مجلة البحوث المالية والتجارية
المجلد (25) – العدد الرابع – أكتوبر 2024

Influence of Logistics Performance on Economic Growth in BRICS Countries

Ass. Prof. Hanaa Abdelaty Hasan Esmail

Faculty of commerce, Port Said University, Port Said, Egypt,
Hanaa.Esmail@com.psu.edu.eg

Dr. Marwa Sweilam

Thebes Higher Institute of Computer and Management Sciences, Cairo, Egypt,

Marwa.sweilam@thebes.edu.eg

تاريخ الإرسال	2024-08-22
تاريخ القبول	2024-09-02
رابط المجلة:	https://jsst.journals.ekb.eg/

Abstract

Logistics have played a crucial role in fulfilling economic development. BRICS countries is expected to take over 38% of the world's GDP after adding new members in 2024. This empirical study examines the impact of the logistics sector on economic growth across all 10 BRICS countries. The analysis utilizes panel data and relies on the World Bank Logistics Performance Index scores. Findings indicate that the Random Effects model exhibits consistency, efficiency and significance, while the overall LPI is negative insignificant determinant for economic growth in BRICS countries during the years. This may be attributed to the wide differences of LPI overall scores and Trade Across Borders (TAB) scores in BRICS countries. Results also reveal that Gross fixed capital formation, as a proxy for infrastructure investment, is the main statistically significant variable affecting GDP per capita in BRICS countries. Additionally, the main two significant variables among individual LPI are, the regularity with which shipments reach the recipient within the specified or anticipated timeframe, along with the capability to monitor and trace these consignments. The study highlights the importance of taking advantage of the wide opportunities exist to share knowledge and exchange experiences in developing logistic sector among BRICS countries.

Key Words

Logistics, BRICS countries, Economic Growth, LPI (Logistics Performance Index), Panel data analysis, Egypt.

Introduction

Logistics significance has been amplified through cross-border production networks globalization and proliferation. Logistics encompasses transportation, storage, customs clearance, and financial transactions. Nations worldwide are enhancing their logistical capabilities to facilitate production, distribution, investment and marketing processes; uplifting their competitiveness in international trade, facilitating integration into global economy and fostering overall income level. Logistics sector is increasingly acknowledged as a crucial driver for economic growth.

Logistics has become a wide area of research in the 20th century where supply chain management, efficient storage and adoption of digital technology are the core of interest. Smart technology contributed in the immense of Logistics 4.0 in the 21st century. It relies mainly on robotic process automation (RPA), Internet of Things (IoT) devices, route optimization, autonomous vehicles, automated warehouses and Artificial Intelligence (AI). Logistics 5.0 promoted additional values for logistics industry, that are related to human well-being, sustainability and resilience in times of crisis, especially in response to Covid-19 pandemic. Mecalux (2023).

Egyptian government developed an ambitious logistic strategy to become a regional center for international trade and logistics. Egyptian logistic strategy aims to amplify connections with Asia, Africa, Europe, while merging Egypt into global supply chains. It aims to raise Egyptian transportation services (railways, ports, and roads) contribution in GDP, which was estimated as 5% in 2020. It targets to eliminate transportation negative impacts on carbon dioxide emissions and to lower logistical costs from 20% down to the global average level of 10-12%. Awad (2021). The strategy is developing sustainable and green infrastructure connections among production areas, seaports and dry ports, implementing institutional and legislative reforms, improving management skills and competences of employees, encouraging

international investment and strategic partnerships with services providers, and enhancing services automation with international shipping lines and terminal operators. Sobhy (2023)

The World Bank assess the efficacy of logistics sector in numerous countries using the global Logistics Performance Index (LPI) for (1=low to 5=high). It helps identify challenges and opportunities for improvement. LPI is published in 2007, 2010, 2012, 2014, 2016, 2018 and 2023. The index formation relays upon results obtained from firms' survey in various countries with respect to logistics indicators. LPI score is a five scale Likert based score, where five points represents the best performance while one point is the least performance. LPI examines six dimensions; Policy regulation areas including customs, infrastructure, logistics competence and quality; Supply chain services performance outcomes including international shipments, tracking & tracing and timeliness. The LPI score is calculated by aggregating and averaging the scores across its six dimensions. Arvis, et. al (2023).

