redin Revista Facultad de Ingeniería, Universidad de Antioquia, No.109, pp. 89-107, Oct-Dec 2023

Study on Transportation Logistics Industry development under economics: The case of HCM, Vietnam

Estudio sobre el desarrollo de la industria de logística de transporte: caso de HCM, Vietnam

Vu Thi Kim Hanh [1*] Nguyen Hong Nga [2]

[1]University of Economics and Law. # 669, Highway 1, Quarter 3, Linh Xuan Ward, Thu Duc City. P. C. 700000. Ho Chi Minh City, Vietnam.
[2]Vietnam National University. Linh Trung Ward, Thu Duc City. P. C. 700000. Ho Chi Minh City, Vietnam.

CITE THIS ARTICLE AS:

V. T. Kim-Hanh and N. Hong-Nga. "Study on Transportation Logistics Industry development under economics: The case of HCM, Vietnam", *Revista Facultad de Ingeniería Universidad de Antioquia*, no. 109, pp. 89-107, Oct-Dec 2023. [Online]. Available: https://www.doi.org/10.17533/udea.redin.20221105

ARTICLE INFO:

Received: November 08, 2021
Accepted: November 24, 2022
Available online: November 25, 2022

KEYWORDS:

Transportation logistics industry; labor productivity; capital productivity GDP

Industria logística del transporte; productividad del trabajo; productividad del capital PIB

ABSTRACT: The objective of this paper is to measure seven factors, including Labor, Capital & Scale, Physical Infrastructure, Information Technology Infrastructure, Institutions, Openness to the Economic Environment, and Emission. Furthermore, another objective is to assess which factors impact on Labor Productivity, Capital Productivity, and Gross Domestic Product (GDP) of the Transportation Logistics Industry in Ho Chi Minh. It will also assess how GDP is impacted by Labor Productivity and Capital Productivity. The Methodology used includes Cronbach's Alpha, Exploratory Factor Analysis, Pearson Correlation and Multivariate regression. Highlight results are Transportation Logistics Industry's Scale, such as total enterprises of Transportation Logistics Industry impacts on Labor Productivity at Sig. $< .001 and Beta = 0.706$, impacts on Capital Productivity at Sig. $< .001 and Beta = 1.728$, and impacts on Transportation Logistics Industry's GDP at Sig. $< .001 and Beta = 0.712$, which impacts all in the positive direction. Besides, while Labor Productivity impacts in the same direction on GDP at $Beta = 1.006$ and Sig. $< .001$, Capital Productivity does not impact on GDP. Therefore, to develop Transportation Logistics Industry, there is a need to focus on Transportation Logistics Industry's GDP by boosting its Labor Productivity. Also, there is a need to focus on the Transportation Logistics Industry's Scale in the direction of increasing total enterprises is important and necessary.

RESUMEN: El objetivo de este documento es medir siete factores, que incluyen mano de obra, capital y escala, infraestructura física, infraestructura de tecnología de la información, instituciones, apertura al entorno económico y emisiones. Además, otro objetivo consiste en evaluar qué factores impactan en la productividad laboral, la productividad del capital y el producto interno bruto (PIB) de la industria de logística de transporte en Ho Chi Minh. También evaluará cómo el PIB se ve afectado por la productividad laboral y la productividad del capital. La Metodología utilizada incluye el Alfa de Cronbach, Análisis Factorial Exploratorio, Correlación de Pearson y Regresión Multivariada. Los resultados destacados son la escala de la industria de la logística del transporte, como el impacto total de las empresas de la industria de la logística del transporte en la productividad laboral en Sig. $< .001 y Beta = 0.706$, impactos en la Productividad del Capital en Sig. $< .001 y Beta = 1.728$, e impactos en el PIB de la Industria Logística de Transporte en Sig. $< .001 y Beta = 0.712$, lo que impacta todo en sentido positivo. Además, mientras que la Productividad Laboral impacta en la misma dirección sobre el PIB en $Beta = 1.006$ y Sig. $< .001$, la Productividad del Capital no impacta en el PIB. Por lo tanto, para desarrollar la Industria de la Logística del Transporte, es necesario centrarse en el PIB de la Industria de la Logística del Transporte aumentando su Productividad Laboral. Además, es importante y necesario centrarse en la escala de la industria de la logística del

* Corresponding author: Vu Thi Kim Hanh
E-mail: hanhvtk20702@sdh.uel.edu.vn
ISSN 0120-6230
e-ISSN 2422-2844

transporte aumentando el total de empresas.

1. Introduction

Transportation Logistics was born and developed in association with human evolution. This is an essential need of current business development activities. When trade activities are being developed strongly, the demand for goods import and export increases which means that Transportation Logistics plays a more and more important role. Transportation Logistics accounts for more than 50% of cost and Logistics; economies are still constantly researching to optimize Transportation Logistics costs in the context of competition on a global scale. Particularly, during the Covid pandemic from December 2019 to the present, Transportation Logistics has increasingly demonstrated its role in transporting goods and maintaining supply chains on a global scale.

Road freight transportation is making an increase of Transportation Logistics activities, and has caused significant impacts on sustainability in the economies [1]. The major role of the transportation industry is not exclusively in an economic scope, but also as one of the leading fields generating the largest share of greenhouse gas emissions globally [2]. Transportation Logistics has many modes such as Road Transportation, Rail Transportation, Water Transportation, and Air Transportation, in order to transport each kind of cargo and human suitably [3]. Today, Transportation Logistics in terms of shipping activities is increasing and can cause potential hazards to commodities, the environment, and human lives [4]. The Transportation Logistics industry generates revenues from motor fuel taxes, vehicle registration, licensing, and parking and traffic which makes federal governments, the state, and the local community highly dependent on them [5].

Vietnam is a developing country in the Asian area. In 2020, despite the Covid-19 pandemic global spread, with a GDP growth rate of 2.9%, Vietnam is still one of very few countries in the world that has positive GDP growth. Ho Chi Minh is the largest trade city in Vietnam, which is the leading economic area of the country, and Ho Chi Minh's GDP contributes roughly 25% of the national GDP annually. However, Transportation Logistics cost is one of the major barriers affecting the competitiveness of Vietnam's economy. Transportation Logistics costs in Vietnam are equivalent to 20.9% of the GDP national country, a much higher rate than other countries in the Asian area, nearly two times higher than developed countries, and higher than the global average of 14%. The reason why transportation cost is too high which is equal to 30 - 40% of product costs, while this rate is only about 15% in other countries in the Asian region. Considering these reasons, a study in terms of Transportation Logistics' development with the empirical case in Ho Chi Minh, Vietnam is necessary and valuable, to contribute to both Vietnam and the researchers related to this field.

The objective of this paper is to measure seven factors. These are Labor, Capital & Scale, Physical Infrastructure, Information Technology Infrastructure, Institutions, Openness to the Economic Environment, and Emission. It also aims at assessing which factors impacts the Labor Productivity, Capital Productivity, and GDP of the Transportation Logistics Industry in Ho Chi Minh, Vietnam. Not everybody knows that Labor Productivity is the core of all factors that make up GDP. To improve Labor Productivity, it is necessary to create positive conditions to promote the Total Factor Productivity (TFP)'s growth rate. The Study model f this paper is developed based on the Cobb-Douglas production function. In this function, factor labor is studied by dividing it into four independent variables. These include female laborers, who have had a trained career, have graduated from high school, and have had a Labor index. Factor capital is divided into two independent variables consisting of business capital and fixed assets & long-term investment capital. Infrastructure, Institution, Openness to the economic environment, Emission belonging to TFP. This content is thought a novel contribution to this paper.

The paper has six sections, including: section 1 is the Introduction. Section 2 is the Literature review. Section 3 is the Methodology and Study Hypothesis. Section 4 is the Theoretical Basis. Section 5 is the Study Results. Section 6 is the Discussion and Section 7 is the Conclusion.

2. Literature review

We divided the Literature review into 2 parts including background theory and previous papers.
Background theory:
Cobb-Douglas production function:

$$\mathrm{P} = bL^kC^j \tag{1}$$

As Equation 1 states:
P is the total production
L is Labor
C is Capital
Labor and Capital are the basis for us to form two groups of variables LB and SC, in which labor is LB; LB includes four independent variables LB_1, LB_2, LB_3, LB_4, and SC is Capital including three independent variables SC_1, SC_2, and SC_3. Accordingly, we demonstrate the influence of Labor and Capital variables on the productivity and GDP

of Transportation Logistics in HCM. Details are shown in Table 1.

The theory of TFP:

$$\mathrm{Q} = \mathrm{F}(\mathrm{K}, \mathrm{L}; \mathrm{t}) \tag{2}$$

As Equation 2 states:
Q is the total output.
K is Capital.
L is Labor.
t is the occurrence of time in function F that allows "technical change". "This is any type of change in the production function. Hence, the slowdown, the acceleration, the improvement in the education level of the workforce, are some variables included in this term" [6].

Accordingly, the theory of TFP focuses on the manufacturing industry. In this paper, we want to clarify the TFP of a service industry called Transportation Logistics through an empirical study in HCM, Vietnam.

Thus, function (2) will be:

$$\mathrm{Q} = \mathrm{F}(\mathrm{K}, \mathrm{L}, \mathrm{PIN}, \mathrm{ITIN}, \mathrm{IN}, \mathrm{OE}, \mathrm{EM}) \tag{3}$$

As Equation 3 states:
PIN is Transport Physical Infrastructure
ITIN is Information Technology
IN is Institutions
OE is Openness Business Environment
EM is Emission
PIN, ITIN, IN, OE, EM are independent variables belonging to t. In which, PIN includes 8 variables are PIN_1, PIN_2, PIN_3, PIN_4, PIN_5, PIN_6, PIN_7, PIN_8, ITIN includes 6 variables are $ITIN_1$, $ITIN_2$, $ITIN_3$, $ITIN_4$, $ITIN_5$, $ITIN_6$, IN includes 6 variables are IN_1, IN_2, IN_3, IN_4, IN_5, IN_6, OE includes 3 variables are OE_1, OE_2, OE_3, EM includes 3 variables are EM_1, EM_2, EM_3. Details are shown in Table 1.

