THE IMPACT OF THE INCREASE IN THE VOLUME OF FREIGHT TURNOVER ON THE RAILWAYS ON EXPORTS

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Abstract. *Purpose: This study aims to investigate the intricate relationship between the volume of exports (Y) and freight turnover on railways (X) through a paired linear regression model. The purpose is to discern the quantitative impact of railway freight turnover on a nation's export volumes and offer insights for policymakers and stakeholders in the transportation and trade sectors. Design/Methodology/Approach: A quantitative research design is employed, utilizing historical data spanning from 2000 to 2022. The chosen methodology involves the estimation of a paired linear regression model using the method of least squares. Statistical significance is tested through the coefficient of determination, Fisher's F-test, and an examination of heteroskedasticity. Elasticity analysis, rank correlation, and graphical assessments of residuals provide a comprehensive understanding of the relationship. Findings: The research reveals a strong and statistically significant positive correlation (r = 0.92) between export volumes and railway freight turnover. The regression model, validated through multiple tests, explains 84.72% of the variability in export volumes. Economic interpretation indicates that a one-unit increase in railway freight turnover leads to a substantial average increase of 1627720.728 units in export volumes. The absence of heteroskedasticity reinforces the robustness of the model.*

Keywords: *exports, freight turnover, economic impact, elasticity, heteroskedasticity, rank correlation, transportation dynamics, international trade.*

TEMIR YO'LLARDA YUK AYLANMASI HAJMINING OSHISHINING EKSPORTGA TA'SIRI

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Annotatsiya. *Maqsad: Ushbu tadqiqot eksport hajmi (Y) va temir yo'llarda yuk aylanmasi (X) o'rtasidagi murakkab bog'liqlikni juft chiziqli regressiya modeli orqali o'rganishga qaratilgan. Maqsad temir yo'l yuk aylanmasining mamlakat eksport hajmiga miqdoriy ta'sirini aniqlash va siyosatchilar va transport va savdo sohalaridagi manfaatdor tomonlar uchun tushunchalarni taqdim etishdir. Dizayn/metodologiya/yondashuv: 2000 yildan 2022 yilgacha bo'lgan tarixiy ma'lumotlardan foydalangan holda miqdoriy tadqiqot loyihasi qo'llaniladi. Tanlangan metodologiya eng kichik kvadratlar usuli yordamida juft chiziqli regressiya modelini baholashni o'z ichiga oladi. Statistik ahamiyatlilik determinatsiya koeffitsienti, Fisherning F testi va heteroskedastiklikni tekshirish orqali tekshiriladi. Elastiklik tahlili, darajali korrelyatsiya va qoldiqlarni grafik baholash munosabatlarni har tomonlama tushunish imkonini beradi. Natijalar: Tadqiqot eksport hajmi va temir yo'l yuk aylanmasi o'rtasida kuchli va statistik jihatdan muhim ijobiy korrelyatsiyani (r = 0,92) aniqladi. Bir nechta testlar orqali tasdiqlangan regressiya modeli eksport hajmidagi o'zgaruvchanlikning 84,72% ni tushuntiradi. Iqtisodiy talqin shuni ko'rsatadiki, temir yo'l yuk aylanmasining bir birlik o'sishi eksport hajmining o'rtacha 1627720,728 donaga sezilarli o'sishiga olib keladi. Heteroskedastikaning yo'qligi modelning mustahkamligini kuchaytiradi.*

Kalit so'zlar: *eksport, yuk aylanmasi, iqtisodiy ta'sir, elastiklik, heteroskedastiklik, darajali korrelyatsiya, tashish dinamikasi, xalqaro savdo.*