Our research examines whether the logistics industry significantly contributes to economic growth in BRICS nations. The current study uses the world bank development indicators to apply a panel data analysis for BRICS countries. The study addresses the logistics sector using LPI scores, on the overall and the individual level during the years 2007, 2010, 2012, 2014, 2016, 2018 and 2023.

The study starts with an overview of BRICS countries' history and contribution to the global GDP and the global supply chains. Next is a literature review for logistics in economic growth theories and empirical studies. Following is a representation of the research methodology hypothesis, and model specification. Finally results and discussion summarizes findings and offers recommendations.

Logistics in BRICS Countries

In 2009, BRICS was officially established, comprising five major economies: Brazil, Russia, India, China, and South Africa. The main objective is related to enhance members' cooperation in various fields such as finance, trade, investment, and technology. BRICS countries

witnesses rapid economic growth; especially China the second largest economy in the world. The New Development Bank (NDB) is the financial institution founded in 2014 within the BRICS coalition. It offers financial assistance with regard to infrastructure in BRICS countries and adopts sustainable development initiatives in cooperation with emerging economies. Barykin, et. al (2021).

In 2024; Egypt, United Arab Emirates, Iran, Ethiopia and Saudi Arabia, are formally admitted to the BRICS alliance. BRICS total GDP in 2022 approaches 25.9 trillion dollars, representing 25.6% of the global world GDP. After adding new members, BRICS total GDP in 2024 is expected to reach 38% of the global GDP. IDSC (2023).

BRICS countries have invested heavily in logistics infrastructure projects, including ports, roads, and railways, in addition to their investments in logistics automation and digitalization as well as adopting advanced logistics technologies to strengthen their capabilities. These initiatives focus on enhancing infrastructure, trade routes, and connectivity to promote global logistics development. Their impact on economic growth and efficiency in BRICS countries is significant.

BRICS countries present immense opportunities for collaboration and investment in logistics and development projects. Their growing middle-class populations and expanding consumer markets raises the demand for enhanced logistics services and infrastructure development. Cooperation among these countries and with international partners can lead to the development of efficient and sustainable logistics networks, fostering economic growth and trade expansion. Nekhoroshkov, et. al (2021).

Even though, BRICS countries face challenges within their alliance such as infrastructure gaps, regulatory complexities, and geopolitical uncertainties. The varying levels of economic development and infrastructure quality across these countries can pose challenges for seamless integration into global supply chains and interrupt the smooth functioning of logistics networks. This is clearly reflected in the varying values of LPI scores 8n BRICS countries.

-

For BRICS 2023, LPI overall scores ranges from 4 points in United Arab Emirates (ranking 7th out of 139 countries) to 2.3 points in Iran Islamic Republic (ranking 123rd out of 139 countries), as presented in Table (1). LPI scores for This is also the case for the individual LPI scores in BRCS countries. The minimum score is 2.1 points recorded for LPI_Logistics competence and quality in Iran Islamic Republic, while the maximum score is 4.2 recorded for LPI_ Timeliness in United Arab Emirates.

Table (1): Logistics Performance Index (LPI) ranks and scores of BRICS alliance in 2023

	Country	LPI rank	LPI overall score	LPI Customs	LPI Infra structure	LPI Logistics Competence and Quality	LPI International shipment	LPI Timeliness	LPI Tracking and Tracing
1	United Arab Emirates (UAE)	7	4	3.7	4.1	4	3.8	4.2	4.1
2	China	19	3.7	3.3	4	3.8	3.6	3.7	3.8
3	South Africa	19	3.7	3.3	3.6	3.8	3.6	3.8	3.8
4	India	38	3.4	3	3.2	3.5	3.5	3.6	3.4
5	Saudi Arabia	38	3.4	3	3.6	3.3	3.3	3.6	3.5
6	Brazil	51	3.2	2.9	3.2	3.3	2.9	3.5	3.2
7	Egypt	57	3.1	2.8	3	2.9	3.2	3.6	2.9
8	Russian Federation	88	2.6	2.4	2.7	2.6	2.3	2.9	2.5
9	Iran	123	2.3	2.2	2.4	2.1	2.4	2.7	2.4
10	Ethiopia	…	…	…	…	…	…	…	…

Source: World Bank database. (2023), Logistics Performance Index LPI, https://lpi.worldbank.org/international/global

The world bank issues the Trading Across Border (TAB) index within Doing Business index to record the time and cost (excluding tariffs) associated with exporting and importing goods, (0=low to 100=high). TAB denote logistics procedures in relation to border compliance and documentary compliance for exporting and importing of goods. The most recent data available is for 2019.

