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The effect of logistics performance indicators on the economic growth of developing countries

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ABSTRACT

Economic growth, in addition to depending on the resources of growth and productivity, depends on the ability of economic and social infrastructure, including transportation infrastructure and its quality. Logistics is one of the important infrastructures for economic growth. Singapore's cash register has the first rank and Iran has the 123rd rank. This study examines the effect of logistics performance indicators on the economic growth of developing countries during the period of 2007-2023. In this research, the panel data of 12 developing countries have been collected and evaluated in the form of four models using the simple panel method. The results of the estimation of the models show that there is a positive and significant relationship between the overall score of logistics performance indicators and economic growth. Therefore, investing in improving logistics performance indicators can help economic growth. The Logistics Performance Index is divided into six sub-indicators, in which the three key indicators of this industry, namely the quality of trade and transportation-related infrastructure, the Logistics Competence Index, and the Ease of Arranging Shipments Index at a competitive price, were also examined, and the results show that all three indicators have a positive and significant relationship with economic growth, and other variables used in the model, ie real gross capital formation and foreign trade, have a positive effect on the economic growth of the studied countries.

Keywords: indicators Logistics performance, economic growth, developing countries, simple panel

1.INTRODUCTION

Economic growth and development is one of the most important macroeconomic goals of any country. Because in order to raise the standard of living of people, a number of indicators such as social and economic indicators must be improved, and this is not possible except in the shadow of the country's economic growth. In order to achieve growth and development, many factors and policies are involved, one of which is trade policy.

Globalization and the expansion of the volume of foreign trade made the promotion and improvement of the logistical capacities of countries considered an important matter. Logistics is one of the tools that plays an important role in changing and improving economic indicators, and the logistics industry also makes significant contributions to the national economy by creating jobs, creating national income, and influx of foreign investment. In fact today, logistics, as a very important component of GDP, have provided the conditions for the growth and development of industrialized countries. And so the industry can affect interest rates, inflation rates, energy costs, and other aspects of the economy. As changes in the

logistics sector have made the process of production, distribution, and marketing easier, countries' investment in this field has created a significant competitive advantage in global trade. Therefore, it can be stated that countries must create a series of precise and effective planning in logistics activities in order to achieve cost and efficiency advantages. In industrialized countries, the logistics sector is known as the lifeblood of the national economy, and this industry is also an important factor in advancing the development of the national economy. In fact, this industry has created a bridge between the production and consumption process and between urban and rural areas. And the development of the logistics industry has important effects in breaking down barriers between regions and linking social production and consumption of residents. Malhotra and Mishra consider logistics as a form of support action that includes activities such as planning, executing, and controlling the movement of goods and people within companies, which are aided and supported in the supply chain process. Recently, the logistics system has been increasingly recognized as one of the main driving forces for economic growth. Logistics services provide sectoral communication in an economy and link the national economy to the global economy. The industry makes important contributions to the country's economy by creating job opportunities, generating additional income, and facilitating the entry of foreign investment (Foon Tang and Abosedra, 2019).

Today, the role of logistics in economic growth has become a topic of interest for researchers and policymakers around the world. So that today, logistics as an academic discipline is expanding, which is far from reaching full maturity. In this paper, the following hypothesis is investigated using panel data based on the dynamic panel method:

Do logistics activities and their performance lead to economic growth in developing countries?

In the second part, we will briefly discuss the relationship between logistics and economic growth, and in the third part, we will examine the empirical literature on the impact of logistics performance on economic growth. In the fourth part, the literature and theoretical foundations of the subject are explained. In the fifth part, the models and method of estimating the empirical model are introduced. And in the sixth part, we will discuss the descriptive statistics and the results of the model estimation. Finally, in the seventh part, we will conclude from the mentioned discussions.

2- The relationship between logistics and economic growth

2.1 Definition of Logistics

Logistics is an important part of a business that deals with goods and services, and it includes all activities and services that support the movement of goods within and outside borders, which is done in an efficient and cost-effective way. In fact, logistics is the science of planning, executing and controlling the flow of goods and services as well as information from the point of origin to the point of destination, which is done in order to increase efficiency, effectiveness and meet the needs of customers. Logistics is also a vital part of foreign trade, the efficiency of which can significantly affect the cost, time, and quality of goods and services provided to customers.

This activity has various dimensions, including transportation, warehousing, inventory management, order processing, and supply chain management. Among these cases, the issue of supply chain management, which is also known as the infrastructure of logistics, is of particular importance because its efficiency can help businesses reduce costs, improve customer service, and increase profit

in addition to the above definition, the World Bank also defines three main types of logistics:

* Intra-firm logistics:

Logistics that are done inside a firm. Such as the movement of raw materials between warehouses and production lines.

* Out-of-Enterprise Logistics:

Logistics that takes place outside firms and throughout the supply chain. Such as shipping goods from the manufacturer to the distributor.

* International Logistics:

Logistics that involves the movement of goods between different countries.

Developments in the growth of the global economy and increased competitiveness make logistics a strategically important sector. Accordingly, many developments have taken place in the logistics sector (Hayaloglu, 2015).

In Figure 1, the mechanism shows the impact of logistics investment on economic growth. Accordingly investment in logistics infrastructure has increased logistics capacity, increased efficiency, improved the quality of services of a secure domain, and increased added value. Therefore, this situation has led to low logistical costs, short shipping times, and the creation of increased labor opportunities. As a result, this process has increased efficiency and competitiveness for countries and has led to economic growth (Sujeta and Navickas, 2014).