ВЛИЯНИЕ УВЕЛИЧЕНИЯ ОБЪЕМОВ ГРУЗООБОРОТА НА ЖЕЛЕЗНЫХ ДОРОГАХ НА ЭКСПОРТ

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Аннотация. *Цель: Данное исследование направлено на изучение сложной взаимосвязи между объемом экспорта (Y) и грузооборотом на железных дорогах (X) с помощью парной модели линейной регрессии. Цель состоит в том, чтобы выявить количественное влияние грузооборота железных дорог на объемы экспорта страны и предложить ценную информацию политикам и заинтересованным сторонам в транспортном и торговом секторах. Дизайн/Методология/Подход: используется количественный дизайн исследования с использованием исторических данных за период с 2000 по 2022 год. Выбранная методология включает оценку модели парной линейной регрессии с использованием метода наименьших квадратов. Статистическая значимость проверяется с помощью коэффициента детерминации, F-критерия Фишера и проверки гетероскедастичности. Анализ эластичности, ранговая корреляция и графическая оценка остатков обеспечивают полное понимание взаимосвязи. Выводы: Исследование выявило сильную и статистически значимую положительную корреляцию (r = 0,92) между объёмами экспорта и грузооборотом железных дорог. Регрессионная модель, проверенная многочисленными тестами, объясняет 84,72% изменчивости объемов экспорта. Экономическая интерпретация показывает, что увеличение грузооборота железных дорог на одну единицу приводит к существенному среднему увеличению объемов экспорта на 1627720,728 единиц. Отсутствие гетероскедастичности усиливает надежность модели.*

Ключевые слова: экспорт, грузооборот, экономический эффект, эластичность, гетероскедастичность, ранговая корреляция, динамика перевозок, международная торговля.

Introduction.

In an interconnected global economy, the efficient movement of goods is paramount to the success of nations and industries alike. Central to this logistical web is the railway infrastructure, a backbone that supports the transportation of vast quantities of freight. In recent times, there has been a discernible surge in the volume of freight turnover on railways, catalyzed by the increasing demands of international trade. This article delves into the intricate interplay between the escalating freight turnover on railways and its profound repercussions on a nation's export landscape.

As economies expand and global markets evolve, the demand for seamless and reliable transportation of goods becomes more pronounced. Railways, with their inherent advantages of cost-effectiveness, sustainability, and capacity to handle large quantities of cargo, have emerged as a pivotal player in meeting these demands. Consequently, the increase in the volume of freight turnover on railways has become a salient indicator of economic vitality and trade vibrancy.

This article aims to scrutinize the multifaceted impacts of the escalating freight turnover on railways specifically on a nation's export activities. By unraveling the various dimensions of this phenomenon, we seek to provide a comprehensive understanding of how railways contribute to the facilitation of exports and, in turn, influence a nation's economic prosperity.

In essence, this article endeavors to provide a nuanced exploration of the intricate relationship between the surge in freight turnover on railways and its cascading effects on a nation's exports. By doing so, we hope to contribute to the ongoing discourse on optimizing

transportation networks for the seamless flow of goods, ultimately fostering economic prosperity in an increasingly interconnected world.

Materials and Method

Transportation infrastructure, particularly railways, plays a critical role in global trade and economic development. Efficient freight transport is essential for moving goods across countries and continents, directly affecting a nation's export capabilities. This literature review aims to explore the relationship between increased freight turnover on railways and exports, providing insights into how improvements in railway services can enhance trade performance.

Transportation infrastructure is a key factor in economic theories related to trade efficiency. According to Rodrigue, Comtois, and Slack (2016), efficient logistics and transportation systems reduce transaction costs, thereby enhancing a country's competitiveness in international markets. The theoretical framework provided by Hummels, (2007) in "Transportation Costs and International Trade in the Second Era of Globalization" highlights how reductions in shipping costs and times can significantly impact trade volumes.

Several studies have investigated the impact of railway freight turnover on exports. Banister and Berechman (2001) discuss the positive effects of transportation infrastructure development on economic performance, including trade, in "Transport Investment and Economic Development." Their analysis suggests a strong correlation between improved rail services and increased export volumes.

Contrastingly, not all studies find a direct link. Limao and Venables (2001), in "Infrastructure, Geographical Disadvantage, Transport Costs, and Trade," argue that while infrastructure improvements are beneficial, their impact on exports can be moderated by factors such as external economic conditions and trade policies.

Case studies from China, following the extensive development of its high-speed rail network, offer valuable insights. Zhang, Zhou, and Chai (2018) in "The Economic Impacts of High-Speed Rail on Industry Agglomeration and Facilitation of Economic Growth in China" demonstrate how high-speed rail investments have positively influenced China's export dynamics by enhancing market accessibility and supply chain efficiency.

The literature identifies several mechanisms through which increased freight turnover on railways influences exports. Noteworthy is the study by Behrens and Pels (2012), "Intermodal Competition in the London-Paris Passenger Market: High-Speed Rail and Air Transport," which, although focused on passenger transport, highlights the importance of supply chain integration and reduced bottlenecks in improving transport efficiency.