TAB scores ranges from 86.5 points in China (ranking 56th out of 213 countries) to 42.2 points in Egypt (ranking 171st out of 213 countries). TAB scores for BRICS countries and the minimum and maximum values are presented in Table (2).

Table (2): Trade Across Borders (TAB) scores and ranks of BRICS countries in 2019

	Country	TAB score	TAB Rank	Time to export		Costs to export		Time to import		Costs to import	
				Border compliance (hours)	Doc. compliance (hours)	Border compliance (USD)	Doc. compliance (USD)	Border compliance (hours)	Doc. compliance (hours)	Border compliance (USD)	Doc. compliance (USD)
1	China	86.5	56	21	9	256	74	36	13	241	77
2	India	82.5	68	52	12	212	58	65	20	266	100
3	Saudi Arabia	76.0	86	37	11	319	73	72	32	464	267
4	UAE	74.1	92	27	5	462	140	54	12	553	283
5	Russian Fed.	71.8	99	66	25	580	92	30	43	520	153
6	Brazil	69.9	108	49	12	862	226	30	24	375	107
7	Iran	66.2	123	101	33	415	60	141	40	660	90
8	South Africa	59.6	145	92	68	1257	55	87	36	676	73
9	Ethiopia	56.0	156	51	76	172	175	72	194	120	750
10	Egypt	42.2	171	48	88	258	100	240	265	554	1000
	Min.	42.2 (Egypt)	56 (China)	21 (China)	5 (UAE)	172 (Ethiopia)	55 (South Africa)	30 (Russian Fed.)	12 (UAE)	120 (Ethiopia)	73 (South Africa)
	Max.	86.5 (China)	171 (Egypt)	101 (Iran)	88 (Egypt)	1257 (South Africa)	226 (Brazil)	240 (Egypt)	265 (Egypt)	676 (South Africa)	1000 (Egypt)

NB: Export/ Import Border Type is port in all BRICS countries, except: Ethiopia export/import border type is land, Brazil import border type is land and Russian federation import border type is land/port.

Source: World Bank. (2021), Trading Across Border TAB, https://archive.doingbusiness.org/en/data/exploretopics/trading-across-borders

Data reveals that China has the minimum time to export: Border compliance with 21 hours, while Iran has the maximum value with 101 hours. For time to export: Document compliance; UAE has the

minimum value with 5 hours, while Egypt has the maximum value with 88 hours.

On the import side, Russia has the minimum time to import: Border compliance with 30 hours, while Egypt has the maximum value with 240 hours. For time to export: Document compliance; UAE has the minimum value with 12 hours, while Egypt has the maximum value with 265 hours.

LPI and TAB scores disclose wide opportunities for BRICS countries to exchange experiences related to developing logistics sector leading to increasing its contribution to economic growth.

Logistics and Economic Growth: A Literature Review

Logistics as a distinct concept are deeply planted in the international trade theories. Adam Smith's advocacy for free trade and specialization has had a profound influence on trade theories, while various economic theories have expanded knowledge of logistics contribution driving economic growth and facilitating trade. Understanding these theories is crucial for comprehending the intricate relationship between trade, logistics, and economic development.

As the era of industrial revolution evolved in the 18th century, Adam Smith introduced his Absolute Advantage Trade Theory that paved the way for inquiring the benefits of international trade, the significance of specialization and free trade in exchanging goods and services, and the labor division in facilitating trade and raising productivity. Schumacher (2012).

