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Analysis of Impact of Distribution Tool Railway Transport on The Economic Growth of Azerbaijan

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Abstract

Purpose: The purpose of this article is to study the theory of railway transport in Azerbaijan. And also to determine the economic importance of this mode of transport and analyze its relationship with the country's GDP. **Research design, data and methodology:** This paper studies the theory of railway transport with a focus on the case of Azerbaijan. The economic value of this type of transport is determined, and its relationship with countries' GDP was analyzed. A qualitative model of multiple regressions was developed to characterize the dependence of the GDP of Azerbaijan on the performance of the railway industry. The feasibility of the Gauss-Markov hypotheses was analyzed. Finally, an economic interpretation of the results from the developed model is provided. **Results:** The results show that the main factors of this dependence are the length of roads and the average monthly salary of employees of the railway industry in Azerbaijan. **Conclusions**: Therefore, it can be concluded that rail transport contributes to the country's economy. The commencement of active work on the new railway Baku-Tbilisi-Kars railway will increase contribution to the economy of Azerbaijan. The development of railway transportation is important for the country's economy, as it will contribute to the development of other sectors in Azerbaijan.

Keywords : Distribution Tool, Railway transport; least squares method; Gauss-Markov conditions, Growth, Economy.

JEL Classification Code : R40, O11, C46.

1. Introduction

Rail transportation is a reliable way to distribution cargo (products, goods) to its destination, so they occupy a significant place in the overall structure of transportation. When carrying out the transportation of goods, railways enter into certain relations with cargo owners. These relationships are regulated by certain norms and regulations, uniform and mandatory both for railways and for all enterprises, organizations and persons using their services. The nature of goods transported by rail is multifaceted. Commercial transfer includes the possibility of delivering any type of product quickly and safely.

Railway transport is still popular globally (Sivilevičius & Maskeliūnaitė, 2018), and Azerbaijan has one of the most developed railway systems among the CIS countries. Infrastructure affects rural development through many channels, such as increasing agricultural productivity,

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increasing non-farm employment in rural areas and migrating the rural population to urban sectors (Fan & Chan-Kang, 2005).

In Azerbaijan, like in other developing countries, domestic and international trade are closely interrelated with different types of transport with logistics. Transport is a backbone infrastructure sector of the Azerbaijani economy, providing basic conditions for the life of society, contributing to the socio-economic development of the state and the implementation of its strategic national priorities. Many experts agree that the development of transport in the country determines the progress and prosperity of human life in general. This is because, theoretically, the improvement of transport should result in increased domestic and international trade volumes and tourism and business development, as people can easily move from one city to another. All these are important for any developing country, including Azerbaijan; therefore, this paper examines the relationship between GDP (GDP) and railway transport.

The share of oil products in export and the GDP of Azerbaijan exceeds 70%, which proves that economy heavily depends on the product. To decrease dependence on oil, the government of Azerbaijan defined other sectors as non-oil sectors, agricultural tourism as priority areas, and strategic road maps were organized in these areas. The development of railways with significant potential in both freight and passenger traffic is one of the main tasks of the country.

The launch of the Baku-Tbilisi-Kars railway represents a new stage in West-Eastern trade. An increase in the working capacity of railways and their contribution to the economy is of great importance in terms of new workspaces opening and balances correction in the region's country. The regions through which the railways pass are more developed than others. Considering the expansion of international trade in the region and the increase in tourist flows, it is expected that the contribution of railways to the national economy (GDP) will increase. However, the non-conformity of railways to modern standards, the inadequacy of investments and a lack of scientific research on rail transport negatively affect the efficiency of this area. Therefore, a multisided study of the impact of the railway is important to ensure more effective planning of economic activities of national relevance and to improve the rationality of investments.

A detailed analysis of the factors that are the basis of the railway transport system, as well as the construction of a qualitative model of multiple regressions, characterizing the dependence of Azerbaijan's GDP on the performance of the railway industry, allowed the author to formulate the main problems of this relationship.