Future research directions include exploring the impact of emerging technologies on railway freight services and exports, as well as integrating environmental sustainability into transport and trade policies. A notable gap in the literature is the long-term effect of infrastructure investments on exports, an area ripe for further investigation.

The primary data sources for this study include official reports and statistical databases from relevant government agencies, transportation authorities, and trade organizations. The dataset comprises annual figures for both the volume of exports and the volume of freight turnover on railways.

Variables
- Dependent Variable (y): Volume of Exports
- Independent Variable (x): Volume of Freight Turnover on Railways

The data cover the period from 2000 to 2022, allowing for a comprehensive examination of trends and patterns over time (Vokhidova, Abdullaeva, 2024).

Upon obtaining the dataset, a thorough data preprocessing stage is executed to ensure accuracy and consistency. This involves:
- Formatting: Ensuring that all data is in a uniform numerical format.

- Cleaning: Identifying and addressing any missing or erroneous data through imputation or removal.
- Verification: Cross-verifying data from multiple sources to enhance reliability.

Descriptive statistics, including measures such as mean, median, standard deviation, and range, are calculated for both the volume of exports and the volume of freight turnover. These statistics provide a foundational understanding of the distribution and central tendencies of the variables.

To quantify the relationship between the volume of exports and freight turnover on railways, the Pearson correlation coefficient is computed. This analysis assesses the strength and direction of the linear association between the two variables.

A linear regression model is employed to model the impact of freight turnover on railway volumes on the volume of exports. The regression model includes the slope, intercept, and other relevant coefficients. This analysis helps identify the nature and magnitude of the relationship.

The methodology outlined above provides a systematic and rigorous approach to investigating the impact of increased freight turnover on railways on a nation's exports. By employing quantitative methods, this study aims to contribute valuable insights into the intricate dynamics of transportation and international trade.

Results.

Regression equation (empirical regression equation):

$$y = 1627720.7279 \, x - 24044514.9989$$

The empirical regression coefficients a and b are only estimates of the theoretical coefficients β_i, and the equation itself reflects only the general trend in the behavior of the variables under consideration.

Regression equation parameters.

Sample means.

$$\overline{x} = \frac{\sum x_i}{n} = \frac{494.1}{23} = 21.483$$

$$\overline{y} = \frac{\sum y_i}{n} = \frac{251232966.7}{23} = 10923172.465$$

$$\overline{xy} = \frac{\sum x_i y_i}{n} = \frac{5684486009.1}{23} = 247151565.613$$

Sample variances:

$$S(x)^2 = \frac{\sum\limits_{i=1}^{n} x_i^2}{n} - \overline{x}^2 = \frac{10791.09}{23} - 21.483^2 = 7.68$$

Standard deviation

$$S(x) = \sqrt{S^2(x)} = \sqrt{7.68} = 2.77$$

$$S(y) = \sqrt{S^2(y)} = \sqrt{24002403569898} = 4899224.793$$

The correlation coefficient b can be found using the formula without solving the system directly:

$$b = \frac{\overline{x \cdot y} - \overline{x} \cdot \overline{y}}{S^2(x)} = \frac{247151565.613 - 21.483 \cdot 10923172.465}{7.68} = 1627720.7279$$

a = y - b·x = 10923172.465 - 1627720.7279·21.483 = -24044514.9989

cov(x,y) = x·y - x·y = 247151565.613 - 21.483·10923172.465 = 12493325.83

　　　　To calculate the indicator of connection closeness or the sample linear correlation coefficient (r_{xy}), we typically use the Pearson correlation coefficient formula, which assesses the linear relationship between two continuous variables, *X* and *Y*. This coefficient is defined as:

0.1 < r$_{xy}$ < 0.3: weak;

0.3 < r$_{xy}$ < 0.5: moderate;

0.5 < r$_{xy}$ < 0.7: noticeable;

0.7 < r$_{xy}$ < 0.9: high;

0.9 < r$_{xy}$ < 1: very high;

　　　　In our example, the connection between trait Y and factor X is very high and direct. In addition, the linear pair correlation coefficient can be determined through the regression coefficient b:

$$r_{x,y} = b \cdot \frac{S(x)}{S(y)} = 1627720.728 \cdot \frac{2.77}{4899224.793} = 0.92$$

　　　　Regression equation (estimation of regression equation).