David Ricardo pioneered the theory of comparative advantage, emphasizing differences in land productivity. In contrast, the Heckscher-Ohlin theory focuses on disparities in factor endowments across countries. Both theories cognize the impact of location on trade and overall economic development. Additionally, Michael Porter highlighted external factors, such as efficient resource allocation, infrastructure, and governance, that contribute to a nation's competitive advantages. Porter (1990) and Panagariya (2013).

Spatial economics underscores the significance of geographical location and accessibility in economic endeavors. Robust logistics and transportation systems play a pivotal role in enhancing connectivity, reducing trade costs, facilitating the smooth flow of goods and services, enlarging economic development and promoting efficient business operations. Rodrigue (2024).

New Economic Geography theory highlights the impact of transportation and logistics on shaping the spatial distribution of economic activities. Regions equipped with well-established logistics infrastructure are more likely to witness growth and development due to improved access to markets and resources. The seamless movement of goods and services facilitated by efficient logistics becomes a driving force behind economic prosperity in these regions. McCann (2005).

Other economic theories, such as, gravity model of trade, and new trade theory, have addressed the dynamics of international trade and the role of logistics in facilitating the movement of goods across borders. These theories emphasize how transportation infrastructure, trade routes, and supply chain efficiency impact the patterns and volume of trade between nations. Host, et. al. (2019)

Khadim et al. (2021) investigated the impact of logistics infrastructure performance on economic growth in developing countries. They utilized the World Bank's Logistics Performance Index (LPI) for multiple years across 50 developing economies. By incorporating the LPI index into the standard Cobb–Douglas production function, they analysed 300 observations, considering labor and capital stock as key determinants of economic growth. It estimated the moderating effect of logistics by incorporating an interactive term involving logistics and capital stock. The findings indicated that the impact of labor and capital endowments varies based on the efficiency of logistics performance. Specifically, the elasticity coefficients differ significantly between countries with high logistics performance and those with low logistics performance. The overall LPI is a negatively insignificant determinant of economic growth in the developing countries. However, in high performance developing countries, estimates showed that a one percent unit increase in the LPI

contributes to approximately a 0.07 increase in economic growth. The study revealed that poor infrastructure and less developed physical capital in developing countries hinder economic growth directly and weaken capital stock indirectly. It concluded that high logistics performance, along with efficient infrastructure and capital stocks, played a moderating role in the economic growth of developing economies.

Muslija, et. al (2021) investigated how the logistics sector is interconnected with government spending, and economic growth. Data from 1971 to 2016 were used for this analysis in G7 countries. The research methodology utilized bivariate panel VAR. The findings showed that economic growth exhibits a positive response to logistics sector, represented by air freight, and government consumption. The authors relied on the Granger causality test, which revealed a bidirectional relationship between GDP and the logistics sector. Additionally, government consumption was found to have a unidirectional causal impact on GDP. Furthermore, the study relied on a trivariate panel VAR model providing additional evidence confirming the positive correlation between the logistics sector, government consumption, and economic growth. Notably, the paper highlighted the tendency for faster and more efficient modes of transport in G7 countries. The paper underscored the need to promote logistics sector developments using renewable energy, to add a significant contribution to economic development.

Historically competitiveness referred to advantages such as lower prices and improved product quality. Nowadays, globalization has broadened this concept to include how competition impacts territories and systems, influencing economic and social development and fostering entrepreneurship. This was highlighted by D'Aleo and Sergi (2017) who examined the possibility of competitiveness for network systems, infrastructure, airports and ports across Europe.

Regarding the relationship between logistics investment and regional economic growth in China. Chu (2012) conducted an investigation using data from 30 provinces in China. The study shed light on the impact of

logistics investment employing a conditional convergence model with a dynamic panel data approach. The study found that logistics investment has a significant and positive effect on economic growth in provinces of China. Importantly, this relationship held even after accounting for various other factors. Furthermore, Chu (2012) conducted a comparative analysis between coastal provinces and interior provinces to assess economic growth. The results indicated that incomes in interior provinces tend to converge as a system, while there is no evidence supporting income convergence among coastal provinces. Notably, logistics investment plays a more pronounced role in underdeveloped interior provinces compared to coastal ones.