2. Literature Review

Man (1998) examined the trend and impact of investment in transport on the region's economic development in China. Results of the multidisciplinary analysis indicated that production was higher in those provinces that invested more in transport infrastructure than in other provinces. Démurger (2001) presents empirical data on the links between infrastructure investments and economic growth in 24 provinces of China (excluding municipalities) from 1985 to 1998. The evaluation of the growth model shows that vehicles are a key differentiating factor in explaining the growth gap and indicate the role of telecommunications in reducing the burden of isolation. Finally, Fan and Chan-Kang (2005) assessed the contribution of roads to poverty reduction and economic growth in China over the past two decades.

While developing the theoretical part of this paper, scientific papers from local and foreign economic journals and a textbook by Tereshina, Podsorin, Danilina and Sokolov (2020) were used. Information from the textbooks by Orlova (2007), Yakovlev (2018) and Eliseeva (2017) were incorporated during model building. The paper also used the work of Mamedov (2002), where the role of transport in the development of the economy of Azerbaijan was considered, as well as the Strategic Road Map of the Republic of Azerbaijan on Logistics and Trade Development, which outlines the goals and priorities of these industries. Azerbaijani scientists Ismailov (2016) and Asadova (2017) investigated the importance of international transport projects and the problems of sustainable development of the Republic's transport. Xueliang (2008) investigated transport infrastructure, spatial distribution and economic growth data from China.

There are many studies in the literature related to the impact of transport infrastructure on economic growth. For example, Aschauer (1989) thoroughly examined this impact. The results indicated that improvements in transport could affect economic growth due to productivity increase, technological expansion and cost reduction (Beyzatlar, Karacal, & Yetkiner, 2014). On the other hand, another study found that economic growth can positively affect transport networks through financial support expansion and technological development (Yu, De Jong, Storm, & Mi, 2012). Deng (2013), Pereira and Andraz (2013) provided detailed reviews of respective empirical studies for different countries of the world.

In addition, in empirical studies, Sahoo, Dash and Nataraj (2012), Fernandes and Pacheco (2010) identified a long-term equilibrium ratio between transport and economic development. Granger causality analysis was performed on the studies by Sahoo et al. (2012) a bidirectional connection

between transport infrastructure and economic growth was observed.

Khadaroo and Seetanah (2008) discovered that transport system development positively affects economic growth. Furthermore, Hakim and Merkert (2016), Maparu and Mazumder (2017) identified the mutual effect of economic growth alone on transport.

The article by Jiang, Zhang, Xiong, and Wang (2016) studied the connection between accessibility and economic growth in China from 1990 to 2010. In the study, the main research units were 333 cities at prefecture level and four municipalities. The authors performed a bidirectional analysis of accessibility structure and economic growth and their growth rates to study this relation using long-term panel data. In the article, the country's regions were compared, and it was found that one of the important factors for the development and GDP increase in the Eastern part of the country was a well-developed transport network.

Zefreh, Török, and Mészáros (2017) analyzed the role of public transport using the example of Budapest; the research covered the advantage of public transport and predicted expected changes. The article emphasized that an important part of the official policy is that price setting in the transport sector should be effective. It stated that prices should equal marginal costs (including environmental costs connected with transportation), and changes in the transport system (including investments) should be estimated using a cost-benefit analysis.

Yoshino and Abidhadjaev (2017) studied the nature and degree of the impact of infrastructure support on regional economic indices. The analysis of empirical data was based on the estimate of difference-in-differences connecting changes in growth rates of economic outcomes at the regional level in the impacted regions with newly built railway communication in the southern part of Uzbekistan, dependent on the time of the regions — invariant individual effects, time-dependent covariates and developing economic features. According to the article, positive and significant improvements in the volume of industrial production of directly impacted and neighborin regions occurred mostly during the design and construction era, when the rail network was being constructed.