Previous papers:
[7] argued that "Sustainable investment policies increase the productivity of the gold mining system in Colombia. Increases of social capital promotion activities and physical infrastructure in the region of influence affect positively the multifactorial productivity of the Colombian gold mining process".

In terms of institutions, Regulatory frameworks play a vital role in Transportation Logistics [8]. The transportation sector's regulatory frameworks are taxes, customs, and duties. Indeed, fuel taxes contribute to a significant portion of the revenue to the budget of governments. In the Transportation Logistics industry, technology can significantly reduce its costs, improving the quality of Transportation Logistics services [9]. The application of information technology German standard Richtlinien für den Lärmschutz an Straben (RLS 90) allows us to predict noise levels with good accuracy in areas where road noise prevails, which improves Transportation Logistics' quality [10].

Industry scale and the covering level also play roles in Transportation Logistics, which are needed to integrate requirements of packing, and operating costs, assign orders to trips, and integrate the reverse flow of empty containers [11]. Transport infrastructure in China's Belt and Road Initiative countries plays an essential role in promoting economic growth [12]. The impact of the road and transport infrastructure of the China-Pakistan economic corridor is positively related to community support for tourism. In this sense, Tourism benefits have been perceived and the satisfaction of the community plays a role in this relationship. Pakistani local's perception in terms of tourism due to road and transport infrastructure development in the China-Pakistan economic corridor [13].

Additionally, logistics transport infrastructure needs to have urgent attention to public spending's impact on the labor share. Policy choices can be suggested to lessen the negative impact of road infrastructure on employment rates in China [14]. Using information technology such as the Frank-Wolfe algorithm demonstrates a positive effect on traffic flow, especially during rush hour causing traffic jams [15]. This is due to the difference between the CO_2 emission factor of diesel $[kgCO_2/dieselgal]$ and biodiesel $[kgCO_2/biodiesel]$. Consequently, to achieve a $230.81kg\ CO_2$ reduction, 304 gallons of biodiesel should be used to replace the same amount of diesel on the market [16]. Information technology applications such as a Vehicular Ad-Hoc Network (VANET), Wireless Sensor Network (WSN) are increasingly needed to exchange information between vehicles and infrastructure to improve driving conditions in order to have a development of Transportation Logistics system [17]. The rapid expansion of the Transportation Logistics network greatly facilitates the movement and transmission of information between cities, which is very important in promoting the development of economic activities and reshaping the spatial model of economic geography [18]. In Tokyo, Japan, the property bubble occurred in the late 1980s and its aftermath led to drastic fluctuations in land prices affecting Transportation Logistics facilities [19]. Citizen participation affects the consideration of the difficulties of managing Transportation Logistics [20]. European Union countries have been improving their Transportation Logistics environmental performance between 2017 and 2018. For less efficient countries, improving Transportation Logistics sustainability is achieved mainly by reducing greenhouse gas emissions from fossil fuel-powered engines, increasing the share of freight transport by rail and inland waterways as well as the share of transport energy from renewable sources [21].

Transportation Logistics has a positive effect on business enterprise activities in the Mekong Delta region. In Vietnam, the degree of Logistics influence varies, depending on the business sector. In Vietnam, Logistics costs are considered the most important factor to improve the country's Logistics system. Therefore, it is necessary to reduce costs to achieve the optimal balance between costs and revenue [22].

In Vietnam, goods transportation's demand, proximity to the market, production areas, customers, and transportation costs are considered the most important factors to determine the location of Logistics centers [23].

3. Methodology and study hypothesis

3.1 Study model

3.2 Study model Variables

3.3 Sample collection method and data source

Sample collection method

Step 1: In theory, the templates are built based on the Cobb–Douglas production function and TFP theory. Accordingly, the Labor (LB) includes 4 independent variables and the capital (SC) includes 3 independent variables based on the Cobb–Douglas production function. TFP includes the Transport Physical Infrastructure (PIN) includes 8 independent variables, the Information Technology (ITIN) includes 6 independent variables, the Institutions (IN) includes 6 independent variables, the Openness Business Environment (OE) includes 3 independent variables, and Emission (EM) includes 3 independent variables. Details are shown in the Background theory of the Literature review.

Step 2: Cronbach's Alpha is used to test the reliability of the variables. Accordingly, variables that do not reach the Alpha scale will be eliminated to proceed to the step of Exploratory Factor Analysis.

Step 3: Exploratory Factor Analysis is used to measure and select variables. Thus, the selected variables are more significant than the excluded ones, but still contain most of the information content of the original observed variables.

Step 4: Pearson Correlation is used to measure the correlation between independent variables, intermediate variables and dependent variables.

Data source

Data is the secondary data of the time series from 2010 to 2020 collected by the authors by manual extraction from the Ho Chi Minh statistical yearbook, from the Ho Chi Minh Statistics Department, the General Statistics Office of Vietnam. From PCI of Vietnam Chamber of Commerce and Industry and United States Agency for International Development in Vietnam. From PAPI of the Center for Development Research and Community Support under the Vietnam Union of Science and Technology Associations and the United Nations Development Program in Vietnam. And from Thomson Reuters.

3.4 Study method

Step 1: Cronbach's Alpha Test: to test the reliability of seven sets of observed independent variables; these steps include Labor, Capital & Scale, Physical Infrastructure, Information Techonology Infrastructure, Institutions, Openness of Economic Environment, and Emission.

Cronbach's Alpha =

$$\frac{\mathrm{n}}{\mathrm{n}-1}\left(1-\frac{\sum_{j=1}^{n}\partial_j^2}{\partial_{ov}^2}\right) \tag{4}$$

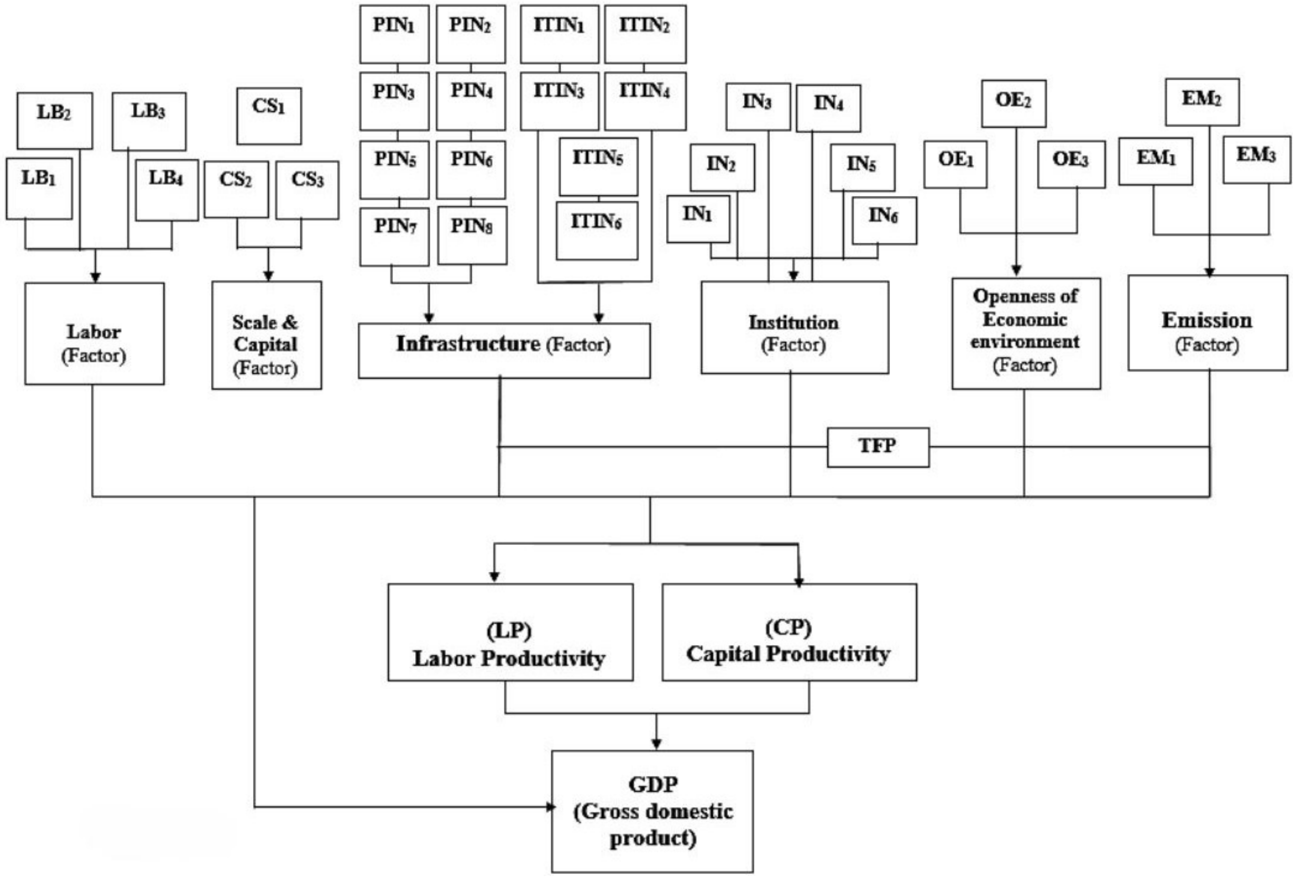
As Equation 4 states:
Where, n is the total observed variables. In this paper; Factor Labor has $n = 3$. Factor Capital & Scale has $n = 3$. Factor Physical Infrastructure has $n = 8$. Factor Information Technology Infrastructure has $n = 6$. Factor Institutions has $n = 6$. Factor Openness of Economic Environment has $n = 3$. Factor Emission has $n = 3$. Details of all observed variables are described clearly in Table 1. ov is observed variables $\partial_{ov}^2 = \sum_{j=1}^{n}\partial_j^2 + \sum_{j=1}^{n} \sum_{z\neq \mathrm{j}}^{n} a_{jz}$ z is [1, 8] and $z \neq j$

