 | 0.0034 | 0.0372 | 0.0009 | 0.4660 | 0.3648 |
| Finland | 0.0256 | 0.0977 | 0.0116 | 0.1086 | 0.1708 | 0.2934 | 0.2676 | 0.1249 | 0.0644 | 0.0803 | 0.0830 | 0.0252 | 0.0417 | 0.0150 | 0.0788 | 0.7464 | 0.1792 | 0.2498 | 0.6330 |
| France | 0.1923 | 0.8050 | 0.1635 | 0.1217 | 0.4299 | 0.1560 | 0.6966 | 0.1660 | 0.0736 | 0.0323 | 0.0372 | 0.0138 | 0.8727 | 0.0943 | 0.4237 | 0.2381 | 0.0475 | 0.4396 | 0.6374 |
| Georgia | 0.0086 | 0.0545 | 0.0032 | 0.0022 | 0.3222 | 0.2276 | 0.3226 | 0.1633 | 0.0309 | 0.4343 | 0.0080 | 0.0001 | 0.0032 | 0.0040 | 0.0155 | 0.0124 | 0.0051 | 0.3891 | 0.0469 |
| Germany | 0.2748 | 1.0000 | 0.0000 | 0.0000 | 0.2152 | 0.1809 | 0.2219 | 0.1045 | 0.0529 | 0.0784 | 0.0506 | 0.0270 | 0.7748 | 0.1479 | 1.0000 | 0.0235 | 0.0038 | 0.4804 | 0.8346 |
| Hungary | 0.0098 | 0.1329 | 0.0324 | 0.0173 | 0.2209 | 0.2655 | 0.7192 | 0.2647 | 0.7517 | 0.1618 | 0.1781 | 0.0000 | 0.0544 | 0.0139 | 0.0500 | 0.0265 | 0.0008 | 0.5267 | 0.6648 |
| Ireland | 0.0448 | 0.0025 | 0.0153 | 0.0092 | 0.7804 | 0.2213 | 0.0540 | 0.0000 | 1.0000 | 0.0004 | 0.0021 | 0.0017 | 0.0160 | 0.0050 | 0.1441 | 0.0000 | 0.0228 | 0.0412 | 0.0000 |
| Italy | 0.0087 | 0.4576 | 0.0354 | 0.0699 | 0.0469 | 0.0840 | 0.3803 | 0.1830 | 0.0079 | 0.0308 | 0.0511 | 0.0054 | 0.8414 | 0.0552 | 0.6788 | 0.1432 | 0.0558 | 0.2198 | 0.5955 |
| South Korea | 0.0957 | 0.0759 | 0.0170 | 0.0456 | 0.6668 | 0.8224 | 1.0000 | 0.1048 | 0.1279 | 0.0093 | 0.0531 | 0.0845 | 0.4721 | 0.1179 | 0.3883 | 0.0150 | 0.0241 | 0.6717 | 1.0000 |
| Latvia | 0.0382 | 0.0116 | 0.0086 | 0.0000 | 0.0000 | 0.0724 | 0.2160 | 0.0000 | 0.2739 | 0.4589 | 0.3152 | 0.0006 | 0.0129 | 0.0018 | 0.0076 | 0.1149 | 0.0374 | 0.5887 | 0.1535 |
| Lithuania | 0.0079 | 0.0102 | 0.0125 | 0.0037 | 0.0704 | 0.0512 | 0.1009 | 0.3237 | 0.0012 | 0.2672 | 0.7034 | 0.0005 | 0.0116 | 0.0031 | 0.0076 | 0.1584 | 0.0105 | 0.9988 | 0.3300 |
| Luxembourg | 0.0128 | 0.0137 | 0.0004 | 0.0015 | 0.4635 | 0.2753 | 0.0774 | 0.0000 | 0.0861 | 0.0052 | 0.0821 | 1.0000 | 0.0200 | 0.0022 | 0.0042 | 0.0195 | 0.0033 | 0.2410 | 0.3193 |
| Mexico | 0.0017 | 0.0000 | 0.0597 | 0.1024 | 0.1980 | 0.0306 | 0.0056 | 0.0000 | 0.2900 | 0.0000 | 0.1661 | 0.0075 | 0.0414 | 0.0219 | 0.4903 | 0.0026 | 0.0067 | 0.2921 | 0.6456 |
| Moldova | 0.1050 | 0.0000 | 0.0014 | 0.0000 | 0.5567 | 0.2355 | 0.0361 | 0.0000 | 0.2628 | 0.2162 | 0.4161 | 0.0004 | 0.0000 | 0.0011 | 0.0018 | 0.0172 | 0.0026 | 0.4081 | 0.2759 |
| Montenegro | 0.0070 | 0.0070 | 0.0015 | 0.0000 | 0.4406 | 0.2132 | 0.2029 | 0.0125 | 0.0018 | 0.0887 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0002 | 0.1148 | 0.0232 | 0.5911 | 0.2053 |
| The Netherlands | 0.0005 | 0.0975 | 0.0210 | 0.0258 | 0.2336 | 0.0649 | 0.2836 | 0.0000 | 0.1302 | 0.0185 | 0.0220 | 0.0428 | 0.1062 | 0.0659 | 0.4216 | 0.0900 | 0.0521 | 0.3475 | 0.7198 |