An analysis of the reasons for passengers' choosing a train ride over air transport was presented in the article by Sivilevičius and Maskeliūnaitė (2018). The results were obtained in the study of 16 criteria (sub-criteria) describing the defined advantages of traveling by rail over air. Mean ranking from all 16 criteria and their standardized subjective weights were calculated with the help of the new method of Average Rank Transformation Into Weight (ARTIW). Average ranks were assigned to train passengers by sub-criteria, and calculated global weights showed which criteria are most important. The least and most important criteria groups were defined using a hierarchical inverse model based on weight sub-criteria.

Dehghan and Safaie (2018) examined the spatial side effects of road and rail transportation infrastructure on economic growth in Iranian provinces from 2001 to 2011 to assess the Durbin spatial model. The results showed that the total length of railways has a positive spatial impact on economic growth in the region.

Khan, Siddique, Zaman, Yousaf, Shoukry, Gani, and Saleem (2018) used econometric methods, which consider the cross-sectional dependence and heterogeneity. Their results provoked the demand for transport energy infrastructure, which is desirable for long-term sustainable growth among countries.

Choudhary and Sultana (2018) used traditional methods of econometrics. Their results showed that road transport has a positive effect, while railways negatively affects a country's economic growth. The results further showed that rail transport requires more policy-oriented action plans to contribute to the country's railway infrastructure development for sustainable economic growth by introducing high-speed rail trains and electrified trains, adhering to safety and quality standards and improving railway tracks and convenient locations. Chong, Chen, and Qin (2019) assessed the economic benefits of high-speed rail transport in China, emphasizing changing connectivity due to development. The research results show that urban growth can benefit from HSR development.

In the narrow sense of the word, the transport industry is a part of the commodity market and the services market; however, all other types of markets and market relations also operate in the transport industry. Transport meets the needs of society by moving both goods and people. But, at the same time, the transport sector is not industrial - it does not create any real goods; it only continues the production process begun in other sectors of the economy.

Nevertheless, the transport component is always reflected in the prices of manufactured physical products.

The following are the best-known two approaches to determining the place of transport in the economy:

1. Classic approach: This economic theory compares transport to the areas of material production.
2. Market approach: This economic theory considers transport as an element of the service sector.

3. The Economic Importance of Transport: Relationship with the country's GDP

Transport, including railway transport, is a necessary condition for the existence of a market mechanism since the requirements for productivity and quality of the transport

system are increasing amid the increasing complexity of the links between market participants. Thus, the innovative development of railway transport causes the whole system to function effectively. At the same time, the unsatisfactory level of transport services is a significant obstacle to the commodity exchange, social communication, development of the domestic market, and participation in international relations.

Transport is also economically significant because it increases the degree of the social division of labor. Transport allows you to fully meet the social needs and the rising standard of living of the population. This function of railway transport as commodity exchange makes it possible to focus the resources of each region on the production of the most efficient goods. The development of transport also improves the demographic situation, helps overcome linguistic, intercultural, religious, and ideological barriers, and ensures intrastate and interstate social integration. Thus, transport contributes to developing an open society based on democratic values and tolerance.

An important indicator characterizing the operation of the transport complex is the transport capacity of the GDP in tonne-kilometres per GDP unit and as the ratio of the gross added value of transport services to GDP. For example, in Russia, a country for which railway transport is of particular importance due to its dependence on trade in oil products, a strong dependence of GDP on the volume of freight traffic, primarily road and rail, is evident.

Moreover, railway transportation plays an essential role in the modern Russian economy, which exceeded the volume of more expensive road transportation by almost 12 times in 2016 (Deruzhinsky, Deruzhinsky, & Tokmazov, 2014). In the framework of cooperation between Russia and Azerbaijan in the field of railway transport, it is interesting to draw attention to the regional economy of the Southern Federal District of Russia, which borders Azerbaijan (Deruzhinsky et al., 2014).

4. Railway Transport of Azerbaijan

Some countries of the EAEU are participants in the Trans-Eurasian International Transport Corridor (TRACESA) Project, which largely follows the route of the Great Silk Road. Azerbaijan is part of it. It is worth noting that, in recent years, the Trans-Caspian International Transport Route (TMTM), which virtually duplicates the Great Silk Road and also includes Azerbaijan, has begun to actively develop Railway transport. It is characterized by the presence of a large number of professions. About 30% of the railway professions are classified as adverse, that is, 2-3 or more production factors associated with a negative effect (Rzayeva, 2012). Currently, this is the main problem of the industry.