Step 2: Exploratory Factor Analysis (EFA): to measure and choose from many interdependent observed variables into a number of less observed variables which are called factors. Hence, the selected observed variables are more meaningful, but they are still contained most of the information content of the original observed variables. In EFA, each measurable variable is represented as a linear combination of basic factors. Each measurable variable's variability is explained by common factors. Measurable variables' overall variability is described by some common factors, and an identified factor for each variable. The Equation below represents the factor model

Table 1 Study model variables Explanation

Independent Variables	**Variables Explanation**
LB_1	Total labor of Transportation Logistics Industry (TLI); the unit is person.
LB_2	Total female labor of TLI; the unit is person.
LB_3	Percentage of labor has been trained career, which is calculated on total labor of TLI; the unit is person.
LB_4	Percentage of labor has been graduated from high school, which is calculated on total labor of TLI; the unit is person.
CS_1	Total enterprises of TLI; the unit is enterprise.
CS_2	Total capital is used on business operation; the unit is billion Vietnam Dong.
CS_3	Total capital is fixed assets and long investment; the unit is billion Vietnam Dong.
PIN_1	Road length; the unit is km.
PIN_2	Road quality; the unit is score.
PIN_3	Rail length, the unit is km.
PIN_4	Rail quality; the unit is score.
PIN_5	Inland waterway length; the unit is km.
PIN_6	Total airlines depart from Vietnam to international destinations; the unit is airline.
PIN_7	Rail airlines; the unit is score.
PIN_8	Total airports are connected between Vietnam airports and international airports; the unit is airport.
$ITIN_1$	Total internet lines; the unit is line.
$ITIN_2$	Total ADSL internet subscribers; the unit is subscriber.
$ITIN_3$	Total internet broadband subscriptions; the unit is subscriber.
$ITIN_4$	International internet network; the unit is KB/sec per subscriber.
$ITIN_5$	Fixed telephone; the unit is subscriber.
$ITIN_6$	Total Mobile phone; the unit is subscriber.
IN_1	Citizen participation; the unit is score.
IN_2	Public and transparency; the unit is score.
IN_3	Duty to explain to citizens and effective interactions with all authorities; the unit is score.
IN_4	Corruption control in the public sector; the unit is score.
IN_5	Public administrative procedures; the unit is score.
IN_6	Public service supply; the unit is score.
OE_1	Investment from the state budget; the unit is billion Vietnam Dong.
OE_2	Foreign investment in the TLI in Ho Chi Minh; the unit is thousand USD.
OE_3	Openness of Economic Environment in Ho Chi Minh, unit is calculated by total export turnover divided by GDP of Ho Chi Minh.
EM_1	CO_2 emission factor; the unit is million ton.
EM_2	Methane emission factor; the unit is KT CO_2 equivalent.
EM_3	Air pollution emission factor; the unit is PM2.5 (Micrograms per Cubicm).
Intermediating Variables	
LP	Labor Productivity, $\mathrm{LP} = \sum_{\mathrm{j=1}}^{\mathrm{n}} i = \left(\frac{\mathrm{GDP}}{\mathrm{LB_1}}\right)$, where n is total years =11
CP	Capital Productivity, $\mathrm{CP} = \sum_{i=1}^{n} i = \left(\frac{\mathrm{GDP}}{(\mathrm{CS_2+CS_3})}\right)$, where n is total years =11
Dependent Variable	
GDP	Gross Domestic Product of the Transportation Logistics Industry

Source: Study result of authors



for the standard measure variables.

$$X_j = a_{j1}Y_1 + a_{j2}Y_2 + a_{j3}Y_3 + \ldots a_{jn}Y_n + U_jO_j \quad (5)$$

As Equation 5 states:
Where, X_j is a measurable variable j has been normalized
a_{jn} is the normalized multiple regression coefficient of factor n for measurable variable j
Y_1, Y_2, ..., Y_n are common factor 1, factor 2,..., factor n
U_j is the normalized regression coefficient of identified factor j for measurable variable j
O_j is an identified factor of measurable variable j

Identified factors are correlated with each other, and they have a correlation with common factors. The common factors are also described as linear combinations of measurable variables, measured by the following Equation:

$$Z_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + \ldots, W_{jk}X_k \quad (6)$$

As Equation 6 states:
Where, Z_j is an estimation of the coefficient of factor j
W_j is the coefficient weight of factor j k is the total measurable variables.

In this paper, after being tested by Cronbach's Alpha, the following selected factors will have EFA one by one:
The Labor factor has four measurable variables;
The Capital & Scale factor has three measurable variables;
The Physical Infrastructure factor has eight measurable variables;
The Information Technology Infrastructure factor has six measurable variables;
The Institutions factor has six measurable variables;
The Openness of the Economic Environment factor has three measurable variables;
The Emission factor has three measurable variables.

Step 3: Pearson Correlation test: to measure the correlation between independent variables and intermediating variables, between independent variables and a dependent variable, and between intermediating variables and a dependent variable.

Pearson Correlation coefficient =

$$\frac{n\left(\sum \mathrm{X}_1\mathrm{X}_2,\ldots,\mathrm{X}_9\right) - \left(\sum \mathrm{X}_1\right)\left(\sum \mathrm{X}_2\right),\ldots,\left(\sum \mathrm{X}_9\right)}{\sqrt{\mathrm{n}\left[\sum \mathrm{X}_1{}^2 - \left(\sum \mathrm{X}_1\right)^2\right]\left[\sum \mathrm{X}_2{}^2 - \left(\sum \mathrm{X}_2\right)^2\right],\ldots,\left[\sum \mathrm{X}_9{}^2 - \left(\sum \mathrm{X}_9\right)^2\right]}} \quad (7)$$

As Equation 7 states:
Where, n is total variables, in this paper $n = 9$, which includes seven sets of independent variables, one set of intermediating variables, and one dependent variable.
Seven sets of independent variables and one set of intermediating variables are calculated by average value, by the Equation below:
The average independent variable of Labor:

$$\text{LB\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(LB_1+LB_2+LB_3+LB_4)}{4} \right)$$

Average independent variable of Capital & Scale:

$$\text{CS\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(CS_1+CS_2+CS_3)}{3} \right)$$

Average independent variable of Physical Infrastructure:

$$\text{PIN\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(PIN_1+PIN_2+PIN_3+PIN_4+PIN_5+PIN_6+PIN_7+PIN_8)}{8} \right)$$

Average independent variable of Information Technology Infrastructure:

$$\text{ITIN\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(ITIN_1+ITIN_2+ITIN_3+ITIN_4+ITIN_5+ITIN_6)}{6} \right)$$

Average independent variable of Institutions:

$$\text{IN\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(IN_1+IN_2+IN_3+IN_4+IN_5+IN_6)}{6} \right)$$

Average independent variable of Openness of Economic Environment:

$$\text{OE\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(OE_1+OE_2+OE_3)}{3} \right)$$

Average independent variable of Emission:

$$\text{EM\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(EM_1+EM_2+EM_3)}{3} \right)$$

Average intermediating variable of Labor Productivity and Capital Productivity:

Where n is total years, $n = 11$

$$\text{P\_AVE} = \sum_{i=1}^{n} i = \left(\frac{(LP+CP)}{2} \right)$$

Step 4: Multivariate regression (MR) Basic MR model:

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \ldots + a_nX_n + u \quad (8)$$

As Equation (8) states:
Where, a_0 is the intersection between the vertical axis and the regression line. u – where u is another factor beyond X_1, X_2, X_3 ,..., X_n that this paper does not have analysis. X_1, X_2, X_3,.., X_n are independent variable 1, independent variable 2, independent variable 3,..., independent variable n.

In this paper, there are total of thirty-three independent variables, two intermediating variables, including Labor Productivity (LP) and Capital Productivity (CP), and one dependent variable GDP. After being assessed by Cronbach's Alpha, EFA, Pearson Correlation, each factor will have Multivariate regression with intermediating variable LP, intermediating variable CP, and dependent variable GDP, respectively.
Y = LB, CP, GDP, respectively. X = independent variables of seven factors mentioned above, which are described clearly in Table 1.

According to [24] and [25], here, $a_0 + a_1 + a_2 + a_3 + \ldots + a_n = 0$ means that the regression model has not been built suitably to the input data and does not have statistical significance.
$a_2 + a_1 + a_2 + a_3 + \ldots + a_n \neq 0$ is to show that the regression model has been built suitably to the input data and it has statistical significance.
$a_1 + a_2 + a_3 + \ldots + a_n > 0$ is to mean that independent variables have the same direction impact on dependent variable.
$a_1 + a_2 + a_3 + \ldots + a_n < 0$ is to mean that independent variables have opposite direction impact on dependent variable.
How strong the impact of independent variables is based on their Beta coefficients.

3.5 Study hypothesis

H_1: The independent variables have an impact on intermediating variable Labor Productivity and intermediating variable Capital Productivity.
H_2: The independent variables have an impact on the GDP of the Transportation Logistics Industry.
H_3: The intermediating variable Labor Productivity and intermediating variable Capital Productivity have an impact on GDP.

4. Theoretical basis

4.1 Female Labor

Participation of women in the workforce has been paid in numbers unprecedentedly in the 20th century [26] The world economy has identified trade as a potential determinant of female labor force participation. The female labor force increases whenever trade expands in areas where they employee a high number of female workers. Under conditions of high complementarity between capital and female labor, women's marginal productivity falls more than men's. As a result, the gender wage gap widens and the female workforce decreases [27].