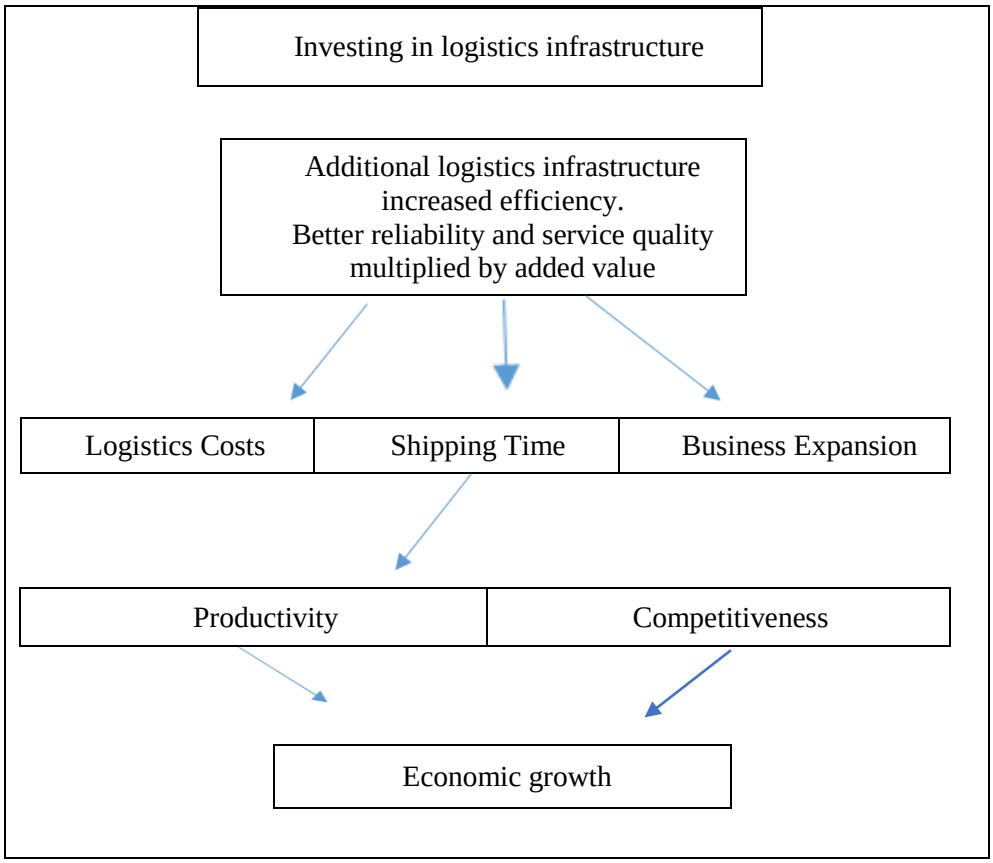

Fig (1) Mechanism of Impact of logistics investment Economic Growth

Logistics infrastructure leads to economic growth through rough mechanisms:

First, investing in infrastructure increases the demand for goods and services.

Second, improving the logistics infrastructure reduces travel time, and passenger and freight transportation directly benefits from saving time and money (Sujeta and Navickas, 2014).

Third, the use of efficient logistics systems can reduce costs for companies, as the expansion of the transportation network enables companies to reduce their inventory levels. In addition, companies can also benefit from advanced marketing information related to improved telecommunications (Foon Tang and Abosedra, 2019). Fourth, an organized logistics system is an important factor in attracting foreign direct investment, which is a key source of economic growth (Hong, 2007). Finally, the use of logistics systems leads to a concentration of business activities that increases productivity (Foon Tang and Abosedra, 2019).

2.2 Logistics Performance Index (LPI):

The Logistics Performance Index is a tool used by the World Bank to assess supply chain performance and logistics performance efficiency in 160 countries. The Logistics Performance Index is a multifaceted index that shows the performance of logistics in 6 dimensions. Also, this index ranges from 1 to 5, with a higher score indicating better performance. The World Bank has divided logistics performance indicators into two formats: inbound and outbound indicators.
The input indicators are:
1) Efficiency of Customs and Transparency of Border Management:
This index refers to the simplicity, speed, and predictability of customs clearance processes in each country.
2) Ease of access to international shipping at a competitive price:
This component refers to the cost and availability of international transportation for merchants in each country.
3) Trade Quality and Transportation Infrastructure:
This component deals with the quality of railways, roads, ports, airports, and other trade-related infrastructure in each country.
And the output indicators are:
1) Qualification and Quality of Logistics Service:
This index looks at the quality of services provided by freight, warehousing, and other logistics service providers in each country.
2) Ability to track and track goods:
This component refers to the ease of tracking and tracking goods during transit in each country.
3) Suitable time for delivery of shipments to customers on time:
This component refers to the reliability of when goods are delivered on time in each country.
The score of the Logistics Performance Index is calculated based on its average scores in the six mentioned components. A higher score indicates a more efficient logistics performance and a stronger supply chain in that country.