Railways play a significant role in the development of the regions of Azerbaijan. As the distance from the railways decreases, the population density and the number of rural points decrease, and the share of industrial products also decreases (Mamedov, 2002). The expansion of the railway network of Azerbaijan creates new opportunities for increasing integration, especially with European countries. The Baku-Tbilisi-Kars railway line, along with shorter transportation times and lower transportation costs, will create opportunities for increasing exports to Europe and optimal risk management. It will also provide Turkey with an additional route for exporting goods to Central Asian countries.

5. Data and Methodology

5.1. Data

A qualitative model of multiple regressions was built to analyze the relation between Azerbaijan's GDP and the country's railway transport. The data was taken from the Statistical Committee of the Republic of Azerbaijan.

The main indicator of the country's economic growth is the GDP of Azerbaijan (Y) in millions of United States dollars (USD).

Factor signs are the main results of the railway transport activities in Azerbaijan:

X1. Length of roads, km
X2. Cargo transportation, thousand tons
X3. Cargo turnover, million T/km
X4. Passenger transportation, thousand
X5. Passenger turnover, million passes/Km
X6. The average distance of cargo transportation, km
X7. The average distance of passenger transportation, km
X8. Revenues from transportation, thousand USD
X9. Expenses for transport, thousand USDX10. Number of employees
X11. The average monthly wage of workers, USD
X12. Investments in fixed capital, thousand USD
X13. Commissioning of fixed assets, thousand USD
14. Number of freight cars, units
X15. Number of passenger cars, units
X16. Number of containers, units.

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5.2. Methodology

1) Correlation formula:

$$r = \frac{\overline{xy} - \bar{x} \cdot \bar{y}}{\sqrt{\left(\overline{x^2} - \bar{x}^2\right)\left(\overline{y^2} - \bar{y}^2\right)}}$$

2) Regression formula:

$$y = x1 + \beta 1 + \ldots xk\beta k + \epsilon.$$

3) Darbin-Watson formula:

$$DW = \frac{\sum(e_i - e_{i-1})^2}{\sum e_i^2}$$

4) Goldfeld-Quandt formula:

$$F = \frac{\sum {e_2}^2}{\sum {e_1}^2}$$

5) RS - criterion:

$$RS = \frac{|\varepsilon_{max} - \varepsilon_{min}|}{S_e}$$

6. Empirical Results

Based on the initial data, a matrix of paired correlation coefficients was constructed using the "Correlation" tool in Excel (Yakovlev, 2018) (Table 1), where the gray color highlights the correlation coefficients, which have an absolute value of more than 0.7.

Table. 1: Matrix of paired correlation coefficients

	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
Y	1,000															
X1	-0,688	1,000														
X2	-0,075	-0,041	1,000													
X3	-0,232	0,044	0,981	1,000												
X4	-0,641	0,467	0,567	0,665	1,000											
X5	-0,226	0,082	0,812	0,840	0,858	1,000										
X6	-0,800	0,342	0,057	0,249	0,538	0,229	1,000									
X7	0,859	-0,795	0,039	-0,098	-0,695	-0,240	-0,642	1,000								
X8	0,898	-0,694	0,161	0,006	-0,539	-0,087	-0,749	0,905	1,000							
X9	0,825	-0,238	-0,251	-0,393	-0,509	-0,255	-0,826	0,555	0,708	1,000						
X10	-0,867	0,523	0,429	0,566	0,802	0,538	0,765	-0,716	-0,702	-0,830	1,000					
X11	0,977	-0,564	-0,129	-0,291	-0,613	-0,227	-0,847	0,805	0,855	0,902	-0,875	1,000				
X12	-0,556	0,529	0,348	0,432	0,441	0,280	0,476	-0,434	-0,390	-0,435	0,581	-0,537	1,000			
X13	-0,630	0,589	0,446	0,515	0,607	0,459	0,372	-0,494	-0,417	-0,461	0,676	-0,591	0,706	1,000		
X14	-0,874	0,404	0,103	0,250	0,480	0,145	0,818	-0,655	-0,815	-0,943	0,857	-0,906	0,466	0,467	1,000	
X15	-0,629	0,082	0,431	0,546	0,554	0,437	0,722	-0,401	-0,557	-0,898	0,800	-0,706	0,327	0,350	0,868	1,000
X16	-0,885	0,620	-0,196	-0,062	0,312	-0,120	0,672	-0,720	-0,846	-0,739	0,679	-0,856	0,521	0,572	0,856	0,517