4.2 Transportation Infrastructure

Transport infrastructure consists of roads, railways, inland water, air transport, and maritime transport infrastructure. Transport policy and infrastructure itself are unified, which is one of the most important elements of the integration of individual European Union countries into one economically and socially efficient structure [28]. The development of the transportation infrastructure system should improve to increase its effectiveness and boost new unique transport, logistics and intelligent technologies [29].

4.3 Institutions

Institutions are man-made rules of interaction that constrains the opportunistic and volatile behavior of people. Institutions make the actions of individuals more predicTable. Institutions that want to be effective must include some forms of sanction for non-compliance [30]. Institutions have an impact on economic growth, it develops through two channels which are supporting more open and efficient markets, and supporting economic growth and poverty reduction. When the institutional structure does not encourage creative entrepreneurial talent, it encourages redistribution and rent-seeking which leads economic growth to be lower. Therefore, an institutional structure that encourages talent and creativity in production is extremely important for economic development [31].

4.4 Economic Environment and Emission

The empirical study in China [32] stated that "There is significant spatiotemporal heterogeneity between economic development and ecological environment. Economic development and ecological environment are in an intermediate coupling coordination stage, causing more regions to lag economically". The costs incurred and the amount of pollutant emitted are roughly equal to the economic regulatory value [33]. The impact of GDP per capita growth on haze pollution has confirmed the relationship of the "inverted U" (Environmental Kuznets Curve). At the same time, urbanization has limited haze pollution, evidence of the existence of an Environmental Kuznets Curve between GDP per capita growth and haze pollution [34].

4.5 Transportation Logistics

Transportation Logistics is a key sector in developed economies; it is an essential catalyst for economic and social activities. However, it is important to emphasize the opposite impacts of this activity identified in economics as opposite externalities [35].

The development of Transportation Logistics has a relationship with the dynamics of economic growth in the countries of the Caspian-Sea-Coast [36]. As one mode of Transportation Logistics, Rail-truck intermodal transportation plays a vital role in freight transportation in North America. Therefore, it is crucial to ensure continuity and minimize the adverse impacts of disruption [37].

5. Study results

5.1 Cronbach's Alpha

Table 2 presents the first testing Cronbach's Alpha. To check up, measure, select and reject independent variables are based on [38]. Cronbach's Alpha of $ITIN = -.214$, $OE = .293$, $EM = .030$, $Labor = .553$, Capital & Scale $= .668$ are all < 0.5, so they are all rejected. Cronbach's Alpha of $IN = .680$, $PIN = .691$, $CS = .668$ are accepted, $EM = .553$ is < 0.6 that can be temporarily acceptable.

To check and reject Corrected Item-Total Correlation is based on [39]. Thereby, Corrected Item-Total Correlation of independent variables $INS_5 = .024 < 0.3$, $INS_6 = -.010 < 0.3$, $PIN_5 = -.362$, $PIN_8 = -.141$, $LB_4 = -.542$ which are all rejected.

Table 3 gives us information on Cronbach's Alpha testing result after ITIN, OE, EM, INS_5, INS_6, PIN_5, PIN_8, LB_4 have been deleted, and Information Technology Infrastructure (ITIN), Openness of economic environment (OE) and Emission (EM) have been removed.

Cronbach's Alpha of $IN = .780$, $PIN = .726$ are quite good. $LB = .622$, $CS = .668$ are both $< .7$ but they can be accepted.

In Exploratory Factor Analysis, one factor will be enough reliability if it has at least three observed variables [40, 41]. Each selected factor in Table 3 has at least three observed variables.

About Corrected Item-Total Correlation, all items in Table

Table 2 Cronbach's Alpha testing result of the first testing

Independent variables	**Reliability Statistics**		**Item-Total Statistics**		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Independent variables	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Institutions (IN)	.680	.607	INS_1	.568	.603
			INS_2	.650	.546
			INS_3	.718	.509
			INS_4	.492	.637
			INS_5	.024	.716
			INS_6	-.010	.727
Physical infrastructure (PIN)	.691	.795	PIN_1	.966	.607
			PIN_2	.716	.705
			PIN_3	.781	.681
			PIN_4	.981	.416
			PIN_5	-.362	.705
			PIN_6	.977	.454
			PIN_7	.770	.705
			PIN_8	-.141	.706
Information technology infrastructure (ITIN)	-.214	.701	$ITIN_1$	.698	-.245[a]
			$ITIN_2$	.644	$-.224^a$
			$ITIN_3$	.260	$-.714^a$
			$ITIN_4$	.704	$-.223^a$
			$ITIN_5$	-.750	.367
			$ITIN_6$	.153	-5.287^a
Openness of economic environment (OE)	.293	-.254	OEC_1	.348	$-5.643E-8^a$
			OEC_2	.348	$-2.878E-6^a$
			OEC_3	-.204	.391
Emission (EM)	.030	-2.852	EEI_1	.951	$-.004^a$
			EEI_2	.942	$-.371^a$
			EEI_3	-.992	.044
Labor (EM)	.553	.343	LB_1	.957	5.366E-6
			LB_2	.957	1.962E-6
			LB_3	.692	.622
			LB_4	-.542	.622
Capital & Scale	.668	.954	SOI_1	.824	.856
			SOI_2	.994	.179
			SOI_3	.990	.090

Source: Study result of authors

3 are > 0.3, which can all be kept. However, to have Cronbach's Alpha be stronger, three items including INS_4, PIN_2, PIN_7 have been removed.

Table 4 illustrates Cronbach's Alpha testing result after INS_4, PIN_2, and PIN_7 have been deleted. Thereby, Cronbach's Alpha of $IN = .839$, $PIN = .806$ are good and strong. Cronbach's Alpha of $LB = .622$ and $CS = .668$, as explained in Table 3 that they cannot remove any more items, because LC and SC each have only three items.

The corrected Item-Total Correlation of all items in Table 4 is strong and > 0.3. All of them are accepted.

5.2 Exploratory Factor Analysis (EFA) results

Table 5 describes the result of EFA, KMO of $PIN = .819$ is good, KMO of $LB = .660$ is accepted. KMO of $IN = .592$, KMO of $CS = .581$ are thought as not good, but they can be acceptable.

The standard of the EFA method is the KMO index must be > 0.5. And, the Barlett's test has a significance level

Table 3 Cronbach's Alpha testing result: after ITIN, OE, EM, INS_5, INS_6, PIN_5, PIN_8, LB_4 have been deleted

Factors	Reliability Statistics		Item-Total Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Independent variables	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Institutions (IN)	.780	.817	INS_1	.618	.742
			INS_2	.671	.687
			INS_3	.742	.644
			INS_4	.470	.839
Physical infrastructure (PIN)	.726	.944	PIN_1	.967	.650
			PIN_2	.716	.756
			PIN_3	.782	.730
			PIN_4	.981	.446
			PIN_6	.977	.487
			PIN_7	.770	.756
Labor (LB)	.622	.910	HRE_1	.957	1.310E-5
			HRE_2	.957	6.155E-6
			HRE_3	.692	.830
Capital & Scale (CS)	.668	.954	SOI_1	.824	.856
			SOI_2	.994	.179
			SOI_3	.990	.090

Source: Study result of authors

Table 4 Cronbach's Alpha testing result: after INS_4, PIN_2, and PIN_7 have been deleted

Factors	Reliability Statistics		Item-Total Statistics		
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Independent variables	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Institutions (IN)	.839	.839	INS_1	.545	.919
			INS_2	.875	.590
			INS_3	.765	.723
Physical infrastructure (PIN)	.782	.876	PIN_1	.967	.781
			PIN_3	.782	.876
			PIN_4	.981	.536
			PIN_6	.977	.584
Labor (LB)	.622	.910	LB_1	.957	1.310E-5
			LB_2	.957	6.155E-6
			LB_3	.692	.830
Capital & Scale (CS)	.668	.954	CS_1	.824	.856
			CS_2	.994	.179
			CS_3	.990	.090

Source: Study result of authors

of Sig < 0.05 to show the data used for factor analysis is appropriate, and observed variables are correlated with each other in the factor.

Sig Bartlett's Test: $IN = .002$, $PIN < .001$, $SC < .001$, $LC < .001$ which are all $< .05$ is to reject the hypothesis that observed variables are not correlated each other. Thus, the hypothesis that the correlation matrix between variables is homogenous is rejected, which is the variables are correlated with each other, and it is satisfied for EFA.

Table 5 Kaiser-Meyer-Olkin (KMO) and Bartlett test

		Institutions (IN)	Physical infrastructure (PIN)	Capital & Scale (SC)	Labor (LB)
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.592	.819	.581	.660
Bartlett's Test of Sphericity	Approx. Chi-Square	14.381	53.951	45.825	25.605
	df	3	6	3	3
	Sig.	.002	$< .001$	$< .001$	$< .001$

Source: Study result of authors

Table 6 presents the result of EFA by Principal components with Varimax rotation.

Three observed variables IN_1, IN_2, and IN_3 of Institutions are initially grouped into one group.
Four observed variables PIN_1, PIN_3, PIN_4, and PIN_6 of Physical Infrastructure are initially grouped into one group.
Three observed variables CS_1, CS_2, and CS_3 of Capital & Scale are initially grouped into one group.
Three observed variables LB_1, LB_2, and LB_3 of Labor are initially grouped into one group. Total variance of Institutions = 76.191% $> 50\%$, it can be said that this factor can explain 76.191% of the variability of input data.
Total variance of Physical infrastructure = 90.458% $> 50\%$, it is to mean that this factor can explain 90.458% of the variability of input data.
Total variance of Capital & Scale = 91.658% $> 50\%$, %, it is to determine that this factor can explain 91.658% of the variability of input data.
Total variance of Labor = 85.005% $> 50\%$, which is to understand that this factor can explain 85.005% of the variability of input data.
The Eigenvalues of Institutions = 2.286, Physical Infrastructure = 3.618, Capital & Scale = 2.750, Labor = 2.550 which are all high (> 1). Figure 1 illustrates factors that have been selected by the Varimax rotation method with the appropriate number of factors that are presented in Table 6.