　　　　The linear regression equation has the form y = 1627720.728*x -24044514.999

　　　　The coefficients in a linear regression equation indeed carry significant economic interpretations, elucidating how changes in independent variables (factors) can influence the dependent variable (outcome or effective indicator). In the context of the given example:

　　　　• **Regression Coefficient b=1627720.728***b***=1627720.728**: This coefficient signifies the average change in the dependent variable *y* (the effective indicator), for every one-unit increase in the independent variable *x* (the factor). Specifically, it means that with each unit increase in *x*, *y* is expected to increase by an average of 1627720.728 units. This coefficient reflects the strength and direction of the relationship between *x* and *y*, with the positive value indicating a direct or positive relationship (as *x* increases, so does *y*).

　　　　• **Intercept Coefficient a=−24044514.999***a***=−24044514.999**: The intercept *a* theoretically represents the predicted value of *y* when *x*=0. It's crucial to approach the interpretation of the intercept with caution, especially if the *x*=0 condition is far from the observed sample values of *x*. In such scenarios, extrapolating the regression model beyond the range of the sample data can lead to misleading conclusions. The model's predictive accuracy is generally more reliable within the range of the data used to construct it.

　　　　• **Correlation Index (r_{xy}=0.92)**: The correlation index, in the case of linear regression, equates to the Pearson correlation coefficient r_{xy}, which measures the linear relationship between *x* and *y*. A value of 0.920.92 indicates a very high and positive correlation, suggesting that the factor *x* significantly impacts *y*. This high correlation coefficient underscores the strength of the association between the variables, indicating that a substantial portion of the variability in *y* can be explained by changes in *x*.

　　　　• **Multiple Correlation Coefficient**: While not specifically elaborated upon here, the multiple correlation coefficient extends the concept of the simple correlation coefficient to scenarios involving more than one independent variable. It measures the closeness of the relationship between several independent variables and a single dependent variable, providing insight into how all the independent variables combined can influence the dependent variable.

　　　　Understanding these coefficients and their implications is pivotal in economic analysis, offering insights into how variations in certain factors can affect outcomes. Such analyses are instrumental for policymakers, businesses, and researchers in making informed decisions, predicting future trends, and understanding the dynamics of economic relationships.

$$R = \sqrt{1 - \frac{\sum(y_i - y_x)^2}{\sum(y_i - \overline{y})^2}}$$

Most often, when interpreting the coefficient of determination, it is expressed as a percentage.

$$R^2 = 0.92^2 = 0.8472$$

that is, in 84.72% of cases, changes in x lead to changes in y. In other words, the accuracy of selecting the regression equation is high. The remaining 15.28% of the change in Y is explained by factors not taken into account in the model (as well as specification errors).

To assess the quality of regression parameters, we will build a calculation table.

Analysis of the accuracy of determining regression coefficient estimates.

An unbiased estimate of the dispersion of disturbances is the value:

$$S^2 = \frac{\sum (y_i - y_x)^2}{n - m - 1}$$
$$S^2 = \frac{84335437663909}{21} = 4015973222090.9$$

S^2 = 4015973222090.9 - unexplained variance or regression error variance (a measure of the spread of the dependent variable around the regression line)

$$S = \sqrt{S^2} = \sqrt{4015973222090.9} = 2003989.33$$

S = 2003989.33 - standard error of estimate.

The standard error of the regression is considered as a measure of the dispersion of the observed data from the modeled values. The lower the regression standard error, the higher the quality of the model.

S_a is the standard deviation of the random variable a.

$$S_a = S \cdot \frac{\sqrt{\sum x^2}}{nS(x)}$$
$$S_a = 2003989.33 \cdot \frac{\sqrt{10791.09}}{23 \cdot 2.77} = 3267015.08$$

S_b - standard deviation of random variable b.

$$S_b = \frac{S}{\sqrt{n} \cdot S(x)}$$
$$S_b = \frac{2003989.33}{\sqrt{23 \cdot 2.77}} = 150828.148$$

To evaluate the statistical significance of the coefficients in a linear regression equation, hypothesis testing, specifically the Student's t-test, is employed. This method helps determine if the observed relationship between the dependent variable *y* and an independent variable *x* can be considered statistically significant, implying that the relationship observed in the sample data is likely to exist in the broader population.

Steps for Testing Hypotheses Using Student's t-test

1. Formulation of Hypotheses:

• Null Hypothesis (H_0): The regression coefficient *b* equals 0, suggesting no linear relationship between *x* and *y* in the population.