3- Previous studies

3-1. Foreign Studies

Pyra (2024) In an article, they analyzed the impact of the logistics sector on Poland's economic growth during the period 2018-2022. In this study, correlation analysis, cluster analysis, time series analysis, and linear regression have been used to better understand the above relationship. The results show that there is a positive and significant relationship between the development of the logistics sector and the growth of the GDP of Poland, and also the results show that investment and modernization of the logistics sector are essential for the economic growth of Poland and there is a need for further development of infrastructure and innovation in this field.
Li and Chen (2021) In a study titled "The Impact of Logistics Development on Economic Growth: An Empirical Study from Guangdong Province in China", the effect of logistics industry development on economic growth was investigated based on panel data from 21 cities in Guangdong Province, China, from 2007 to 2019. In this paper, the effect of spatial density in the logistics industry was measured using the general entropy method and Moran index. The results of this study show that the development of the logistics industry has had a positive and significant effect on economic growth.
Chakamera and Pisa (2020) In an article, he examines the relationship between logistics and economic growth in 32 African countries since 2007 - 2018. The results show that five indicators of the six logistics performance indicators have poor positive economic growth and the relatively high economic growth effects result from the "competence and logistics quality" index. The study also shows that growth potential in African countries depends on improving logistics performance, and prioritization for improved investment can improve long -term growth and development in Africa.
Saeedi et al (2020) In a study, they examined the relationship between transportation, logistics, foreign direct investment (FDI) and economic

growth in developing countries during the period 2000-2016. In this paper, panel data from 46 developing countries have been collected and estimated using the generalized moment method. The results of empirical analysis show that transportation and logistics infrastructures contribute to the attractiveness of FDI, and the sustainable economic growth of these results is of particular interest to policymakers working in developing countries and help them design and develop modern transportation and logistics. The results also show that there is a positive and significant relationship between economic growth and logistics performance.

Richard (2020) In an article titled "Logistics Contribution to Economic Growth: Evidence from Tanzania", he examines the role of logistics in Tanzania's economic growth during the period 2007-2016. In this paper, a simple regression model has been used for estimation, and the results of the estimation show that there is a positive and significant relationship between logistics and economic growth in Tanzania.

Malhotra and Mishra (2019) In an article titled " The Growth Effect Economic Sector on the Logistics Sector in India" to examine the effect of Economic growth focused on net profits in the logistics sector in India.

In this paper, the effect of variables such as changes in taxes, changes in inflation rates, and changes in GDP in the service sector on the profits of the logistics industry during the period of 1991-2017 has been investigated, and the results of the model estimation show that tax costs and inflation rate have a negative effect on the profitability of the logistics sector, while the change in the service sector has a positive effect on the profitability of the logistics sector. However, the GDP service sector has a lower impact on the profitability of the transportation industry compared to tax rates and inflation.

Foon Tang and Abosedra (2019) In this study, the relationship between logistics performance, exports and economic growth of Asian countries was investigated. This paper relies on the balanced panel data of 23 Asian countries during the period 2010-2016 and the results show that the performance of logistics and exports has a positive and significant effect on the economic growth of the studied countries. Also, the performance of the logistics sector is an important factor for business. Therefore, economic growth in Asia is contingent on the level of logistics performance in the countries studied.

Sezer (2017) In a study, the causal relationship between logistics and economic growth of BRICS countries and Turkey has been examined. And the data related to the above relationship were collected during the period 1993-2017. The results of this study show that the growth of air transportation has no significant causal effect on economic growth in the samples of BRICS countries and Turkey. Also, air transportation has more limited data compared to road, sea, and rail transportation and may have a more limited logistical area due to its costs.

Sezer and Abasiz (2017) In this article, the impact of the logistics industry on the economic growth of 34 OECD countries was investigated, in this paper, the effect of transportation industry variables and communication industry variables that make up the logistics industry on the increase of per capita income in OECD member countries was evaluated, and panel data analysis was also used to investigate the above relationships. The results show that the development of the logistics industry in the studied countries facilitates the process of growth and development by creating a significant competitive advantage.

Hayaloglu (2015) In this article, panel data analysis has been used and various variables such as domestic transportation infrastructure investment, rail transportation, and road transportation have been used as indicators of developments in the logistics sector. Domestic transportation has a positive relationship with economic growth, but rail transportation has no effect on economic growth.

Civelek et al (2015) In this article, the mediating effect of foreign direct investment on the relationship between logistics performance and economic growth is examined. In this study, the hierarchical regression method of the research model has been used to test the above

relationships, and the results of the model estimation show that the mediating effect of foreign direct investment on the relationship between logistics performance and GDP is a significant effect, but there is no direct relationship between logistics and GDP.

4. Theoretical Foundations

According to exogenous economic growth models, capital and labor play a fundamental and essential role in driving economic growth. However, in endogenous growth models, greater emphasis is placed on the quality of production factors, as well as technological and technical changes. It can be argued that investment priorities have a more significant impact on promoting economic growth. Among these priorities, social and economic infrastructures are particularly important, with communication infrastructure being a key component. Within the various forms of communication, logistics and the supply chain have garnered more attention in relation to economic growth. The roots of the logistics industry can be traced back to ancient times when civilizations needed to transport goods over long distances. The ancient Egyptians used sophisticated logistical systems to build their pyramids, or the Romans used a network of roads to move soldiers through their territory, but what we know about today's logistics industry dates back to the advent of the Industrial Revolution. The invention of railways, steam engines, and automobiles made the transportation of goods faster and more efficient, and this led to an increase in trade and the need for more efficient systems for supply chain management.

Because of the close relationship between economics and logistics, the concept of logistics economics was created. Logistics economics studies a process In which logistics companies maximize their returns at the lowest possible cost to meet the infinite demands of their customers, naturally this efficiency is possible only with good management will be acceptable.