5.3 Pearson correlation

Table 7 describes the Pearson Correlation results. The authors evaluate three correlations below:
The correlations between two intermediating variables Labor productivity (LP) and Capital productivity (CP) by calculating the average value of LP & CP (LP&CP_AVE) with four sets of independent variables by calculating the average value. Four sets independent variables include Institution (IN_AVE), Physical Infrastructure PIN_AVE, Capital & Scale (CS_AVE), Labor (LB_AVE).

The correlation between the dependent variable GDP and four sets of independent variables IN_AVE, PIN_AVE, CS_AVE, LB_AVE.
Correlation between dependent variable GDP and intermediating variable LP&CP_AVE. Sig. of intermediating variable LP&CP_AVE in correlation with four sets independent variables IN_AVE, PIN_AVE, LB_AVE, CS_AVE are 0.009, $< .001$, $< .001$, 0.006, respectively. They are all $< .05$, which is to show they have a correlation with each other.
Sig. of dependent variable GDP in correlation with four sets independent variables IN_AVE, PIN_AVE, LB_AVE, CS_AVE are 0.004, $< .001$, $< .001$, $< .001$, respectively. They are all $< .05$, which is to determine that they have a correlation with each other.
Sig. of GDP in correlation with intermediating variable LP&CP_AVE is $< .001$, and is $< .05$, is to understand that they have a correlation with each other.

5.4 Multivariate regression (MR) results

Table 8 presents the result of MR between independent variables Capital & Scale and intermediating variable Labor Productivity. R= .995, R Square = .990, Adjusted R Square = .985 is mean that the MR model is built at high reliability, which also indicates that input data has been explained by regression output at 98.5%. ANOVA has Sig. $< .001$ is to show the MR model has statistical significance at a level is $< .001$.

Durbin-Watson = 2.672, which is $1 < 2.672 < 3$ to mean there is no Autocorrelation [42]. SC_1 has Standardized Coefficients Beta = .706, Sig. $< .001$ and VIF of SC_1 = 4.616 < 10 showing that there is no Multicollinearity. So, CS_1 has the same direct impact on Labor Productivity at Beta = .706.
CS_2 has Sig. = .297 $> .05$, VIF = 101.902, CS_3 Sig. = .747 $> .05$, VIF = 82.036, which is show that there are Multicollinearities [43]. Hence, these results of CS_2 and

Table 6 Eigenvalues and extracted variances

Independent variables	Independent variables (component)	Initial eigenvalues			Extraction sums of squared loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Institutions	INS_1	2.286	76.191	76.191	2.286	76.191	76.191
	INS_2	.586	19.531	95.722			
	INS_3	.128	4.278	100.000			
Physical infrastructure (PIN)	PIN_1	3.618	90.458	90.458	3.618	90.458	90.458
	PIN_3	.315	7.870	98.328			
	PIN_4	.048	1.209	99.537			
	PIN_6	.019	.463	100.000			
Capital & Scale (CS)	CS_1	2.750	91.658	91.658	2.750	91.658	91.658
	CS_2	.245	8.161	99.819			
	CS_3	.005	.181	100.000			
Labor (LB)	LB_1	2.550	85.005	85.005	2.550	85.005	85.005
	LB_2	.408	13.602	98.607			
	LB_3	.042	1.393	100.000			

Source: Study result of authors

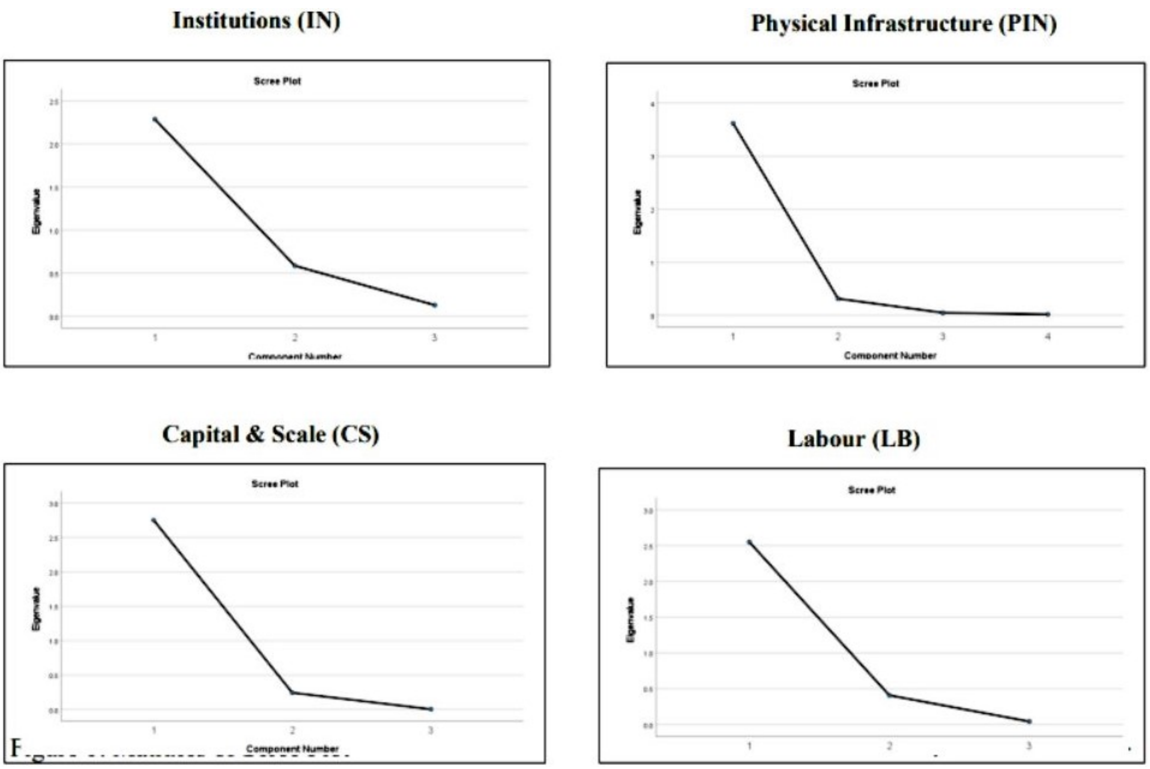


Figure 1 Matrixes of Scree Plot

CS_3 are not reliable.

Table 9 illustrates the MR results between independent variables Capital & Scale and intermediating variable Capital Productivity. R= .985, R Square = .971, Adjusted R Square = .959 means that the MR model is built at high reliability, and input data has been explained by regression output at 96%. ANOVA has Sig. $< .001$, that is to show MR model has statistical significance at a level is $< .001$.

Durbin-Watson = 1.571 is between 1 and 3. Which is to show there is no Autocorrelation. CS_1 has Sig. $< .001$ and Standardized Coefficients Beta = 1.728, and VIF of CS_1

Table 7 Eigenvalues and extracted variances

		IN_AVE	PIN_AVE	LB_AVE	CS_AVE	LP&CP_AVE	GDP
IN_AVE	Pearson Correlation	1	-.744**	-.815**	-.734*	-.745**	-.786**
	Sig. (2-tailed)		0.009	0.002	0.01	0.009	0.004
	N	11	11	11	11	11	11
PIN_AVE	Pearson Correlation	-.744**	1	-.984**	.944**	.914**	.992**
	Sig. (2-tailed)	0.009		$< .001$	$< .001$	$< .001$	$< .001$
	N	11	11	11	11	11	11
LB_AVE	Pearson Correlation	-.815**	.984**	1 .910**	.938**	.991**	
	Sig. (2-tailed)	0.002	$< .001$		$< .001$	$< .001$	$< .001$
	N	11	11	11	11	11	11
CS_AVE	Pearson Correlation	-.734**	.944**	.910**	1	.763**	.923**
	Sig. (2-tailed)	0.01	$< .001$	$< .001$		0.006	$< .001$
	N	11	11	11	11	11	11
LP&CP_AVE	Pearson Correlation	-.745**	.914**	.938**	.763**	1	.949**
	Sig. (2-tailed)	0.009	$< .001$	$< .001$	0.006		$< .001$
	N	11	11	11	11	11	11
GDP	Pearson Correlation	-.786**	.992**	.991**	.923**	.949**	1
	Sig. (2-tailed)	0.004	$< .001$	$< .001$	$< .001$	$< .001$	
	N	11	11	11	11	11	11
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

Source: Study result of authors

Table 8 Multivariate regression result between Capital & Scale and Labor Productivity

Reliability				**ANOVA**	**Coefficients**			
R	R Square	Adjusted R Square	Durbin-Watson	Sig.	Independent Variables	Standardized Coefficients Beta	Sig.	VIF
.995	.990	.985	2.672	$< .001$	(Constant)		.024	
					CS_1	.706	$< .001$	4.616
					CS_2	.439	.297	101.902
					CS_3	-.117	.747	82.036

Source: Study result of authors

= 4.616 < 10 is meant that there is no Multicollinearity. Hence, CS_1 impacts in the same direction on Capital Productivity at Beta = 1.728.

CS_2 has Sig. = .220, VIF = 101.902 > 10, and CS_3 has Sig. = .434, VIF = 82.036 > 10, there are Multicollinearities. Hence, the result of CS_2 and CS_3 are not reliable.

Table 10 describes the Multivariate regression result between independent variables, Physical Infrastructure and intermediating variable Capital Productivity. R= .947, R Square = .897, Adjusted R Square = .828 shows the MR model has been built at high reliability, and input data has been explained by regression output at 83%. ANOVA has Sig. = .004, which means the MR model has statistical significance at level = .004.