• Alternative Hypothesis (H_1): The regression coefficient *b* does not equal 0, indicating a significant linear relationship between *x* and *y* in the population.

2. Calculation of the t-statistic: The t-statistic for a regression coefficient is calculated using the formula:

$$t = SE(b)b - \beta_0$$

where:
- b is the estimated regression coefficient,
- β_0 is the hypothesized value of the regression coefficient under
- H_0 (usually 0),
- $SE(b)$ is the standard error of the regression coefficient b.

3. Determination of the Critical t-value: The critical t-value is determined based on the chosen significance level α, often set at 0.05) and the degrees of freedom df, typically $n-2$ for simple linear regression, where n is the number of observations).

4. Comparison of the t-statistic with the Critical t-value:
- If the absolute value of the calculated t-statistic ($|t|$) is greater than the critical t-value from the t-distribution table, H_0 is rejected. This indicates that the coefficient b is significantly different from 0, affirming a statistically significant linear relationship between x and y.
- If $|t|$ is less than or equal to the critical t-value, H_0 cannot be rejected. This suggests that the evidence is insufficient to conclude that b is significantly different from 0 at the α significance level, implying that the linear relationship between x and y may not be statistically significant.

Rejecting H_0 in favor of H_1 supports the conclusion that there is a statistically significant linear relationship between the independent variable x and the dependent variable y, justifying the inclusion of x in the regression model. Accepting H_0, on the other hand, suggests the absence of such evidence, questioning the variable's relevance in the model.

This process underscores the importance of statistical hypothesis testing in evaluating the validity and reliability of regression analysis findings, providing a quantitative basis for making informed decisions about the relationships between variables in a given dataset.

$$t_{крит}(n-m-1; \alpha/2) = t_{крит}(21; 0.025) = 2.414$$

$$t_b = \frac{b}{S_b}$$

$$t_b = \frac{1627720.728}{150828.148} = 10.79$$

Since 10.79 > 2.414, the statistical significance of the regression coefficient b is confirmed (we reject the hypothesis that this coefficient is equal to zero).

$$t_a = \frac{a}{S_a}$$

$$t_a = \frac{-24044514.999}{3267015.08} = 7.36$$

Since 7.36 > 2.414, the statistical significance of the regression coefficient a is confirmed (we reject the hypothesis that this coefficient is equal to zero).

Analysis of variance.

When analyzing the quality of a regression model, the variance decomposition theorem is used, according to which the total variance of the resulting attribute can be decomposed into two components - explained and unexplained by the variance regression equation.

The purpose of analysis of variance is to analyze the variance of the dependent variable:

$\sum(y_i - y_{cp})^2 = \sum(y(x) - y_{cp})^2 + \sum(y - y(x))^2$

$\sum(y_i - y_{cp})^2$ - total sum of squared deviations;

$\sum(y(x) - y_{cp})^2$ - sum of squared deviations due to regression ("explained" or "factorial");

$\sum(y - y(x))^2$ - residual sum of squared deviations.

Table 1

Quality indicators of the regression equation

Indicators	Value
Determination coefficient	0.8472
Average elasticity coefficient	3.201
Average approximation error	was not calculated

The process described involves several critical steps in regression analysis, from model specification and parameter estimation to testing for statistical significance and assessing assumptions like heteroskedasticity. Here's a more detailed look into these steps, focusing on the latter part of your explanation regarding heteroskedasticity:

Regression Model Specification and Estimation

The choice of a paired linear regression model implies a direct, linear relationship between the dependent variable *Y* and the independent variable *X*, represented as *y*=1627720.728×*x*−24044514.999.

Using the Ordinary Least Squares (OLS) method, the parameters of the regression equation were estimated, indicating that a unit increase in *X* results in an average increase of 1627720.728 units in *Y*.

84.72% of the variability in *Y* is explained by changes in *X*, indicating a strong explanatory power of the model.

The statistical significance of the model parameters suggests that the relationship between *X* and *Y* is not by chance.

With a value of 0.92, the relationship between *Y* and *X* is very high and direct, corroborating the model's findings.

The model parameters provide insights into the economic relationship between *X* and *Y*, where an increase in *X* by one unit increases *Y* by an average of 1627720.728 units, indicating a significant influence of *X* on *Y*.