In other words, logistics is about how companies achieve maximum returns with minimal costs in the micro domain. And it requires how productivity, employment, growth, and contribution to the national economy can be improved (Sezer and Abasiz, 2017).

Early studies in the field of logistics, particularly in the field of transportation economics, have their roots in the second half of the 19th century and the research of Henry Adams. However, the real revolution in this field occurred with the publication of Peter Drucker's The Dark Continent of Economics in the 1960s. By highlighting the importance of the supply chain and the vital role of logistics in it, Drucker presented a more comprehensive and strategic view of this area.

In the 1960s, the decline in the profit rate in companies in developed countries led the latter companies to produce and develop and implement the processes of ordering, transportation, and packaging. With the impact of the increase in oil prices in the mid-1990s, it became important to carry out logistical activities at a lower cost. As a result, logistics that included only the physical supply and distribution phases became apparent after this period of logistics activities including transportation, inventory management, ordering, procurement, packaging, storage, information activities, and changing logistics activities and better organization.

Since the 1970s, advances in information and communication technology, advances in transportation methods, and advances in technology have led to the globalization of the industry. International, regional and global organizations have removed physical barriers to trade, and global trade has accelerated, all of which paves the way for the growth of international trade and the logistics industry. Along with the increase in trade in goods that had not been exchanged before and the rapid movement of information and services between nations, the foundations of today's understanding of logistics were laid. And this made the logistics system have a positive effect on the economy (Sezer and Abasiz, 2017).

The world wars also affected this industry in a way that countries used new and innovative

methods to move their supplies and soldiers, which had a great impact on the development of supply chain management and led to the introduction of new technologies in the world.

5- Model and data

5.1 Research Methodology

Typically, composite data is estimated based on dynamic patterns. And one of the characteristics of the combined data is the interpretation of the dynamics between the variables due to the input of the time factor. And the shape of a dynamic pattern in the combined data is as follows:

$$Y_{it} = \alpha + \beta X_{it} + \mu_t \quad (1)$$

where X_{it} is the vector of the independent variable, Y_{it} is the vector of the dependent variable, μ_t the error factor is related to the sections, and the error factor of the intersection i at the time t.

in this study, we use a simple hybrid model or a model without effects, which is known as the Pooled model. In this model, it is assumed that there is no trace of inconsistency between the units of observation and that all units follow the same functional relationship. In other words, in this model, it is assumed that the coefficients are the same for all countries.

In fact, the Pooled model is estimated using the conventional least squares method on panel data. And to find out if the Pooled model is suitable or not, we can use the Chu and Haussmann tests.

5.2 Introduction of Research Model

To conduct this research, the data of the panel of a sample of 12 countries based on various criteria such as the homogeneity of countries in the direction of the research and the availability of information have been used. The purpose of this realization is to investigate the following hypothesis:

Do logistics activities and their performance lead to economic growth in developing countries?

In addition, it has been tried to pay attention to the diversity of the geographical location of the countries in the selection of countries, these countries are:

Iran, Cameroon, Colombia, Mexico, Qatar, Singapore, Egypt, India, Indonesia, Algeria, Ghana, Thailand, where the required data were collected from the World Bank during the period 2007-2023.

In this article, four models have been used to investigate the relationship between logistics performance indicators on economic growth, and the models used in this research are as follows:

$$ln\, GDPr_{it} = \alpha + \beta_1\, ln\, LPI_{it} + \beta_2\, ln\, GCF_{it} + \beta_3\, ln\, POP_{it} + \varepsilon_{it} \quad (2)$$

$$ln\, GDPr_{it} = \alpha + \beta_1\, ln\, QTTI_{it} + \beta_2\, ln\, GCF_{it} + \beta_3\, ln\, POP_{it} + \varepsilon_{it} \quad (3)$$

$$ln\, GDPr_{it} = \alpha + \beta_1\, ln\, CQLS_{it} + \beta_2\, ln\, GCF_{it} + \beta_3\, ln\, POP_{it} + \varepsilon_{it} \quad (4)$$

$$ln\, GDPr_{it} = \alpha + \beta_1\, ln\, EACPS_{it} + \beta_2\, ln\, GCF_{it} + \beta_3\, ln\, POP_{it} + \varepsilon_{it} \quad (5)$$

Where:

ln GDPr: Natural logarithm of real GDP per capita

ln LPI: Natural Logarithm of Logistics Performance Index: Overall Score

ln GFC: Natural logarithm of gross capital formation

ln QTTI: Natural logarithm of trade quality and transportation-related infrastructure

ln CQLS: Natural logarithm competence and quality of logistics services

ln POP: Natural logarithm of the population (As a Labor Force Variable)

ln EACPS: Ease of arranging shipments at a competitive price

5.3Investigating the Reliability of Variables

In the panel data, as in the time series data, it is necessary to examine the reliability (static) of the variables, and in the panel data, if the variables are not the same, the regression pattern can be considered a false pattern. For this reason, in this study, before estimating the model, we will investigate the reliability of the variables, and among the methods of the variables' durability test, only the Levin-Lin-Chu test (LLC) has been used. In This hypothesis test (H0) indicates the existence of a single root in the variable (uncertainty). Therefore, if the obtained statistic rejects the hypothesis (H0) or in other words, the hypothesis (H1) is accepted, we can say that the variable in question is mana.