Durbin-Watson = 2.646, as $2.646 > 1$ and $2.646 < 3$, so there is no Autocorrelation. PIN_3 has Sig. $= .058 > .05$ which nearly has statistical significance, so it can temporarily be accepted, VIF of $PIN_3 = 2.696 < 10$ means there is no Multicollinearity. Hence, PIN_3 has an

Table 9 Multivariate regression result between Capital & Scale and Capital Productivity

Reliability				ANOVA	Coefficients			
R	R Square	Adjusted R Square	Durbin-Watson	Sig.	Independent Variables	Standardized Coefficients Beta	Sig.	VIF
.985	.971	.959	1.571	$< .001$	(Constant)		$< .001$	
					CS_1	1.728	$< .001$	4.616
					CS_2	-.876	.220	101.902
					CS_3	-.484	.434	82.036

Source: Study result of authors

Table 10 Multivariate regression result between Physical Infrastructure and Capital Productivity

Reliability				ANOVA	Coefficients			
R	R Square	Adjusted R Square	Durbin-Watson	Sig.	Independent Variables	Standardized Coefficients Beta	Sig.	VIF
.947	.897	.828	2.646	$.004^b$	(Constant)		794	
					PIN_1	872	.166	17.765
					PIN_3	-.503	.058	2.696
					PIN_4	3.059	.007	34.639
					PIN_6	-3.132	.003	23.010

Source: Study result of authors

impact on Capital Productivity in the opposite direction at Beta = -.503.

PIN_6 has Sig. = .003 $< .05$, VIF $= 23.010 > 10$, PIN_4 has Sig. = .007 $< .05$, VIF = 34.639 > 10, PIN_1 has Sig. = .166 $> .05$, VIF = 17.765 > 10, all have Multicollinearities. Hence, the results of PIN_6, PIN_4, PIN_1 are not reliable.

Table 11 describes MR results between independent variables Capital & Scale and dependent variable GDP. R= .998, R square = .996, Adjusted R Square = .995 which means the MR model is built at high reliability, and to mean that input data has been explained by regression output at a perfect level of 99.5%. ANOVA has Sig. $< .001$ which means the MR model has statistical significance at level $< .001$.

Durbin-Watson = 1.768 which is 1.768 > 1 and 1.768 < 3, that means there is no autocorrelation. Independent variable CS_1 has Sig. $< .001$, Standardized Coefficients Beta = .712, VIF = 4.616 < 10 which means there is no Multicollinearities. So, CS_1 impacts on GDP in the same direction at beta = .712.

CS_2 has Sig. = .920 $> .05$, VIF = 101.902 > 10, and CS_3 has Sig. = .182 $> .05$. VIF = 82.036 > 10 is show there are Multicollinearities. So, these results of CS_2 and CS_3 are not reliable.

Table 12 illustrates the MR results between intermediating variable Labor Productivity, variable Capital Productivity, and the dependent variable GDP.

R= .994, R Square = .988, Adjusted R Square = .985 is to show MR model is built at high reliability, and input data has been explained by regression output at a high level of 98.5%. ANOVA has Sig. $< .001$ is mean MR model has statistical significance at level $< .001$.

Durbin-Watson = 1.767, as 1.767 > 1 and $1.767 < 3$, so there is no autocorrelation. There are only Labor Productivity (LP) impacts on GDP at Sig. $< .001$, Standardized Coefficients Beta of LP = 1.006, which is to show LP impacts on GDP in the same direction at Beta = 1.006. Capital productivity (CP) has Sig. = .566 $> .05$ is mean that there is no statistical significance, or it can be said CP does not impact on GDP. VIF of LP = 1.290 < 10 and VIF of CP =1.290 < 10. So, there is no Multicollinearity.

6. Discussion

Based on study results in section 5, we have Cronbach's Alpha results after testing three times. There are three sets of independent variables that have been removed. The result indicates Cronbach's Alpha of Institutions $= .839$, Information Technology Infrastructure $= .806$, Labor $= .622$, Capital & Scale $= .668$. These four sets of independent variables that have been assessed by Exploratory Factor Analysis with the results are KMO of PIN $= .819$ is good, IN $= .592$ and LB $= .660$ are

Table 11 Multivariate regression result between Capital & Scale and GDP

Reliability				ANOVA	Coefficients			
R	R Square	Adjusted R Square	Durbin-Watson	Sig.	Independent Variables	Standardized Coefficients Beta	Sig.	VIF
.998	.996	.995	1.768	$< .001$	(Constant)		$< .001$	
					CS_1	.712	$< .001$	4.616
					CS_2	.024	.920	101.902
					CS_3	.309	.182	82.036

Source: Study result of authors

Table 12 Multivariate regression result between Labor Productivity, Capital Productivity, and GDP.

Reliability				ANOVA	Coefficients			
R	R Square	Adjusted R Square	Durbin-Watson	Sig.	Independent Variables	Standardized Coefficients Beta	Sig.	VIF
$.994^a$	.988	.985	1.767	$< .001$	(Constant)		$< .001$	
					LP	1.006	$< .001$	1.290
					CP	-.026	.566	1.290

Source: Study result of authors

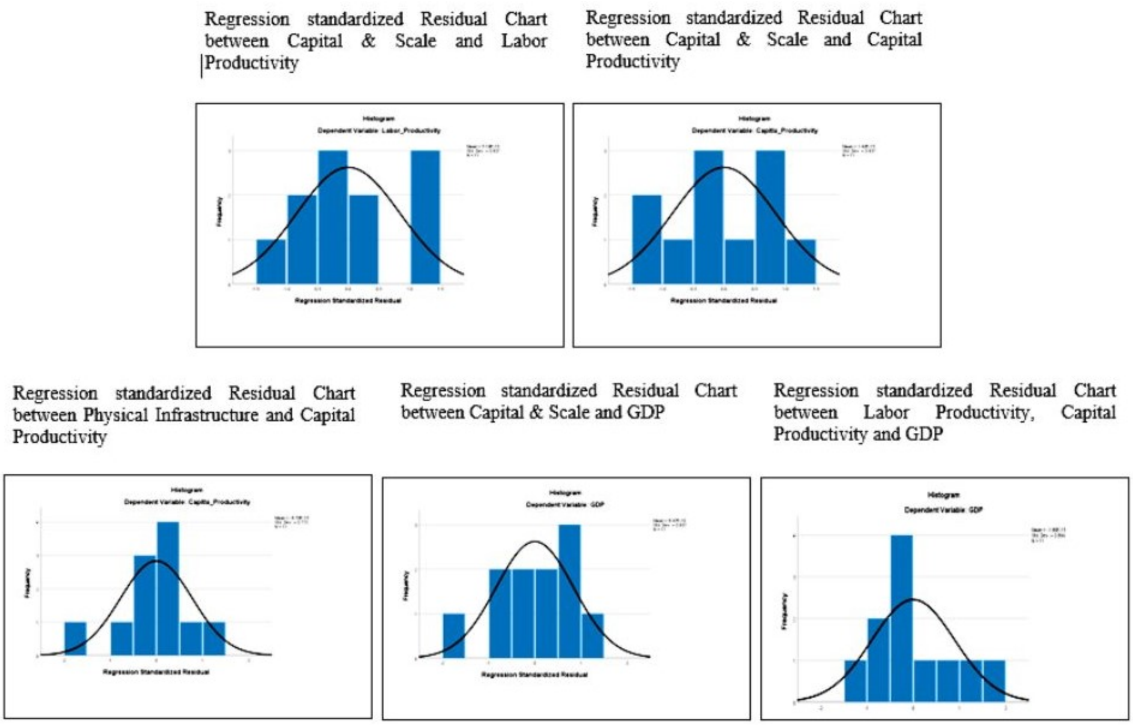


Figure 2 are Regression standardized Residual charts presented in table 8, table 9, table 10, table 11, and table 12

accepted, $CS = .581$ is thought to be not as good, but it can be accepTable. Sig Bartlett's Test of all these four sets IN, PIN, LB, SC are $< .05$ which means to reject the hypothesis that observed variables are not correlated with each other.

Principal components with the Varimax rotation method, include the Institutions factor that has three independent variables INS_1, INS_2, and INS_3. The Physical infrastructure Factor has four independent variables PIN_1, PIN_3, PIN_4, and PIN_6. The Capital & Scale Factor has three independent variables CS_1, CS_2, and CS_3. The Labor Factor has three independent variables LB_1, LB_2, and LB_3 which are initially grouped into one group per each, respectively.

The total variance of these four sets, consisting of Institutions = 76.191%. Physical Infrastructure = 90.4581%. Capital & Scale = 91.658%. Labor = 85.005% which are all $> 50\%$. These mean that factors IN, PIN, CS, LB can explain 76.191%, 90.4581%, 91.658 and 85.005% of the variability of the input data, respectively.

The Sig. of Pearson Correlation testing between LP&CP_AVE and four sets of independent variables IN, PIN, CS, and LB are 0.009, $< .001$, $< .001$, 0.006, respectively. Between GDP and four sets of independent variables are 0.004, $< .001$, $< .001$, $< .001$, respectively. Between GDP and LP&CP_AVE is $< .001$. These figures are to show that they correlate with each other.

Multivariate regression results of five models have shown that R, R Square, and Adjusted R Square are at high reliability which Adjusted R Squares are from 83% to 99.5%. ANOVAs of four models have Sig. $< .001$, there is one model that has Sig. $= .004$; these are to prove that five Multivariate regression models have been built at high reliability, which is to show the input data are appropriate to the models, and have high statistical significance. There is no Autocorrelation in all models. Although Multivariate regression models are built at a high statistical significance and high reliability, and there is no Autocorrelation, there are Multicollinearities in three independent variables that have Sig. > 0.5, in two independent variables have Sig. < 0.5. Hence these results are not reliable and have been rejected.

