

Measuring the Environmental Impact of ICT Usage in Azerbaijan's Transport Sector

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Abstract - The main purpose of presented study is to evaluate the environmental impact of ICT use in the transport sector of Azerbaijan, analyze the level of ICT usage in this sector, and provide relevant suggestions and recommendations to address existing shortcomings. The transport sector plays a crucial role in the economy, prompting each country to pay more attention to its development. However, according to many studies, transport is one of the sectors that negatively impacts the environment. Countries focus not only on economic development but also on environmental protection. One of the key factors influencing environmental protection is the increased use of contemporary technologies across all sectors of the economy. The article presents econometric assessments showing that ICT usage in Azerbaijan's transport sector has a positive impact on environmental indicators at the national level. The studies conducted indicate that the level of ICT usage in the transport sector in Azerbaijan is relatively low compared to other countries. Relevant recommendations have been provided to address this deficiency.

Keywords: Transport, Environmental Issues, ICT, Econometric Evaluation

I. INTRODUCTION

The rapid development of the world economy, along with many positive results, also has some negative effects. One of such negative effects is the increase in environmental problems and the increase in emissions such as CO₂. Environmental issues are one of the main areas of attention of countries around the world at the present time. Environmental pollution negatively affects the economy in many ways. Thus, environmental pollution leads to an increase in health care expenditures, as well as household and government expenditures. In addition, an increase in environmental emissions can reduce workers' productivity. Healthy employees can work more actively and productively. Increasing efficiency in energy consumption in order to protect the environment leads to a decrease in costs for firms and the economy as a whole.

One of the sectors that has a major share in the increase in CO₂ emissions in the world is transport. The transport sector,

as one of the important economic sectors, has an important role in meeting the needs of various markets. In previous economic studies, the transport sector was considered an intermediary sector in meeting basic needs, but in the current period, every country in the world is trying to benefit more from the existing opportunities in a seriously competitive environment. The priority of the transport sector is noticeable in reducing production costs, facilitating access to markets, and gaining a competitive advantage. However, along with all these benefits, the transport sector is considered the main source of global CO₂ emissions and one of the main factors of global warming. The transport sector accounts for 21% of global carbon emissions. In order to reduce CO₂ emissions in the transport sector, many modern ICT devices are used. Examples of such innovative devices include on-vehicle and in-house systems. At the same time, the application of some Internet devices (e-tickets, software systems, electronic marketplaces, electronic reservation, and smart transport systems) is increasingly used.

II. PROBLEM STATEMENT

Many empirical studies have been conducted on the impact of ICT adoption in firms on the economy. A study conducted across 51 countries shows that ICT has a positive impact on economic growth [1]. The positive impact of ICT adoption by firms on their income, productivity and resource efficiency has been noted in many studies. For example, an empirical study using a panel method across 18 OECD countries found that broadband internet usage by firms has a positive impact on their productivity [2]. ICT adoption by firms, especially those operating in the transport sector, leads to a relative reduction in environmental problems in the economy. Despite the significant impact of ICT adoption in increasing cost efficiency and reducing pollution, there has been little research on increasing ICT use in the transport sector in order to reduce CO₂ emissions in countries [3]. It should be noted that a number of developed countries have reached a level of ICT development that is already capable of preventing pollution [4]. A study conducted in 42 countries covering the years 2000-2012 concluded that ICT leads to a decrease in CO₂ emissions in the field of energy consumption.

ICT leads to economic growth and structural change, the development of technologies, and the strengthening of environmental legislation. This ultimately creates conditions for the creation of less waste by positively affecting environmental issues [5].

A study covering 23 European Union countries based on statistical data from 2001 to 2014 concluded that new technologies have a positive impact on reducing environmental pollution and that ICT can stimulate a reduction in carbon emissions in the long term [6]. ICT leads to a reduction in environmental emissions. Thus, ICT usage has a positive impact on reducing energy consumption and, consequently, on reducing carbon emissions [7]. In a study covering 75 countries from 2000 to 2014, countries were divided into three categories according to their income level. This study observed that freight transport is a strong polluter in high-income countries. However, a negative impact was reported in low- and middle-income countries [8]. In both developed and developing countries, many vehicles use fuels such as gasoline and diesel. The use of such fuels causes a large amount of carbon emissions into the atmosphere and, as a result, environmental pollution. In such a situation, the transformation of people from private vehicles to public vehicles as a result of the establishment of an efficient transport system can lead to a decrease in carbon emissions in the transport sector [9]. In another study, the negative impact of road freight transport of smartphones on the environment was studied in the case of China. Using many interviews and other assessment methods, it was concluded that freight applications have a positive effect on the identification of adequate trucks, strengthening the delivery process and traffic management, and ultimately leading to a decrease in CO₂ emissions by increasing efficiency in fuel consumption [10]. It was also emphasized that the use of smart transport, which benefits from modern technologies, directly and indirectly stimulates the reduction of CO₂ emissions [11]. As a result of a study covering the years 1980-2019 in 24 OECD countries, it was noted that ICT leads to a strengthening of environmental sustainability [12].