The results of whether or not the variables are permanent, are shown in Table 1:

Table (1): Results of Unit Root Test (Source: Researcher's Findings)

Variables	Possibility	Survival conditions
ln GDPr	0.0263	At the Mana Level I (0)
ln GCF	0.0175	At the Mana Level I (0)
ln LPI	0.0003	At the Mana Level I (0)
ln QTTI	0.0134	At the Mana Level I (0)
ln POP	0.0000	At the Mana Level I (0)
ln CQLS	0.0099	At the Mana Level I (0)
ln EACPS	0.0004	With a Mana Difference I (1)

6. Results
6-1 Descriptive Statistics

Table (2): Top countries in logistics performance indicators

Rating	Country	Overall Score LPI	Customs Concession	Infrastructure Concession	International Cargo Points	Logistics Merit Score	Points of timeliness	Tracking Score
1	Singapore	4.3	4.2	4.6	4.0	4.4	4.3	4.4
2	Finland	4.2	4.0	4.2	4.1	4.2	4.3	4.2
3	Denmark	4.1	4.1	4.1	3.6	4.1	4.1	4.3
4	Germany	4.1	3.9	4.3	3.7	4.2	4.1	4.2
5	New zealan	4.1	3.9	4.2	3.7	4.2	4.0	4.2
6	Switzerland	4.1	4.1	4.4	3.6	4.3	4.2	4.2
7	Australia	4.0	3.7	3.9	3.8	4.0	4.3	4.2
8	Belgium	4.0	3.9	4.1	3.8	4.2	4.2	4.0
9	Canada	4.0	4.0	4.3	3.6	4.2	4.1	4.1
10	Hong Kong (China)	4.0	3.8	4.0	4.0	4.1	4.1	4.2
123	Iran	2.3	2.2	2.4	2.4	2.1	2.7	2.4

In Table (1), it can be seen that Singapore and Finland have scored above 4 in all indicators, which indicates the efficiency of the supply chain in these countries. The World Bank also attributes the success of these countries to strong infrastructure, advanced logistics services, a suitable business environment, and a skilled workforce. Unfortunately, Iran has not been able to improve its position in the world due to challenges such as sanctions, lack of political stability, complex administrative bureaucracy, and lack of modern infrastructure, but despite the above challenges, there is a lot of potential for the growth of the logistics industry in Iran. In the coming years, we will be able to improve our position in the world.

In the following, evaluate the overall average of the Logistics Performance Index and We will also discuss its six indicators in 2007 (the first report) and 2023 (the last report) for the countries examined.

Figures (1) and (2) compare the overall LPI score and six key logistical performance characteristics for the countries studied in this study in 2007 and 2023.

As you can see, Singapore has the highest LPI among the countries, followed by Thailand, Qatar, and India, and Cameroon, although it had a relatively favorable situation in 2007, is in the lowest position in 2023.

Unfortunately, our country is also not in a good position among the countries studied, even in 2023, the amount of the overall LPI score has decreased slightly compared to 2007, and this can indicate that there are significant challenges in the supply chain and logistics performance in the country.