Multivariate regression results:
The multivariate regression result between intermediating variable Labor Productivity, intermediating variable Capital Productivity, and dependent variable Transportation Logistics Industry GDP: While intermediating variable Labor Productivity impacts in the same direction on GDP at beta = 1.006 and Sig. $< .001$, intermediating variable Capital Productivity does not impact on GDP at Sig. = .566 $> .05$.

CS_1 is the independent variable, which is the total number of enterprises of the Transportation Logistics Industry: Multivariate regression's result between independent variables Capital & Scale and Transportation Logistics Industry GDP shows independent variable CS_1 has Sig. $< .001$, Standardized Coefficients Beta = .712, VIF = 4.616. Hence, CS_1 impacts on Transportation Logistics Industry GDP in the same direction at beta = .712.
The Multivariate regression's result between independent variables Capital & Scale and Labor Productivity shows that CS_1 has Standardized Coefficients Beta = .706 and Sig. $< .001$ and VIF = 4.616, that is to say, CS_1 has the same direct impact on Labor Productivity at beta = .706.

The result of the Multivariate regression between Capital & Scale and Capital Productivity shows CS_1 impacts in the same direction on Capital Productivity at Beta = 1.728, Sig. $< .001$ and VIF = 4.616.
Multivariate regression result between Physical Infrastructure and Capital Productivity: PIN_3 has Sig. = .058 $> .05$ which is nearly has statistical significance, so it can be temporarily accepted, VIF of PIN_3 = 2.696 < 10. Hence, PIN_3 has an impact on Capital Productivity in the opposite direction at Beta = -.503, PIN3 is Rail length.

Managerial implications:
Based on the study results and discussion, the authors have policy implications, including: First, since Labor Productivity affects the GDP of Transportation Logistics in the same direction, attention should be paid to increasing Labor Productivity as much as possible.
In addition, the total number of enterprises in Transportation Logistics has a positive impact on GDP of Transportation Logistics, on Labor Productivity, and on Capital Productivity. Therefore, managers and policymakers should focus on encouraging an increase in the number of businesses operating in the field of Transportation Logistics.
Moreover, in the planning and management policy mechanism, it is not necessary to care about Capital Productivity because Capital Productivity does not affect the GDP of Transportation Logistics.
Besides, PIN_3 (Rail Length) has Sig. = .058 $> .05$ is close to statistical significance and should be temporarily accepted, Rail Length has an impact on Capital Productivity in the negative direction. Therefore, for the management and policy-making of Transportation Logistics, there should also be attention to minimizing the Rail Length.

7. Conclusion

Based on the study results in section 5, and the discussion in section 6, some remarkable findings are:
There are four sets of independent variables Instituion, Physical Infrastructure, Labor, and Capital & Scale factors that have been chosen in a total of seven sets of independent variables. Three sets of independent variables including Information Technology Infrastructure, Openness of Economic Environmment, and Emission have been rejected after being tested by Cronbach's Alpha.
The Institution factor has Cronbach's Alpha = .839 at a

good reliability level after rejecting three independent variables from a total of six variables. Also the Institution factor has the KMO of Exploratory Factor Analysis = .592 at an accepTable level, and Pearson Correlation testing has Sig. = 0.009 in a correlation with Institutions, and Labor & Capital productivity, Sig. = 0.004 in a correlation between Institutions and GDP. These show Institutions has a correlation with Labor & Capital Productivity, and GDP. There is no variables impact on Labor Productivity, Capital Productivity and GDP.

Multivariate regression results have no Autocorrelation. After Multicollinearities are rejected in all results of Multivariate regressions. The final results are; Regarding factor Capital & Scale, there is one independent variable, which is called the total number of enterprises in the Transportation Logistics Industry. This impacts in the same direction on Labor Productivity at Sig. $< .001$ and Beta = .706, it impacts Capital Productivity in the same direction at Sig. $< .001$ and Beta = 1.728, and it impacts on Transportation Logistics Industry GDP in the same direction at Sig. $< .001$ and Beta = .712.

In terms of Physical Infrastructure factor, there is an independent variable PIN_3 (PIN_3 is Rail Length) which has Sig. = .058 $> .05$, Sig. = .058 nearly having statistical significance. The authors consider it can provisionally be accepted, VIF of PIN_3 = 2.696 < 10 which means there is no Multicollinearity. Hence, Rail Length has an impact on Capital Productivity in the opposite direction at Beta = -.503.

Finally, the Multivariate regression result between the intermediating variable Labor Productivity, the intermediating variable Capital Productivity, and the dependent variable Transportation Logistics Industry's GDP shows that while intermediating variable Labor Productivity impacts in the positive direction on GDP at beta = 1.006 and Sig. $< .001$ VIF = 1.290, intermediating variable Capital Productivity has at Sig. = .566 $> .05$ which shows that there is no statistical significance, or it can be said that Capital Productivity does not impact GDP at Sig. = .566 $> .05$ VIF = 1.290.

Therefore, in order to develop accurately Transportation Logistics Industry, it needs to focus on Transportation Logistics Industry's GDP. On the one hand, based on the theory that as we all know, Labor Productivity is the core of all factors that make up GDP. On the other hand, the result of this study is to prove that Labor Productivity impacts on Transportation Logistics Industry's GDP in the same direction as Sig. $< .001$ and beta = 1.006. Thereby, in order to develop Transportation Logistics Industry, this industry needs to boost the GDP of the Transportation Logistics Industry by boosting its Labor Productivity. In particular, as total number enterprises of Transportation Logistics Industry impacts on Transportation Logistics Industry's GDP in the same direction at Beta = .712. So in order to boost the GDP of Transportation Logistics Industry, it needs to consider and re-organize the Scale of the Transportation Logistics Industry in the direction of increasing the number of enterprises. Besides, the independent variable total number of enterprises in the Transportation Logistics Industry impacts positively Labor Productivity at Beta = .706. Hence, it is more evidence to emphasize that the independent variable total number of enterprises of the Transportation Logistics Industry must be considered, re-organized and improved increasing the number of enterprises.

Limitation:

The study results have not shown the authors' expectations. The study model has been built which has seven factors, including seven sets of independent variables, two intermediating variables, and one dependent variable. There has been strictly tested step by step by Cronbach's Alpha, Exploratory Factor Analysis, Pearson Correlation, and Multivariate regressions. The final results show that there are only two sets of independent variables which impact on intermediating variable Labor Productivity, intermediating variable Capital Productivity, and the dependent variable Transportation Logistics Industry's GDP.

Authors plan to do the next study on this topic but using a different method to improve the research result.

8. Declaration of competing interest

We declare that we have no significant competing interests, including financial or non-financial, professional, or personal interests interfering with the full and objective presentation of the work described in this manuscript.

9. Acknowledgement

This research is funded by University of Economics and Law, Vietnam National University Ho Chi Minh City / VNU-HCM.We thank Dr. James Bleach and Dr. Graham Birley of the ōbex project for editorial support.

10. Funding

This research is funded by University of Economics and Law, Vietnam National University Ho Chi Minh City / VNU-HCM.

11. Author contributions

Both authors contributed equally to the conception and design of the study.

Vu Thi Kim Hanh1, E-mail: hanhvtk20702@sdh.uel.edu.vn. Is responsible for collecting data, writing, and adapting to all requirements of the Journal.
Nguyen Hong Nga2, E-mail: nganh@uel.edu.vn. Is responsible for conceptualizing, building study model, and processing study model.
1.University of Economics and Law, Ho Chi Minh City, Vietnam.
2.Vietnam National University, Ho Chi Minh City, Vietnam.

12. Data availability statement

The data is time series data which has been collected and extracted by manual method of author Vu Thi Kim Hanh. Data is betweet 2010 and 2020 are from Ho Chi Minh Statistics Department, the Statistical Year-Book of Ho Chi Minh, Vietnam Chamber of Commerce and Industry and United States Agency for International Development in Vietnam (PCI), the Center for Development Research and Community Support under the Vietnam Union of Science and Technology Associations and the United Nations Development Program in Vietnam (PAPI), and Thomson Reuters.

References

[1] A. Budak and P. A. Sarvari, "Profit margin prediction in sustainable road freight transportation using machine learning. journal of cleaner production," *Journal of Cleaner Production*, vol. 314, Sep. 10, 2021. [Online]. Available: https://doi.org/10.1016/j.jclepro.2021.127990

[2] M. Liu, X. Zhang, M. Zhang, Y. Feng, Y. Liu, and *et al.*, "Influencing factors of carbon emission in transportation industry based on cd function and lmdi decomposition model: China as an example. environmental impact assessment review," *Environmental Impact Assessment Review*, vol. 90, Sep. 2021. [Online]. Available: https://doi.org/10.1016/j.eiar.2021.106623

[3] G. E. Jeong, W. S. Choi, and S. S. Cho, "Topology optimization of tie-down structure for transportation of metal cask containing spent nuclear fuel. nuclear engineering and technology," *Nuclear Engineering and Technology*, vol. 53, no. 7, Jul. 2021. [Online]. Available: https://doi.org/10.1016/j.net.2021.01.019

[4] P. Erdem and E. Akyuzb, "An interval type-2 fuzzy slim approach to predict human error in maritime transportation," *Ocean Engineering*, vol. 232, Jul. 15, 2021. [Online]. Available: https://doi.org/10.1016/j.oceaneng.2021.109161

[5] R. Lewis and B. Y. Clark, "Retooling local transportation financing in a new mobility future. transportation research interdisciplinary perspectives," *Transportation Research Interdisciplinary Perspectives*, vol. 10, Jun. 2021. [Online]. Available: https://doi.org/10.1016/j.trip.2021.100388

[6] R. M. Solow, "Technical change and the aggregate production function. the review of economics and statistics is currently published by the mit press," *The Review of Economics and Statistics*, vol. 39, no. 3, Aug. 1957. [Online]. Available: https://doi.org/10.2307/1926047

[7] C. A. Delgado, S. A. Aramburo, and A. R. Hernández, "A system approach to analyze the productivity of a colombian gold mining process," *Revista Facultad de Ingeniería*, no. 72, pp. 173–185, Sep. 2014.