III. THE MAIN PART

The transport sector plays an important role in the economy today. The efficiency of the transport sector is a key component of economic development. The efficient operation of the transport system plays an important role in effectively accessing markets, increasing employment, and attracting additional investments. Transport is the basis of trade infrastructure, it ensures an increase in the competitiveness of economic sectors. The transport sector also stimulates the development of foreign trade.

The development of transport infrastructure is considered the main infrastructure for economic growth [13]. Transport infrastructure directly supports production and processing activities in the economy. According to a number of studies, transport has a positive impact on economic growth in the following ways: it increases labor and capital productivity [14]; it saves costs as a result of increasing transport efficiency [15]; it changes aggregate demand in the market [14]. A study conducted on the multiplicative effects of investment in the transport sector of Azerbaijan on the economy concluded that one million manats of investment in transport creates 1.5 million manats of demand across the country due to production links [16].

Azerbaijan has achieved success in many areas since the early days of independence, and has also made some progress in the transport sector. Thus, the share of total output in the transport sector in GDP has increased from 6% to 8% [18]. However, as noted, the transport sector plays an important role in the generation of CO₂ emissions in countries of the world and in our republic. The table below shows the share of CO₂ in the world by economic sectors.

TABLE I. SHARE OF WORLD'S CO₂ EMISSIONS BY SECTOR [17]

2022	Global CO ₂ emissions by sector (million tons)	Share of total
Power industry	14669.3	38%
Agriculture	150.6	0%
Industrial combustion	6537.5	17%
Transport	7967.6	21%
Buildings	3421.6	9%
Fuel Exploitation	2531.9	7%
Waste	17.2	0%
Processes	3226.3	8%

Table I shows that the power industry has the highest share of CO₂ emissions by sector at the global level (38%). The transport sector has the second-largest share in this ranking with 21%. When we look at the statistical figures for Azerbaijan, we witness approximately the same picture. The table below shows the volume of CO₂ emissions in Azerbaijan in 2022 and its share by economic sectors (Table II).

TABLE II. INTERNET USAGE IN SOME OECD COUNTRIES AND AZERBAIJAN, [11], [12]

2022	Azerbaijan's CO ₂ emissions by year and sectors (thousand tons)	Share of total
Power industry	11983.5	32%
Agriculture	273.2	1%
Industrial combustion	3316.8	8%
Transport	8393.3	23%
Buildings	9281.9	25%
Fuel exploitation	2096.3	6%
Waste	2.4	0%
Processes	1782.2	5%

Table II shows that the largest share of CO₂ emissions among sectors in Azerbaijan belongs to the power industry sector (32%). The second-largest share of this ranking, with 25%, belongs to the building sector, and the third-largest share belongs to the transport sector with 23%. Looking at the statistical figures by year, we can see that CO₂ in Azerbaijan has increased both in terms of volume and per capita (Table III).

TABLE III. VOLUME OF CO₂ IN AZERBAIJAN FOR 2000-2022 [17]

Year	Fossil CO ₂ emissions (thousand tons)	CO ₂ emissions per capita	Share of World's CO ₂ emissions
2000	27 900.0	3.41	0.11%
2005	30 339.2	3.53	0.10%
2010	24 543.3	2.68	0.073%
2015	32 466.7	3.33	0.090%
2018	33 569.7	3.34	0.089%
2021	37 187.1	3.63	0.098%
2022	37 129.6	3.61	0.096%

Table III shows that from 2000 to 2022, we can observe an increase in CO₂ in Azerbaijan in terms of volume. Thus, while in 2000 this figure was 27,900 thousand tons, in 2022 it increased to 37,129.6 thousand tons. This can also be attributed to the high economic growth of our country in recent years, and it should be noted that the main part of this increase was provided by the transport sector. At the same time, when we look at the volume of CO₂ in the transport sector of Azerbaijan, a very large increase can be noted (Table IV).