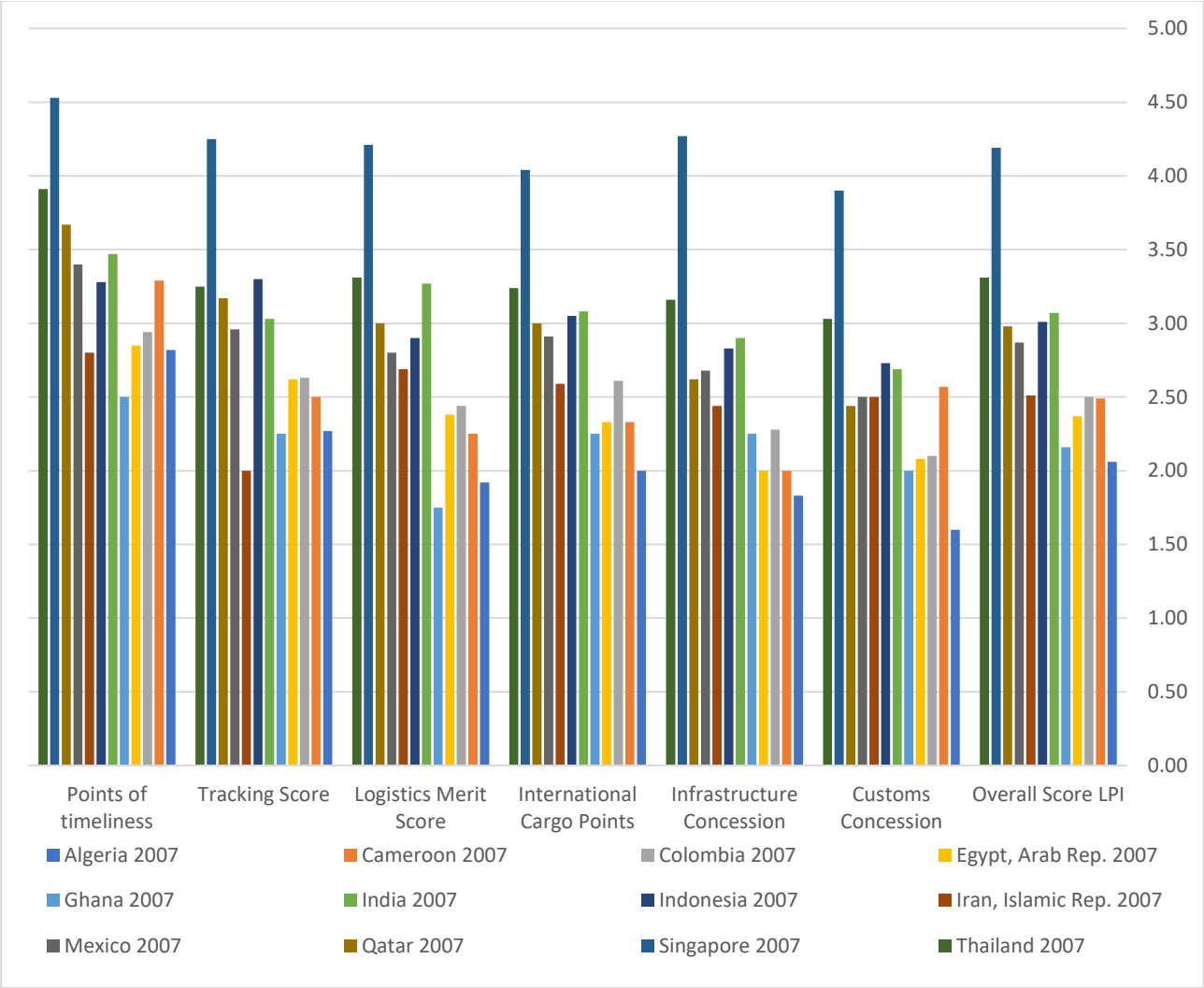

Figure (2): Logistics Performance Indicators in 2007

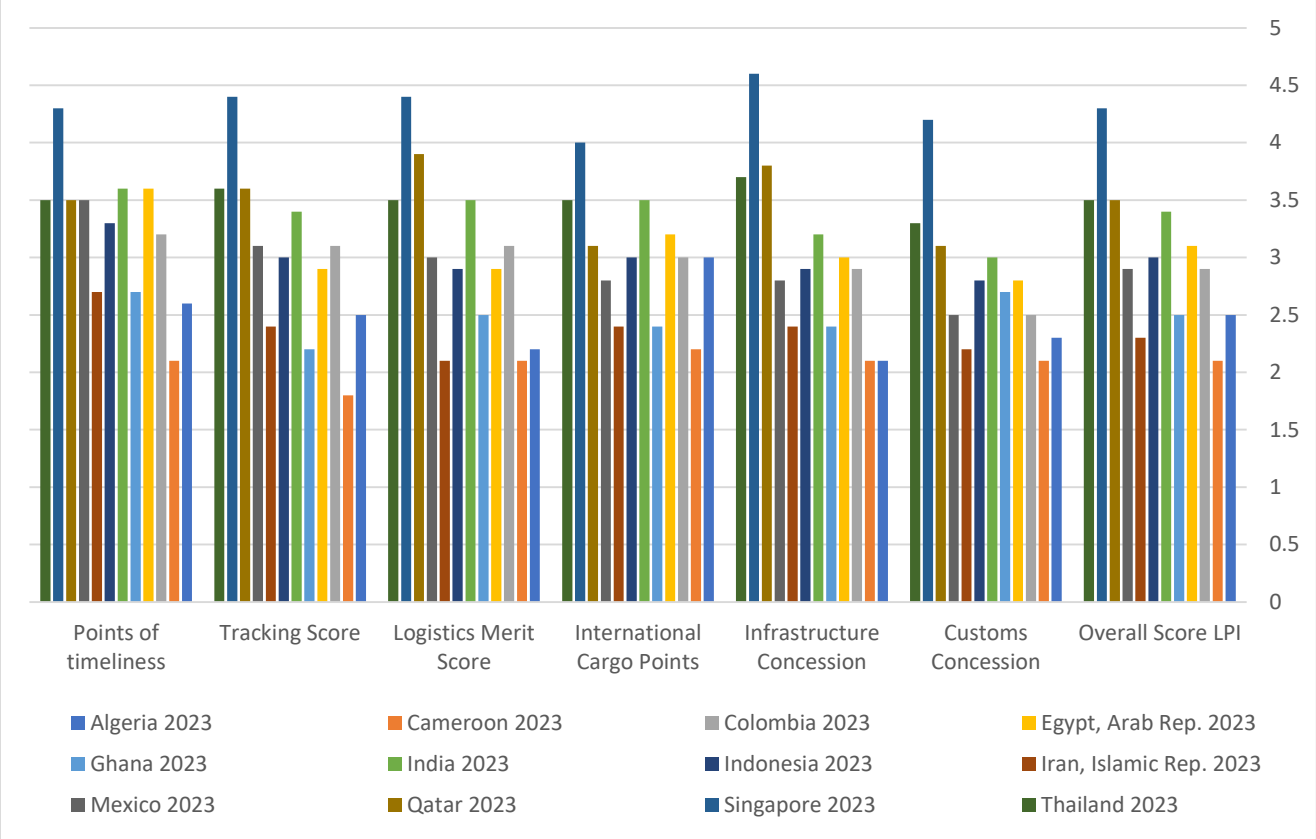

Figure (3): Logistics Performance Indicators in 2023

According to the charts, if we want to compare Iran's situation with the countries studied in terms of logistics performance indicators, we find that Iran is not in a good position even among Asian countries because Iran is in a lower position compared to countries such as Thailand, Singapore, Indonesia, and India. This situation can have various reasons, including a lack of investment in transportation infrastructure, weakness in customs processes, lack of integration of information systems, limitations in the use of new technologies, and most importantly, international sanctions, which have made the supply chain inefficient. But despite all these challenges, Iran can improve its position in the world in the coming years by improving customs processes and using more investment in infrastructure, due to its strategic geographical location and extensive transportation network. In the following, in the form of several tables, we calculate the amount of changes in logistics performance indicators from 2007 in 2022 for the countries under study.