The highest direct correlation is observed between GDP and the average monthly wage of railway workers. Interconnected GDP and factors such as the average distance of freight, the average distance of passengers, transportation income, transportation costs, the number of workers in the industry, the number of freight cars, and the number of containers are also high on the Chaddock scale. However, factor X2 - transportation of goods, has no connection with the result of Y - GDP because $r_{x2y} < 0.1$; therefore, it was removed from further analysis.

Multicollinearity between the remaining factors was checked using Farrar-Glober statistics (Eliseeva, 2017).

The estimated value of Farrar – Globe statistics was:

$$FGobserv = - [-1- 1/6 (2k+5)] \ln (\det [R1]) = 469,919 \quad (1)$$

Where $n = 18$: number of observations;
$k = 15$: number of factors.

The actual value of this criterion FG_{obser} compared with the table value χ^2 at $\frac{1}{2}k(k-1)$ degrees of freedom and level of significance α= 0.05 by defining it with the CI2OB function.

Insofar as $FG_{obser} > FG_{crit}$ (469,919 > 129,918), there was multicollinearity in the array of explanatory variables.

All the factors have the following model characteristics (Table 2).

Table 2: A fragment of the statistics of the model with a full set of factors

	Coefficients	Standard error	t-statistics	P-Value
Y-intersection	547526,628	686969,477	0,797	0,509
X1	-218,049	269,922	-0,808	0,504
X3	-0,247	2,468	-0,100	0,929
X4	-11,930	12,009	-0,993	0,425
X5	25,880	106,924	0,242	0,831
X6	8,788	237,252	0,037	0,974
X7	-257,151	281,454	-0,914	0,457
X8	0,006	0,275	0,021	0,985
X9	-0,011	0,097	-0,115	0,919
X10	2,357	4,329	0,545	0,641
X11	179,911	111,272	1,617	0,247
X12	0,145	0,432	0,334	0,770
X13	0,166	0,371	0,447	0,698
X14	-4,228	8,911	-0,474	0,682
X15	59,167	119,034	0,497	0,668
X16	-0,198	1,774	-0,112	0,921

The tabular value of the student's t-test:

$$tcrit = TINV(0,05;18-4-1) = 4,303 \quad (2)$$

The regression coefficient is considered statistically significant if the absolute value of $t_{расч}$ exceeds t_{table} – tabular (critical) value of the Student's t-test.

For further improvement, the least significant factor was removed from the model; that is, the X8 factor with the lowest value t_{table}. Then the model was rebuilt, the factors were discarded, and only significant factors were left in the model. This method is the systematic selection of factors with the exception.

The factors X1, X4, X7, X10, X11, X14 and X15 were significant, but multicollinearity was observed between the factors. To get rid of this, we used the Farrar-Glober algorithm.

To check the presence of multicollinearity of each variable with other variables,

We calculate the inverse matrix $C = R_1^{-1}$

We calculate F-criteria $F_j = (c_{jj} - 1) * \frac{n-k-1}{k}$,

Where c_{jj} – matrix diagonal elements C:

$$F_1 = (4,749 - 1) * \frac{18 - 7 - 1}{7} = 5,356$$
$$F_4 = 26,619$$
$$F_7 = 18,693$$
$$F_{10} = 35,652$$
$$F_{11} = 17,238$$
$$F_{14} = 82,201$$
$$F_{15} = 30,626$$

The actual values of the F-criteria are compared with the table values. $F_{table} = 3,135$ at $\nu_1 = 7$ and $\nu_2 = (n - k - 1) = 10$ degrees of freedom and level of significance α=0.05, where k is the number of factors.