TABLE IV. VOLUME OF CO₂ IN THE TRANSPORT SECTOR IN AZERBAIJAN IN 2000-2022 [17]

Year	Transport sector's Fossil CO ₂ emissions (thousand tons)	Share of total CO ₂ emissions
2000	2 359.8	8%
2005	4 212.8	14%
2010	4 951.7	20%
2015	6 799.5	21%
2018	8 408.1	25%
2021	7 779.9	21%
2022	8 393.3	23%

As can be seen from Table IV, the volume of CO₂ generated by the transport sector has increased significantly in the years 2000-2022. Thus, while the volume of CO₂ emissions from the transport sector of Azerbaijan in 2000 was 2359.8 thousand tons, in 2022 this figure increased to 8393.3 thousand tons. For this reason, we believe that in order to reduce the volume of CO₂ emissions from the transport sector, it would be appropriate to increase the ICT adoption of this sector. Econometric modeling was used to assess the impact of the level of ICT use by firms in the transport sector of Azerbaijan on the volume of CO₂ emissions generated in the transport sector.

For the purpose of carrying out econometric evaluation, the statistical figures listed in Table 5 were used for various variables using international and Azerbaijani official statistical databases. Here, trans_CO₂_emis - Azerbaijan's transport sector CO₂ emissions (tons), trans_com - Share of enterprises using computers in transport among enterprises in the sector (in %), trans_intern - Share of enterprises using the Internet in transport among enterprises in the sector (in %), invest_transp - Investment in fixed capital, a million manats, trans_turn_ton - Turnover of goods in transport sector (thousand tonnes).

TABLE V. DATABASE USED FOR THE PURPOSE OF CONDUCTING AN ECONOMETRIC EVALUATION [17,18]

Year	Transp_CO ₂ _emis	Trans_com	Trans_intern	Invest_transp	Trans_turn_ton
2005	-	29.5	6	516	128328
2006	3778290	35.3	9.6	629	145596
2007	4772560	29.5	16.8	748	167533
2008	4248430	22.6	13	1986	183093
2009	4951700	22.5	13.4	1706	190372
2010	5796700	50.2	30.4	2435	196452
2011	6401740	61.3	42.8	2509	203586
2012	7293110	62.4	44.6	2610	210862
2013	7552160	62.7	45.8	3560	217926
2014	6799500	67.4	53.2	2432	221991
2015	6338640	67.5	54.3	2195	222373
2016	7607510	68.8	54.5	1391	222461
2017	8408070	69.6	56.3	1774	226419
2018	8303630	70.5	57.1	1923	230144
2019	6815170	62.6	58.2	2189	235288
2020	7779940	64.2	59.5	2092	188629
2021	8393300	64.4	59.7	2857	193903
2022	-	64.7	59.9	4613	218716
2023	-	65.3	61	5417	229897

Descriptive stats of variables are given in the table below.

TABLE VI. DESCRIPTIVE STATS OF VARIABLES

Year	Transp_CO ₂ _emis	Trans_com	Trans_intern	Invest_transp	Trans_turn_ton
Mean	6577528.	55.09375	41.82500	2064.750	203539.3
Median	6807335.	62.65000	49.50000	2140.500	207224.0
Maximum	8408070.	70.50000	59.70000	3560.000	235288.0
Minimum	3778290.	22.50000	9.600000	629.0000	145596.0
Std. Dev.	1495795.	17.33130	18.70317	737.1961	24716.78
Skewness	-0.490282	-1.024502	-0.734451	-0.245425	-0.778351
Kurtosis	2.047900	2.391520	1.899038	3.140419	2.938997
Jarque-Bera	1.245333	3.045778	2.246528	0.173768	1.618027
Probability	0.536512	0.218081	0.325217	0.916783	0.445297
Sum	1.05E+08	881.5000	669.2000	33036.00	3256628.
Sum Sq. Dev.	3.36E+13	4505.609	5247.130	8151871.	9.16E+09
Observations	16	16	16	16	16

To make an econometric assessment, first, a specification equation was formed in the following form to calculate the elasticity coefficient of the impact of the proportion of firms using computers in the transport sector on the volume of CO₂ in the transport sector of Azerbaijan (1).