Table (3). Changes in the Trade Quality Index and Transportation-Related Infrastructure (QTTI)

Percentage Changes	(2022)	(2007)	QTTI /Countries
+0.1	2.1	2	**Cameron**
+0.62	2.9	2.28	**Colombia**
-0.04	2.4	2.44	**Iran**
+0.12	2.8	2.68	**Mexico**
+1.17	3.8	2.63	**Qatar**
+0.33	4.6	4.27	**Singapore**
+1	3	2	**Egypt**
+0.3	3.2	2.9	**India**
+0.07	2.9	2.83	**Indonesia**
+0.27	2.1	1.83	**Algeria**
+0.15	2.4	2.25	**Ghana**
+0.54	3.7	3.16	**Thailand**

Table (4). Rate of Changes in the Competence and Quality Index of Logistics Services (CQLS)

Percentage Changes	(2022)	(2007)	CQLS/ Countries
-0.15	2.1	2.25	**Cameron**
+0.66	3.1	2.44	**Colombia**
-0.59	2.1	2.69	**Iran**
+0.2	3	2.8	**Mexico**
+0.9	3.9	3	**Qatar**
+0.19	4.4	4.21	**Singapore**
+0.52	2.	2.38	**Egypt**
+0.23	3.5	3.27	**India**
0	2.9	2.9	**Indonesia**
+0.28	2.2	1.92	**Algeria**
+0.75	2.5	1.75	**Ghana**
+0.19	3.5	3.31	**Thailand**

Table (5). Rate of Changes in the Efficiency Index of Customs Clearance Processes (ECCP)

Percentage Changes	(2022)	(2007)	ECCP/Countries
-0.47	2.1	2.57	**Cameron**
+0.4	2.5	2.1	**Colombia**
-0.3	2.2	2.5	**Iran**
0	2.5	2.5	**Mexico**
+0.66	3.1	2.44	**Qatar**
+0.3	4.2	3.9	**Singapore**
+0.72	2.8	2.08	**Egypt**
+0.31	3	2.69	**India**
+0.07	2.8	2.73	**Indonesia**
+0.7	2.3	1.6	**Algeria**
+0.7	2.7	2	**Ghana**
+0.27	3.3	3.03	**Thailand**

Table (6). Rate of Changes in the Ability index to Track and Trace Consignments (ATTC)

Percentage Changes	(2022)	(2007)	ATTC/Countries
-0.7	1.8	2.5	**Cameron**
+0.47	3.1	2.63	**Colombia**
+0.4	2.4	2	**Iran**
+0.14	3.1	2.96	**Mexico**
+0.43	3.6	3.17	**Qatar**
+0.15	4.4	4.25	**Singapore**
+0.28	2.9	2.62	**Egypt**
+0.37	3.4	3.03	**India**
-0.3	3	3.3	**Indonesia**
+0.23	2.5	2.27	**Algeria**
-0.05	2.2	2.25	**Ghana**
+0.35	3.6	3.25	**Thailand**

Table (7). Rate of Changes in the Ease of Arrangement Index or Competitive Price(EACPS)

Percentage Changes	(2022)	(2007)	EACPS/Countries
-0.13	2.2	2.33	**Cameron**
+0.39	3	2.61	**Colombia**
-0.19	2.4	2.59	**Iran**
-0.11	2.8	2.91	**Mexico**
+0.1	3.1	3	**Qatar**
-0.04	4	4.04	**Singapore**
+0.87	3.2	2.33	**Egypt**
0.42	3.5	3.08	**India**
-0.05	3	3.05	**Indonesia**
+1	3	2	**Algeria**
+0.15	2.4	2.25	**Ghana**
+0.26	3.5	3.24	**Thailand**

Table (8). Rate of changes in the frequency index of shipments in the scheduled times (FSRCST)

Percentage Changes	(2022)	(2007)	FSRCST/Countries
-1.19	2.1	3.29	**Cameron**
+0.26	3.2	2.94	**Colombia**
-0.1	2.7	2.8	**Iran**
0.1	3.5	3.4	**Mexico**
-0.17	3.5	3.67	**Qatar**
-0.23	4.3	4.53	**Singapore**
+0.75	3.6	2.85	**Egypt**
+0.13	3.6	3.47	**India**
+0.02	3.3	3.28	**Indonesia**
-0.22	2.6	2.82	**Algeria**
+0.2	2.7	2.5	**Ghana**
-0.41	3.5	3.91	**Thailand**

Table (9). Rate of Changes in the overall score of logistics performance indicators (LPI)

Percentage Changes	(2022)	(2007)	LPI/Countries
-0.04	2.44	2.48	**Cameron**
+0.4	2.93	2.49	**Colombia**
+0.19	2.63	2.5	**Iran**
+0.15	3.01	2.86	**Mexico**
+0.51	3.48	2.97	**Qatar**
-0.14	4.05	4.19	**Singapore**
+0.53	2.9	2.37	**Egypt**
+0.16	3.23	3.07	**India**
+0.11	3.11	3	**Indonesia**
+0.4	2.46	2.06	**Algeria**
+0.38	2.54	2.16	**Ghana**
+0.12	3.43	3.31	**Thailand**