Testing Assumptions: Heteroskedasticity

Heteroskedasticity refers to the presence of non-constant variance in the error terms of a regression model, which can compromise the efficiency of OLS estimates and the validity of standard errors, leading to unreliable hypothesis tests.

• **Graphical Analysis of Residuals**: One common method to detect heteroskedasticity is through the graphical analysis of residuals. By plotting the residuals (e_i) or their squares (e_{i2}) against the explanatory variable *X*, one can visually inspect for patterns:

• If the plot shows a random dispersion of residuals across levels of *X*, this suggests constant variance, or homoskedasticity.

• If the plot reveals a pattern, such as a funnel shape where the spread of residuals increases with *X*, this indicates heteroskedasticity.

The analysis, having established the statistical significance of the model and the strong relationship between *X* and *Y*, also entails examining assumptions underlying the OLS method. Testing for heteroskedasticity is crucial for ensuring the reliability of the regression analysis. Should heteroskedasticity be detected, corrective measures such as using robust standard errors or transforming variables could be necessary to uphold the integrity of the model's inferences.

Checking the correctness of the matrix based on the checksum calculation

$$\sum x_{ij} = \frac{(1+n)\cdot n}{2} = \frac{(1+23)\cdot 23}{2} = 276$$

The sum of the columns of the matrix is equal to each other and the checksum, which means that the matrix is composed correctly.

Since among the values of features x and y there are several identical ones, i.e. associated ranks are formed, then in this case the Spearman coefficient is calculated as:

$$p = 1 - \frac{\sum 6d^2 + A + B}{n^3 - n}$$

Where

$$A = \frac{1}{12} \sum (A_j^3 - A_j)$$
$$B = \frac{1}{12} \sum (B_k^3 - B_k)$$

j - numbers of connectives in order for characteristic x;
A_j is the number of identical ranks in the j-th connective in x;
k - numbers of connectives in order for the characteristic y;
B_k is the number of identical ranks in the k-th connective in y.

$$A = [(2^3-2) + (6^3-6)]/12 = 18$$
$$D = A + B = 18$$
$$p = 1 - \frac{6 \cdot 1907 + 18}{23^3 - 23} = 0.0563$$

The connection between the trait $|e_i|$ and factor X weak and direct
Estimation of Spearman's rank correlation coefficient.
Using the Student's table we find $t(\alpha/2, k) = (0.05/2; 21) = 2.41$

$$T_{kp} = 2.414 \cdot \sqrt{\frac{1 - 0.0563^2}{23 - 2}} = 0.53$$

Since $T_{kp} > p$, we accept the hypothesis that the Spearman rank correlation coefficient is equal to 0. In other words, the rank correlation coefficient is statistically insignificant and the rank correlation between the scores on the two tests is insignificant.

Let's check the hypothesis H_0: there is no heteroskedasticity.

Since 2.414 > 0.53, the hypothesis of the absence of heteroskedasticity is accepted.

Conclusion.

In conclusion, this research focused on examining the relationship between the volume of exports (Y) and the volume of freight turnover on railways (X) using a paired linear regression model. The methodology involved several key steps:

A paired linear regression model was chosen to describe the relationship between Y and X.

Model parameters were estimated using the method of least squares, resulting in the equation y = 1627720.728*x - 24044514.999.

The statistical significance of the regression equation was verified using the coefficient of determination and the Fisher's F-test. The model was found to be statistically significant, explaining 84.72% of the total variability in Y, and the parameters were deemed statistically significant.

The parameters of the model were economically interpreted, indicating that an increase in X by 1 unit leads to an average increase in Y by 1627720.728 units.

The linear correlation coefficient was calculated and found to be 0.92, signifying a highly positive and strong correlation between Y and X.

The analysis of the elasticity coefficient indicated a substantial impact of X on Y.

Assumptions of the least squares method were verified, including the absence of heteroskedasticity.

The assumption of homoskedasticity (absence of heteroskedasticity) was confirmed through both graphical analysis and formal testing.

In summary, the research findings support the existence of a strong and significant relationship between the volume of exports and the volume of freight turnover on railways. The chosen regression model effectively captures this relationship, and the methodology applied ensures the reliability and validity of the results. Further, the absence of heteroskedasticity reinforces the robustness of the model. These findings contribute valuable insights into the complex dynamics of transportation and international trade, providing a foundation for informed decision-making in relevant sectors.

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