$$\begin{aligned} \text{LOG}(\text{TRANSP_CO2_EMIS}) &= C(1) + \\ &C(2)*\text{LOG}(\text{TRANS_COMP}(-4)) + \\ &C(3)*\text{LOG}(\text{INVEST_TRANSP}(-1)) + \\ &C(4)*\text{LOG}(\text{TRANS_TURN_TON}(-2)) + \\ &C(5)*\text{LOG}(\text{TRANSP_CO2_EMIS}(-1)) + \\ &C(6)*\text{DUMMY2015} + C(7)*\text{DUMMY2019} \end{aligned} \quad (1)$$

The formed equation was evaluated in the EViews application package, and the answer was obtained in the following form (2).

$$\begin{aligned} \text{LOG}(\text{TRANSP_CO2_EMIS}) &= -5.68103578905 - \\ &0.167144168711*\text{LOG}(\text{TRANS_COMP}(-4)) - \\ &0.167995643771*\text{LOG}(\text{INVEST_TRANSP}(-1)) + \\ &1.58789347657*\text{LOG}(\text{TRANS_TURN_TON}(-2)) + \\ &0.251426375659*\text{LOG}(\text{TRANSP_CO2_EMIS}(-1)) \end{aligned}$$

$$1)) - 0.132863141742 * \text{DUMMY2015} - 0.194676253873 * \text{DUMMY2019} \quad (2)$$

According to the results, the level of computer usage of transport firms has a positive effect on the reduction of CO₂ in the transport sector. That is, with a four-year lag, if the share of firms operating in the transport sector in the total number of firms in the transport sector increases by 1%, the volume of CO₂ in transport decreases by 0.17%. In addition, with a one-year lag, if investment in fixed capital in the transport sector increases by 1%, the volume of CO₂ in transport decreases by 0.17%, and the increase in freight transport leads to an increase in the volume of CO₂ in transport (model 2). According to Table 7, the elasticity coefficients of all variables are statistically significant at the 1% level.

TABLE VII. STATISTICAL CHARACTERISTICS OF MODEL (2)

Dependent Variable: LOG(TRANSP CO2 EMIS)				
Method: Least Squares				
Included observations: 13 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.681036	1.460820	-3.888936	0.0081
LOG(TRANS_COMP(-4))	-0.167144	0.028894	-5.784746	0.0012
LOG(INVEST_TRANSP(-1))	-0.167996	0.030427	-5.521281	0.0015
LOG(TRANS_TURN_TON(-2))	1.587893	0.200536	7.918237	0.0002
LOG(TRANSP_CO2_EMIS(-1))	0.251426	0.075308	3.338645	0.0156
DUMMY2015	-0.132863	0.023599	-5.630146	0.0013
DUMMY2019	-0.194676	0.024706	-7.879646	0.0002
R-squared	0.990833	Mean dependent var	15.76620	
Adjusted R-squared	0.981665	S.D. dependent var	0.156991	
S.E. of regression	0.021258	Akaike info criterion	-4.560464	
Sum squared resid	0.002711	Schwarz criterion	-4.256260	
Log likelihood	36.64301	Hannan-Quinn criter.	-4.622991	
F-statistic	108.0811	Durbin-Watson stat	2.121860	
Prob(F-statistic)	0.000008			

A specification equation was formed in the following form to calculate the elasticity coefficient of the impact of the proportion of firms using the internet in the transport sector on the volume of CO₂ in the transport sector of Azerbaijan (3).

$$\begin{aligned} \text{LOG(TRANSP_CO2_EMIS)} &= C(1) + \\ &C(2)*\text{LOG(TRANS_INTERN(-3))} + \\ &C(3)*\text{LOG(TRANS_TURN_TON(-2))} + \\ &C(4)*\text{LOG(TRANSP_CO2_EMIS(-1))} + \\ &C(5)*\text{LOG(INVEST_TRANSP(-1))} + \\ &C(6)*\text{DUMMY2015} + C(7)*\text{DUMMY2019} \end{aligned} \quad (3)$$

The formed equation was evaluated in the EViews application package, and the answer was obtained in the following form (4):

$$\begin{aligned} \text{LOG(TRANSP_CO2_EMIS)} &= -12.6958659946 - \\ &0.159546555088*\text{LOG(TRANS_INTERN(-3))} + \\ &1.96886429027*\text{LOG(TRANS_TURN_TON(-2))} + \\ &0.341918807711*\text{LOG(TRANSP_CO2_EMIS(-1))} - \\ &0.0585502518546*\text{LOG(INVEST_TRANSP(-1))} - \\ &0.159852572323*\text{DUMMY2015} - \\ &0.212734575073*\text{DUMMY2019} \end{aligned} \quad (4)$$