Since all $F_j > F_{table}$, all factors are multicollinear with others.

The partial correlation coefficients are calculated using the following formula:

$$r_{ij(\ )} = \frac{-c_{ij}}{\sqrt{c_{ii} * c_{jj}}}$$

Where c – matrix elements C

t-criteria is calculated using the formula:

$$t_{ij} = \frac{r_{ij(\ )}\sqrt{n-k-1}}{\sqrt{1 - r_{ij(\ )}{}^2}}$$

The result is presented in Table 3.

Table 3: Checking the presence of multicollinearity of each pair of variables

	X4	*X7*	*X10*	*X11*	*X14*	*X15*
r1j	-0,156	-0,477	0,401	0,227	0,044	-0,317
t1j	-0,500	-1,716	1,383	0,737	0,141	-1,058
	r4j	-0,775	0,811	-0,152	-0,856	0,699
	t4j	-3,872	4,388	-0,487	-5,238	3,088
		r7j	0,639	0,166	-0,616	0,505
		t7j	2,627	0,533	-2,471	1,850
			r10j	-0,137	0,599	-0,287
			t10j	-0,438	2,368	-0,947
				r11j	-0,487	0,385
				t11j	-1,764	1,318
					r14j	0,870
					t14j	5,585

The actual values of the t-criteria are compared with the table values with degrees of freedom (n - k - 1) = 10 and significance level α = 0.05: t_{table} = 2,228. Since $|t_{14,15}| > t_{table}$ and $r_{14,15}$= 0,870→1. The result shows a strong multicollinearity between pairs of independent variables X14 and X15.

To get rid of multicollinearity, one of the variables of multicollinear pairs was excluded. For example, the variable X14 was removed from the pair X14 and X15 since it had a higher F-criterion value. Consequently, it had more effect on the overall multicollinearity of factors.

The model was rebuilt; insignificant factors were removed according to Student's t criterion, and a model was obtained with significant factors in the absence of multicollinearity.

The result of building a model with significant variables is shown in Table 4.

Table 4: Statistic models with two variables

Regression Statistics						
Multiple R	0,990676581					
R-Square	0,981440088					
Normalized R-square	0,978965433					
Standart error	3349,53982					
Observations	18					
Analysis of Variance	*Df*	*SS*	*MS*	*F*	*Significance F*	
Regression	2	8899168645	4449584323	396,5967502	1,03352E-13	
Remainder	15	168291255,1	11219417			
Total	17	9067459900				
	Coefficients	*Standart error*	*t-statistics*	*P-value*	*Below 95%*	*Above 95%*
Y-intersection	396390,3243	85166,76642	4,654284071	0,000311621	214861,6596	577918,989
X1	-189,0966249	40,143417	-4,710526383	0,000278873	-274,6602924	-103,5329573
X11	210,4747626	10,38318913	20,27072415	2,59644E-12	188,343519	232,6060063

The equation of multiple linear regressions with two independent variables is:

$$\widehat{Y} = 396390{,}324 - 189{,}097 * X1 + 210{,}475 * X2 \quad (3)$$

The economic interpretation of the parameters is as follows:

- All other things being equal, when the length of roads in Azerbaijan increases by 1 km, Azerbaijan's GDP decreases by 189.097 million USD;
- All other things being equal, an increase in the average monthly wage of railway industry workers by 1 USD increases the GDP by 210.475 million USD.

The correlation coefficient (Multiple R) of the two-factor model is 0.991, which on the Chaddock scale indicates a very high relationship between the result and the factors.

The coefficient of determination (R squared) shows how much of the variance of the effective trait can be explained by the regression equation. Therefore, 98.1% of the variation in Azerbaijan's GDP is due to this model.