http://dx.doi.org/10.21511/ppm.23(1).2025.45

http://dx.doi.org/10.21511/ppm.23(1).2025.45

**Table A3 (cont.).** Normalized input data on transport and logistics development indicators in 2022

| Country | nLR | nLeR | nLRd | nLrRd | nRD | nRdD | nRP | nRdP | nAP | nRF | nRdF | nAF | nRI | nRdI | nAI | nRM | nRdM | nTSE | nMTV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Zealand | 0.0196 | 0.0186 | 0.0144 | 0.0025 | 0.1921 | 0.0962 | 0.0471 | 0.1117 | 0.2325 | 0.0443 | 0.0856 | 0.0124 | 0.0157 | 0.0073 | 0.2175 | 0.0259 | 0.0070 | 0.2537 | 0.3953 |
| North Macedonia | 0.0148 | 0.0075 | 0.0023 | 0.0031 | 1.0000 | 0.4198 | 0.0553 | 0.4685 | 0.0000 | 0.0538 | 1.0000 | 0.0000 | 0.0021 | 0.0017 | 0.0094 | 1.0000 | 0.1283 | 0.0000 | 0.4675 |
| Norway | 0.0028 | 0.0650 | 0.0142 | 0.0054 | 0.0949 | 0.0652 | 0.0864 | 0.0573 | 0.0000 | 0.0187 | 0.0185 | 0.0000 | 0.1268 | 0.0307 | 0.1965 | 0.0000 | 1.0000 | 0.8153 | 0.4816 |
| Poland | 0.0159 | 0.5822 | 0.0637 | 0.0167 | 0.4926 | 0.3437 | 0.5694 | 0.2036 | 0.0368 | 0.2196 | 0.5395 | 0.0032 | 0.0648 | 0.0272 | 0.0750 | 0.0000 | 0.0005 | 0.5380 | 0.4155 |
| Portugal | 0.1477 | 0.0574 | 0.0021 | 0.0288 | 0.1129 | 0.1438 | 0.2883 | 0.0000 | 0.2159 | 0.0269 | 0.0995 | 0.0196 | 0.0356 | 0.0019 | 0.0458 | 0.0047 | 0.0012 | 0.3800 | 0.3369 |
| Romania | 0.0119 | 0.1961 | 0.0128 | 0.0088 | 0.0525 | 0.0258 | 0.3868 | 0.0000 | 0.0649 | 0.1351 | 0.2100 | 0.0001 | 0.0138 | 0.0195 | 0.0016 | 0.0050 | 0.0066 | 0.5029 | 0.6574 |
| Serbia | 0.0764 | 0.0557 | 0.0068 | 0.0087 | 0.1851 | 0.0454 | 0.1100 | 0.0000 | 0.1377 | 0.1124 | 0.1232 | 0.0022 | 0.0206 | 0.0095 | 0.0052 | 0.0145 | 0.0050 | 0.3233 | 0.2842 |
| The Slovak Republic | 0.0188 | 0.0000 | 0.0068 | 0.0080 | 0.2696 | 0.0360 | 0.4777 | 0.1752 | 0.0005 | 0.1824 | 0.2375 | 0.0000 | 0.0175 | 0.0103 | 0.0042 | 0.0028 | 0.0005 | 0.7378 | 0.5665 |
| Slovenia | 0.0077 | 0.0336 | 0.0057 | 0.0057 | 0.3418 | 0.0925 | 0.2208 | 0.3180 | 0.0023 | 0.2022 | 0.0190 | 0.0001 | 0.0308 | 0.0038 | 0.0025 | 0.0000 | 0.0010 | 0.5629 | 0.3844 |