According to the results, if the share of firms using the Internet in the total firms in the transport sector increases by 1%, it causes a 0.15% decrease in the transport sector's CO₂ with a lag of three years. At the same time, if the volume of freight transportation increases by 1%, it causes a 1.9% increase in CO₂ with a lag of two years. Both coefficients are statistically significant at the 5% level. However, since investment in fixed capital is not statistically significant, it is not explained (Table VIII). Necessary tests were performed for the adequacy of both models (model 2 and model 4) and the models were determined to be adequate.

TABLE VIII. STATISTICAL CHARACTERISTICS OF MODEL (4)

Dependent Variable: LOG(TRANSP CO2 EMIS)				
Method: Least Squares				
Included observations: 14 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-12.69587	4.322549	-2.937125	0.0218
LOG(TRANS_INTERN(-3))	-0.159547	0.063555	-2.510366	0.0404
LOG(TRANS_TURN_TON(-2))	1.968864	0.388275	5.070794	0.0014
LOG(TRANSP_CO2_EMIS(-1))	0.341919	0.125047	2.734330	0.0292
LOG(INVEST_TRANSP(-1))	-0.058550	0.046704	-1.253633	0.2502
DUMMY2015	-0.159853	0.049204	-3.248755	0.0141
DUMMY2019	-0.212735	0.050934	-4.176663	0.0042
R-squared	0.972760	Mean dependent var	15.73019	
Adjusted R-squared	0.949411	S.D. dependent var	0.202249	
S.E. of regression	0.045490	Akaike info criterion	-3.035801	
Sum squared resid	0.014485	Schwarz criterion	-2.716272	
Log likelihood	28.25061	Hannan-Quinn criter.	-3.065379	
F-statistic	41.66223	Durbin-Watson stat	1.917769	
Prob(F-statistic)	0.000040			

Econometric evaluations show that the increase in the level of ICT adoption by firms in the transport sector of Azerbaijan leads to a decrease in CO₂ emissions in the transport sector. However, as in some sectors in our country, the level of ICT use of firms in the transport sector is relatively low. Although the share of firms using the Internet among all firms in many OECD countries that are close to Azerbaijan in terms of economic level is 90-100%, this figure is approximately 60% in firms operating in Azerbaijan. Also, although in many OECD countries the number of firms using websites is 45-75% of all firms, this figure for our country was 10.5% [19]. Thus, it is clear from the econometric evaluations that it is advisable to increase the computer and Internet adoption levels of firms operating in this sector in order to reduce the volume of CO₂ in transport in our country.

IV. CONCLUSION

As a result of the research, it was determined that one of the main issues that concern countries around the world in the current situation is the increase in environmental problems. Looking at statistical figures, we can observe that CO₂ emissions have increased globally and in Azerbaijan over the past years. Numerous studies have identified the main factors affecting environmental pollution. According to existing studies, one of the sectors that has a large share in the generation of CO₂ emissions in the world and in Azerbaijan is transport. In this direction, studies conducted in various countries of the world have concluded that the increase in the

level of ICT in firms has a positive effect on the reduction of CO₂ emissions.

Econometric evaluation was used to assess the impact of the ICT level of firms in the transport sector in Azerbaijan on CO₂ emissions in this area. According to the results obtained, the increase in the level of computer and internet usage by firms in the transport sector of Azerbaijan has a positive effect on the reduction of CO₂ in the transport sector. Therefore, we believe that there is a great need to increase the level of ICT adoption of firms in the transport sector in order to reduce CO₂ emissions in the transport sector in our republic. In the current situation, when comparing a number of countries in the world, we can observe that the ICT adoption levels of firms in the transport sector of Azerbaijan are low. Considering that the reduction of CO₂ emissions is one of the main priorities of the government in our republic, we consider it appropriate for the state to play an active role in increasing the level of ICT adoption of firms. To this end, implementing activities such as creating the necessary conditions for obtaining loans and providing subsidies on preferential terms for firms in the country to have ICT tools, increasing digital skills, and raising managers' awareness of the benefits of using ICT would greatly contribute to achieving the desired results.