The significance of the regression equation is estimated using the Fisher F-test. F-statistics was calculated using the regression tool of the Data Analysis Package of Excel (Yakovlev, 2018) and is shown in cell F, equal to 396,597.

The tabular value of the F-test:

Fcrit=FINV (0,05; 2; -2-1 = 3,682) (4)

Insofar as $F > F_{крит}$ the statistical significance of the equation is recognized with a probability of 95%.

Since the P-value for all regression coefficients is less than 0.05, the regression parameters are statistically significant and reliable, with a 95% probability by the student's criterion.

The average approximation error was:

$$\overline{A} = \frac{1}{n} * \sum \left|\frac{(y-\hat{y})}{y}\right| * 100\% = 9\% \quad (5)$$

The average approximation error does not exceed 10%, indicating a high quality of the regression equation, i.e., it characterizes a good selection of the model to the actual initial data.

For a regression model based on OLS to have the highest quality and adequate estimates, the following conditions, known as Gauss-Markov conditions, must be fulfilled:

1. The mathematical expectation of residuals in any observation should be zero.
2. In the model, the perturbation (or dependent variable) is a random quantity, and the explanatory variable is not a random quantity.
3. The absence of a systematic connection between the values of residuals in any two observations, that is, the absence of autocorrelation of some residues, should be met.
4. The variance of residuals should be constant for all observations (homoscedasticity).
5. The residues εi, i = 1, 2, ..., n have a normal distribution (Eliseeva, 2017).

When the assumptions are fulfilled, the estimates obtained by the OLS will have the properties of unbiasedness, strength and efficiency.

Consider the satisfiability of the conditions of Gauss-Markov.

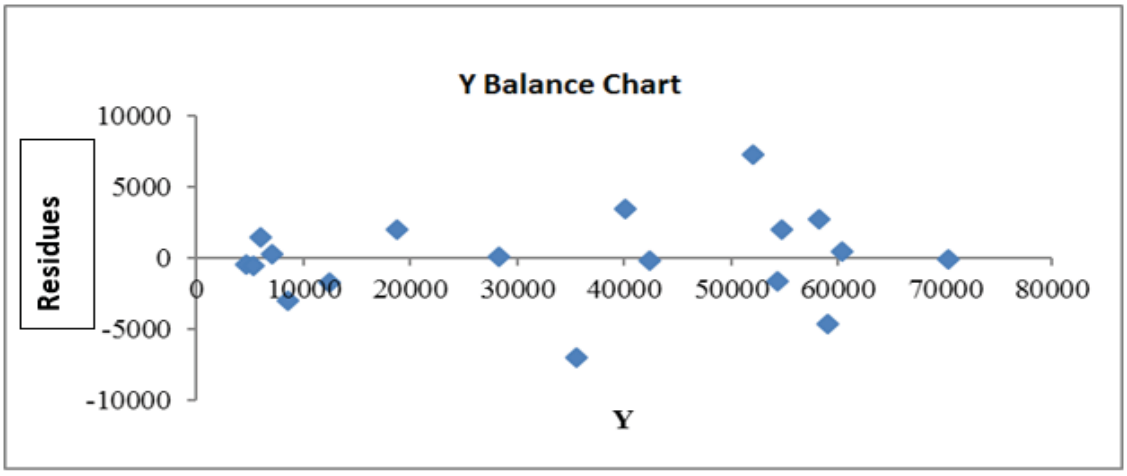

Figure 1: The dependence of residues on Y

In Fig. 1, a horizontal bar was obtained; therefore, the residuals are not systematic, and the expectation of some residues is zero (the first prerequisite is satisfied).

Residues are not dependent on factor X (the 2nd prerequisite is fulfilled).

Durbin-Watson Statistics:

$$DW = \frac{\sum(e_i - e_{i-1})^2}{\sum e_i^2} = 2{,}106 \qquad (6)$$

Since $d_U = 1{,}53 < DW < 4 - d_U = 2{,}47$, the calculated value of the Durbin-Watson criterion falls within the area of accepting the hypothesis of the absence of residual autocorrelation; therefore, the 3rd prerequisite of the least-squares is satisfied, the residuals are not automatically correlated.