| Spain | 0.0885 | 0.3884 | 0.0246 | 0.1465 | 0.1408 | 0.0584 | 0.2011 | 0.1299 | 0.2072 | 0.0184 | 0.1605 | 0.0059 | 0.2359 | 0.0406 | 0.7712 | 0.0000 | 0.0000 | 0.2308 | 0.4481 |
| Sweden | 0.0603 | 0.2804 | 0.0297 | 0.0203 | 0.2531 | 0.0564 | 0.3614 | 0.0950 | 0.2145 | 0.1007 | 0.0572 | 0.0054 | 0.1749 | 0.0259 | 0.1754 | 0.0007 | 0.0002 | 0.2306 | 0.7287 |
| Switzerland | 0.0201 | 0.1224 | 0.0126 | 0.0143 | 0.1305 | 0.1421 | 0.3937 | 0.0659 | 0.0934 | 0.0383 | 0.0006 | 0.0153 | 0.2877 | 0.0439 | 0.2307 | 0.0000 | 0.0000 | 0.2601 | 0.6215 |
| Türkiye | 0.0411 | 0.1291 | 0.0384 | 0.0336 | 0.1942 | 0.1145 | 0.3588 | 0.2045 | 0.5740 | 0.0455 | 0.3175 | 0.1135 | 0.1643 | 0.0379 | 0.2936 | 0.0013 | 0.0082 | 0.6947 | 0.4217 |
| The United Kingdom | 0.1246 | 0.3362 | 0.0624 | 0.0357 | 0.3371 | 0.0734 | 0.2737 | 0.0995 | 0.0581 | 0.0132 | 0.0304 | 0.0131 | 1.0000 | 0.0861 | 0.0000 | 0.0087 | 0.0144 | 0.1267 | 0.6088 |
| The United States | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 0.2792 | 0.1006 | 0.0133 | 0.1408 | 0.1945 | 0.2241 | 0.1064 | 0.0196 | 0.6505 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.1827 | 0.5057 |
| Uzbekistan | 0.0178 | 0.0445 | 0.0000 | 0.0000 | 0.0717 | 0.0000 | 0.4915 | 1.0000 | 0.1967 | 1.0000 | 0.2350 | 0.0054 | 0.0335 | 0.0078 | 0.0128 | 0.0000 | 0.0000 | 0.5639 | 0.1478 |

*Note*: the 'n' sign before the indicator abbreviation means its normalized value; LR – Length of rail tracks; LeR – Length of electrified rail tracks; LRd – Length of roads; LrRd – Length of rural roads; RD - Rail density; RdD – Road density; RP – Rail passenger transport; RdP – Road passenger transport; AP – Air passenger transport; RF – Rail freight transport; RdF – Road freight transport; AF – Air freight transport; RI Rail investment spending; RdI – Road investment spending; AI – Air investment spending; RM – Rail maintenance spending; RdM – Road maintenance spending; TSE – Transport services export; MTV – Machinery and transport equipment value added.