REFERENCES

- [1] Komijani, A., and Mahmoodzadeh, M., "The Infrastructure, Usage and Spillover Impacts of Information and Communication Technology (ICT) on Economic Growth in Developing Countries", *Iranian Journal of Trade Studies*, 13(49), 2009, pp. 31-74
- [2] Gasimov, A., Najafov, S., Farzaliyev, M. and Baymmamadli, N., "Main Factors Affecting the Level of ICT Use in Enterprises in Order to Improve Effectiveness of Their Decision-Making," 2023 IEEE 17th International Conference on Application of Information and Communication Technologies (AICT), Baku, Azerbaijan, 2023, pp. 1-6
- [3] Wang, Y., Rodrigues, V. S., and Evans, L., "The Use of ICT in Road Freight Transport for CO₂ Reduction – an Exploratory Study of UK's Grocery Retail Industry". *International Journal of Logistic Management*, 2015, 26, pp. 2-29
- [4] Higón, A., Gholami, R., and Shirazi, F., "ICT and Environmental Sustainability: a Global Perspective". *Telematics Informatics*, 34(4), 2017, pp. 85-95
- [5] Simpson, J., Dunlap, R., and Fullerton, A., "The Treadmill of Information: Development of the Information Society and Carbon Dioxide Emissions". *Sociology of Development*, 5(4), 2019, pp.381–409
- [6] Park, Y., Meng, F., and Baloch, M. A., "The Effect of ICT, Financial Development, Growth, and Trade Openness on CO₂ Emissions: An Empirical Analysis". *Environmental Science and Pollution Research*, 25, pp. 30708-30719
- [7] Kouton, J., "Information Communication Technology Development and Energy Demand in African Countries". *Energy*, 2019, 189:116192
- [8] Saidi, S., and Hammami, S. "Modeling the Causal Linkages Between Transport, Economic Growth and Environmental Degradation for 75 Countries. *Transportation Research Part D*, 53, 2017, pp.415-427
- [9] UNEP, (2021) Transport. <https://www.unep.org/explore-topics/energy/what-we-do/transport>.
- [10] Li, Y., and Yu, Y., "The Use of Freight Apps in Road Freight Transport for CO₂ Reduction". *European Transport Research Review*, 2017, 9, 36
- [11] Zhao, C., Wang, K., Dong, X., Dong, K., "Is Smart Transportation Associated with Reduced Carbon Emissions?" The case of China. *Energy Econ* 105:105715, 2022
- [12] Shobande, O.A., Ogbefun, L., "Has Information and Communication Technology Improved Environmental Quality in the OECD?" A Dynamic Panel Analysis. *International Journal of Sustainable Development & World Ecology*, 29(1), 2022, pp. 39-49
- [13] Hasselgren, B., "Transport Infrastructure in Time, Scope and Scale: an Economic History and Evolutionary Perspective". Springer International Publishing AG, Switzerland, 05 June 2018
- [14] Pradhan, R., Bagchi, T., "Effect of Transportation Infrastructure on Economic Growth in India: the VECM approach". *Research in Transportation Economics*, 38 (1), 2013, pp. 139-148
- [15] Gunasekera, K., Anderson, W., Lakshmanan, T.R., "Highway-Induced Development: Evidence from SriLanka", *World Development*, 36 (11) (2008), pp. 2371-2389
- [16] Hasanli, Y., Ibishov, E., and Rahimli, G., "Estimation of the Impact of Transport Sector on the Economy in Azerbaijan: Multiplier Models," 2024 3rd International Conference on Problems of Logistics, Management and Operation in the East-West Transport Corridor (PLMO), Baku, Azerbaijan, 2024, pp. 1-3
- [17] Worldometer, <https://www.worldometers.info/co2-emissions/>
- [18] State Statistical Committee of the Republic of Azerbaijan. <https://www.stat.gov.az/source/transport/?lang=en>
- [19] Gasimov, A., Huseynov, R., Ibrahimov, V., Farzaliyev M. and Najafov, S., "Measuring the Impact of Information and Communication Technologies on Transport Sector in Azerbaijan," 2024 3rd International Conference on Problems of Logistics, Management and Operation in the East-West Transport Corridor (PLMO), Baku, Azerbaijan, 2024, pp. 1-5
- [20] William H.G. "Econometric Analysis", Eighth Edition, Pearson Education, Inc. 2018
- [21] Wooldridge J.M., "Introductory Econometrics: A Modern Approach", South-Western, Cengage Learning, Fifth edition, 2013, ISBN-13:978-1-111-53104-1