[8] S. A. Eisheh, W. Kuckshinrichs, and A. Dwaikat, "Strategic planning for sustainable transportation in developing countries: The role of vehicles," *Transportation Research Procedia*, vol. 48, 2020. [Online]. Available: https://doi.org/10.1016/j.trpro.2020.08.184

[9] A. Nechaev, Y. Skorobogatova, and M. Nechaeva, "Toolkit for the transportation and logistics infrastructure," *Transportation Research Procedia*, vol. 54, 2021. [Online]. Available: https://doi.org/10.1016/j.trpro.2021.02.116

[10] D. M. Murillo, J. C. Gil, V. Z. Rodríguez, and J. J. Téllez, "Assessment of the rls 90 calculation method for predicting road traffic noise in colombian conditions," *Revista Facultad de Ingeniería*, no. 75, Jun. 2015. [Online]. Available: https://doi.org/10.17533/udea.redin.n75a17

[11] R. Masson, A. Trentini, F. Lehuédé, N. Malhéné, O. Péton, and *et al.*, "Optimization of a city logistics transportation system with mixed passengers and goods," *EURO Journal on Transportation and Logistics*, vol. 6, no. 1, Mar. 2017. [Online]. Available: https://doi.org/10.1007/s13676-015-0085-5

[12] C. Wang, M. K. Lim, X. Zhang, L. Zhao, and P. T. WooLee, "Railway and road infrastructure in the belt and road initiative countries: Estimating the impact of transport infrastructure on economic growth," *Transportation Research Part A: Policy and Practice*, vol. 134, Apr. 2020. [Online]. Available: https://doi.org/10.1016/j.tra.2020.02.009

[13] S. Kanwal, M. I. Rasheed, A. HameedPitafi, A. Pitafi, and M. Ren, "Road and transport infrastructure development and community support for tourism: The role of perceived benefits, and community satisfaction," *Tourism Management*, vol. 77, Apr. 2020. [Online]. Available: https://doi.org/10.1016/j.tourman.2019.104014

[14] X. Zhang, G. Wan, and X. Wang, "Road infrastructure and the share of labor income: Evidence from china's manufacturing sector," *Economic Systems*, vol. 41, no. 4, Dec. 2017. [Online]. Available: https://doi.org/10.1016/j.ecosys.2017.08.001

[15] C. A. González, G. G. Calderón, and J. J. Posada, "Solving the traffic assignment problem using real data for a segment of medellin's transportation network," *Revista Facultad de Ingeniería*, no. 59, pp. 47–58, Jun. 2011.

[16] A. N. Benavides and J. A. Lozano, "Waste cooking oil logistics and environmental assessment for biodiesel production in cali," *Revista Facultad de Ingeniería*, no. 88, 2018. [Online]. Available: https://doi.org/10.17533/udea.redin.n88a02

[17] M. A. Ramírez, M. E. Rivero, and I. V. Jiménez, "Vehicular traffic monitoring in v2i systems using a wireless sensor network. revista facultad de ingeniería," *Revista Facultad de Ingeniería*, no. 71, pp. 115–125, Jun. 2014.

[18] L. Duan, W. Sun, and S. Zheng, "Transportation network and venture capital mobility: An analysis of air travel and high-speed rail in china," *Journal of Transport Geography*, vol. 88, Oct. 2020. [Online]. Available: https://doi.org/10.1016/j.jtrangeo.2020.102852

[19] T. Sakai, K. Kawamura, and T. Hyodo, "Logistics facility distribution in tokyo metropolitan area: Experiences and policy lessons," *Transportation Research Procedia*, vol. 12, 2016. [Online]. Available: https://doi.org/10.1016/j.trpro.2016.02.064

[20] V. T. Alves, J. C. Mairesse, A. L. Neuenfeldt, M. Soliman, and L. D. Dalla, "Performance assessment of internal logistics for service companies," *Revista Facultad de Ingeniería, Universidad de Antioquia*, no. 74, pp. 188–199, Mar. 2015.

[21] S. B. Gruetzmacher, C. B. Vaz, and A. Ferreira, "Sustainability performance assessment of the transport sector in european countries," *Revista Facultad de Ingeniería*, no. 104, 2022. [Online]. Available: https://doi.org/10.17533/udea.redin.20210742

[22] V. L. Dang and G. T. Yeo, "Weighing the key factors to improve vietnam's logistics system," *The Asian journal of shipping and logistics*, vol. 34, no. 4, Dec. 2018. [Online]. Available: https:

//doi.org/10.1016/j.ajsl.2018.12.004

[23] T. Y. Pham, H. M. Ma, and G. T. Yeo, "Application of fuzzy delphi topsis to locate logistics centers in vietnam: The logisticians' perspective," *The Asian Journal of Shipping and Logistics*, vol. 33, no. 4, Dec. 2017. [Online]. Available: https://doi.org/10.1016/j.ajsl.2017.12.004

[24] K. Bhattarai, *Research Methods for Economics and Related Studies*. England, UK: University of Hull Business School, 2015.

[25] J. M. Wooldridge, *Introductory Econometrics: A Modern Approach*, 5th ed. United States of America, USA: Michigan State University, 2020.

[26] P. A. McManus and K. L. Johnson, "Female labor force participation in the us: How is immigration shaping recent trends?" *Social science research*, vol. 87, Mar. 2020. [Online]. Available: https://doi.org/10.1016/j.ssresearch.2019.102398

[27] P. Sauré and H. Zoabi, "International trade, the gender wage gap and female labor force participation," *Journal of Development Economics*, vol. 111, Nov. 2014. [Online]. Available: https://doi.org/10.1016/j.jdeveco.2014.07.003

[28] A. C. Kopiec, L. O. Siguencia, Z. G. Szostak, and G. Marzano, "Transport infrastructures expenditures and costs analysis: the case of poland," *Procedia Computer Science*, vol. 149, 2019. [Online]. Available: https://doi.org/10.1016/j.procs.2019.01.169

[29] S. Seliverstov, Y. Seliverstov, B. Gavkalyk, and S. Fahmi, "Development of transport infrastructure organization model for modern cities with growing effectiveness," *Transportation Research Procedia*, vol. 50, 2020. [Online]. Available: https://doi.org/10.1016/j.trpro.2020.10.073

[30] W. Kasper, M. E. Streit, and P. J. Boettke, *Institutional economics: Property, competition, policies*, 2nd ed. United Kingdom, UK: Edward Elgar Publishing, 2012.

[31] W. J. Baumol, "Formal entrepreneurship theory in economics: Existence and bounds," *Journal of business venturing*, vol. 8, no. 3, May. 1993. [Online]. Available: https://doi.org/10.1016/0883-9026(93)90027-3

[32] T. Shi, S. Yang, W. Zhang, and Q. Zhou, "Coupling coordination degree measurement and spatiotemporal heterogeneity between economic development and ecological environment empirical evidence from tropical and subtropical regions of china," *Journal of Cleaner Production*, vol. 244, Jan. 2020. [Online]. Available: https://doi.org/10.1016/j.jclepro.2019.118739

[33] B. Dey, B. Bhattacharyya, and F. P. García-Márquez, "A hybrid optimization-based approach to solve environment constrained economic dispatch problem on microgrid system," *Journal of Cleaner Production*, vol. 307, Jul. 20, 2021. [Online]. Available: https://doi.org/10.1016/j.jclepro.2021.127196

[34] W. Wu, W. Wang, and M. Zhang, "Using china's provincial panel data exploring the interaction between socio-economic and eco-environment system," *Ecological Complexity*, vol. 44, Dec. 2020. [Online]. Available: https://doi.org/10.1016/j.ecocom.2020.100873

[35] M. Sánchez, F. Zouaghi, F. Lera, and J. Faulin, "An extended behavior model for explaining the willingness to pay to reduce the air pollution in road transportation," *Journal of Cleaner Production*, vol. 314, Sep. 10, 2021. [Online]. Available: https://doi.org/10.1016/j.jclepro.2021.128134

[36] N. Akbulaev and G. Bayramli, "Maritime transport and economic growth: Interconnection and influence (an example of the countriesin the caspian sea coast; russia, azerbaijan, turkmenistan, kazakhstan and iran)," *Marine Policy*, vol. 118, Aug. 2020. [Online]. Available: https://doi.org/10.1016/j.marpol.2020.104005

[37] G. Y. Ke and M. Verma, "A framework to managing disruption risk in rail-truck intermodal transportation networks," *Transportation Research Part E: Logistics and Transportation Review*, vol. 153, Sep. 2021. [Online]. Available: https://doi.org/10.1016/j.tre.2021.102340

[38] L. J. Cronbach, "Coefficient alpha and the internal structure of tests," *Psychometrika*, vol. 16, 1951. [Online]. Available: https://doi.org/10.1007/BF02310555

[39] J. C. Nunnally and I. H. Bernstein, "The assessment of reliability," *Psychometric Theory*, vol. 3, pp. 248–292, 1994.

[40] H. F. Kaiser, "An index of factorial simplicity," *Psychometrika*, vol. 39, 1974. [Online]. Available: https://doi.org/10.1007/BF02291575

[41] B. Habing, "Exploratory factor analysis," University of South Carolina, South Carolina, SC, Tech. Rep., Oct. 15, 2003.

[42] N. E. Savin and K. J. White, "The durbin-watson test for serial correlation with extreme sample sizes or many regressors," *Econometric*, vol. 45, Nov. 1997. [Online]. Available: http://dx.doi.org/10.2307/1914122

[43] J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*, 7th ed. United States of America, USA: Prentice Hall, 2009.