Goldfeld-Quandt test:

$$F = \frac{\sum e_1^2}{\sum e_2^2} = 1{,}442 \qquad (7)$$

Since $F < F_{табл} = 6{,}944$the hypothesis of the absence of heteroscedasticity is confirmed, and the 4th hypothesis is fulfilled, homoscedasticity occurs - the constancy of the dispersions of residuals.

RS - criterion:

$$RS = \frac{|\varepsilon_{max} - \varepsilon_{min}|}{S_e} = 4{,}394 \qquad (8)$$

Estimated RS - criterion falls within the interval bounded by tabular values (3.18; 4.49) (Orlova & Polovnikov, 2007). With a significance level of α = 0.05, the hypothesis about the normal distribution of the residual component is confirmed, and the fifth prerequisite OLS is satisfied.

The regression model is statistically significant, with a 95% probability for the Fisher criterion and the model parameters for the student criterion. There is a very close and almost functional relationship between the factors and the result. The model is adequate for accurate data since the average approximation error is less than 10%.

Correlation and regression analysis allowed us to obtain a statistically significant and predictable regression model of the dependence of Azerbaijan's GDP on factors: the length of roads and the average monthly salary of railway industry workers.

The decreased GDP with an increased length of roads is primarily associated with the maintenance cost of railway tracks and their construction.

The increase in GDP with an increase in the average monthly wage of employees of the railway industry in Azerbaijan is due to workers' contribution to the final consumption of households.

6. Discussion

The theoretical significance of the paper is as follows:

- It provides comprehensive coverage of the essence of the considered problem of the importance of Railway transport in the economy of a country;
- Its results will serve as a stimulus for raising the level of GDP from railway transport;
- It presents a new insight on the issue of statistical data confirming dependence, which will broaden the approach to its study.

The practical significance of the work is that it summarizes the experience of creating a qualitative model of multiple regressions and characterizes the dependence of the GDP of Azerbaijan on the performance of the railway industry.

The practical significance of the work further includes:

- Replenishment of the academic and pragmatic base of the industry with new information, filling gaps in the theory;
- Evidence of the promise of scientific direction; and
- Confirmation of efficiency of innovations in the field of railway transport of Azerbaijan.

Many studies mentioned in the literature review identified the connection between rail transport and economic growth. In addition, empirical and econometric analyses were made to identify the connection between rail transport and economic growth. In this study, a multiple regression model was built. The analysis results revealed that the main factors of transport and economic growth dependence are the length of roads and the average monthly salary of workers in the railroad industry in Azerbaijan. Therefore, this study is different from other studies based on the data used and the analysis result.

7. Conclusions and Recommendations

Transportation of goods by rail currently occupies one of the leading positions in the country in terms of the volume of transported goods per year. This is due, first of all, to the fact that the weight of transported products can vary within several hundred tons, and the road network in Azerbaijan is developed and makes it possible to distribution even to remote locations.

In conclusion, transport, including railway transport, can be characterized as a market object in a market economy. The development of railway transport is economically important for each country because improvements in this area lead to other positive changes. For example, demographic wages are improved, barriers between different areas of the country and between countries are overcome, people interact with each other as subjects of market relations. Specifically, for Azerbaijan, railway

transport is an important concept. This is confirmed by the state's actions aimed at developing infrastructure, increasing the wages of workers, and attracting large investments.

Building a qualitative model of multiple regressions that characterizes the dependence of the GDP of Azerbaijan on the performance of the railway industry has provided a statistically significant and predictable regression model. The main factors of this dependence were the length of the roads and the average monthly wage of railway workers.

This study was limited to rail transport. Further research should study the transport sector and the economic growth of Azerbaijan. First, it is necessary to take into account such factors restraining the development of the industry as non-competitive services, lack of rolling stock, a high degree of depreciation of tangible assets, problems with the safety of goods during transportation, poor-quality repairs using counterfeit spare parts, and incomplete coverage of the road network with electric traction.

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