Table (10). Models Estimation Results (Source: Researcher's Findings)

lnGDPr	first model	second model	third model	fourth model
ln GCF	0.6875** (0.0000)	0.7296** (0.0000)	0.6720** (0.0000)	0.7591** (0.0000)
ln POP	-0.8888** (0.0000)	-0.9121** (0.0000)	-0.8834** (0.0000)	-0.9286** (0.0000)
ln LPI	1.4429** (0.0000)	---	---	---
ln QTTI	---	0.8481** (0.0008)	---	---
ln CQLS	---	---	1.4196** (0.0000)	---
ln EACPS	---	---	---	0.2473** (0.0065)
obs	204	204	204	204
R-squared	0.8673	0.8589	0.8693	0.8671
F-statistic	435.8015	405.9758	443.6032	409.1943
D-W	0.093	0.057	0.070	0.087

The models have been estimated based on a sample of 12 countries over the period 2007–2023 using data from the World Bank. The estimation results are presented in the table above, where the numbers in parentheses indicate the significance levels of the variables, and the numbers marked with ** represent the estimated coefficients of the variables. As previously mentioned, in the first model, the effect of the overall average of logistics indices on economic growth has been considered. The estimation results of the first model indicate a positive and significant relationship between logistics and per capita GDP. Additionally, there is a positive and significant relationship between gross capital formation and per capita GDP. However, the population variable has a negative relationship with per capita income. For example, if the population increases by 10%, per capita GDP decreases by 8.8%.

he coefficient of the gross capital formation variable, while statistically significant, has a relatively small numerical magnitude (0.68). This implies that a 10% increase in gross capital formation leads to a 6.8% rise in output levels. Similarly, a 10% improvement in the overall Logistics Performance Index (LPI) score results in a 14.4% increase in output levels. In the second model, in addition to gross capital formation and population, one of the key logistics indicators the quality of trade and transport related infrastructure has been examined for its impact on real GDP per capita. The findings indicate that gross capital formation maintains a positive and significant relationship with real GDP per capita in this model as well.

Specifically, a 10% increase in gross capital formation leads to a 7.2% rise in output levels. Furthermore, the population variable exerts a negative impact on GDP per capita, with a coefficient of -0.91, suggesting that a 10% increase in population results in a 9.12% decline in GDP per capita. The quality of trade and transport-related infrastructure index also exhibits a positive and significant relationship with GDP per capita, where a 10% improvement in this index leads to a 0.84% increase in GDP per capita. In the third model, another logistics performance indicator logistics competence and service quality has been analyzed. The results confirm a positive and statistically significant effect on GDP per capita. Based on its coefficient, a 10% improvement in this index increases real GDP per capita by 1.41%.

Finally, in the fourth model, the ease of arranging shipments at competitive prices index has been examined. Similar to other logistics performance indicators, this index also has a positive and significant relationship with GDP per capita. This implies that a 10% increase in this index leads to a 2.47% rise in real GDP per capita.

8-Conclusion and Recommendations

This study has examined the impact of logistics performance indices on economic growth in 12 developing countries from 2007 to 2023. The relationships between variables were estimated using a simple panel method (Pooled OLS).

The findings of this study indicate that:

Gross capital formation has a positive and significant effect on real GDP per capita. However, the impact of physical capital accumulation on the economic growth of the analyzed countries remains limited and relatively small.

Governments can accelerate capital accumulation and enhance productivity by implementing policies to reduce economic risks, eliminate unnecessary regulations, attract foreign investors, identify investment opportunities, and ensure policy stability.

Population growth exhibits a negative relationship with GDP per capita in the studied countries. This finding suggests that population growth alone is not sufficient to guarantee economic growth. Other factors such as

demographic structure, migration rates, income distribution, labor quality, technological advancements, and the quality of social and economic inputs must also be considered.

Investing in human capital, particularly in education, healthcare, and skill development, along with the expansion of critical economic infrastructure, can help improve the relationship between population growth and economic development. However, such measures must be tailored to each country's specific conditions to be effective.

The overall Logistics Performance Index (LPI) score (Model 1), quality of trade and transport-related infrastructure (Model 2), logistics competence and service quality (Model 3), and ease of arranging shipments at competitive prices (Model 4) all have a positive and significant effect on the economic growth of the studied countries. This emphasizes the critical importance of logistics performance and supply chain efficiency. Additionally, the findings of Pira et al (2024), Chakamra and Piza (2020), and Tang and Abousadra (2019), align with the results of this research, confirming the positive relationship between logistics development and economic growth.

In general, it can be said that the development of the logistics industry has a very important role in promoting the economic growth of the countries under study, and also the logistics industry has a positive impact on the development of countries and the promotion of their all-round power.

As mentioned earlier, unfortunately, Iran has had a poor performance in this industry and has not been able to improve its position among the countries of the world. Based on the above analysis, we suggest the following to improve the logistics industry:

First, the infrastructure should be improved and the logistics equipment in the country should be upgraded, and this upgrade will be done through investment in transportation infrastructure.

Second, the use of new technologies such as geographic information systems and logistics management software, which reduce costs and increase efficiency in the logistics industry.

Third, communication and cooperation with countries that are advanced in the field of logistics should be strengthened, this cooperation can help exchange technical knowledge and access to best practices, as well as investment in logistics infrastructure.

Fourth, flexibility in the laws of the country and the lack of complexity of administrative bureaucracy can provide the conditions for innovation and improvement in logistics operations. The higher the transparency in the administrative processes the less corruption and the conditions to increase the efficiency of the logistics.

Resources

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