Nguyen (2021) examined the impact of logistics determinants on Vietnam's economy, particularly following its accession to the WTO. The study utilized logistics performance index and its sub-indices, using data from the World Bank for 2007-2019. The study applied an OLS model to evaluate the impact of logistics on Vietnam's economy. The results showed that logistics activities, mainly; competitive pricing, infrastructure, up-to-date delivery, on-time shipment positively affect the Vietnamese economy. In contrast, service quality is insignificant, and convenient customs had a significant negative effect. The study suggests the model is effective for assessing logistics' economic impact and could guide Vietnam's economic policy development.

Kuzu and Önder (2014) explore the long-term relation between the Turkish economic growth and the development of the logistics sector. The study employed econometric tools; Unit Root Tests, the Engle-Granger test, and the Granger Causality test. In its econometric specification GDP was used representing economic growth and the Turnover Index of Transportation and Storage was set as an indicator of logistics development. The analysis indicates that these variables are co-integrated, identifying a long-term causal relationship from economic growth to logistics development. The study estimates that a one-unit change in the turnover index of transport and storage leads to a 0.3 percentage point change in GDP, with a directly proportional relationship between the two variables.

-

Economic agglomeration at the national level is highly relevant to logistics. According to Agglomeration Theory, businesses tend to cluster together to share resources, including logistics infrastructure. For example, agglomeration economies, arising through close proximity and interaction of firms—referred to as urbanization— could experience reduced effects over greater distances; Storper and Venables (2004). Conversely, the advantages of localization economies come from cost savings for firms situated near others in the same industry; Van Soest et al. (2006). Whether the agglomeration is urbanization or localization, it influences the dynamics of economic benefits and resource sharing in a particular area. As a result, efficient logistics networks in a region can promote economic development by enhancing collaboration and resource use. Duranton and Kerr (2015).

Hayaloglu (2015) investigates logistics developments impacts on economic growth across 32 OECD countries, through the years 1994-2011, utilizing static panel data analysis. The study employs various logistics indicators, including transportation activities (road, rail, and air), inland transport infrastructure investments and telecommunication activities (such as lines, mobile subscriptions and internet usage). The findings reveal that logistics sector advancements positively influence economic growth, particularly through infrastructure investments, road transportation, airline transport, and telecommunication activities. However, railway transportation is not proved significant in determining economic growth.

Rizkallah (2023) emphasizes the differing effects of logistics investment on economic growth between OECD and Arab countries. In OECD nations, the quality of roads is confirmed to significantly influence investment. Conversely, in Arab countries, economic growth is most strongly influenced by the internet, railways, and road quality. The study also highlights the crucial impact of trade openness, competitiveness, and logistics efficiency on economic growth in the Arab countries.

Sharipbekoval and Raimbekov (2018) explore the effects of the Logistics Performance Index, focusing on CIS countries from 2007 to 2016. Their

study employs factor analysis to evaluate both logistics sectors (such as transport and telecommunications) and economic indicators (including GDP, trade, and industry). They identify several key factors: general and agricultural industry; trade and investment; freight turnover, auto transport, communications; air transport and railway; service and mobile networks; and exports. These factors are interconnected and significantly contribute to economic growth. The study highlights that logistics efficiency drives economic growth as well as impacts countries overall development.

Ali Aden et al. (2022) examines how green logistics operations impact economic growth in addition to environmental, and social indicators in Sub-Saharan African countries participating in the Belt and Road Initiative (BRI). The study underscores the role of green logistics in improving infrastructure, sharing information among partners in the supply chain, increasing the volume of trade, and supporting sustainability. The authors use the System Generalized Method of Moments (S-GMM) to analyze data from 2008 to 2018. The study highlights the substantial improvement in logistics quality in SSA BRI host countries due to Chinese outbound FDI, which enhances infrastructure, cost, time, customs services, tracking, and international shipments' consistency. The study reveals a positive association between green logistics operation and China's foreign direct investment, trade openness, and economic output. Additionally, it finds that logistics are positively related to the use of renewable energy while they are negatively related to carbon emissions. On the hands, the study assured that social indicators, such as health expenditure and institutional quality, are also directly associated with green logistic operations. Finally, the research offers policy recommendations for developing policies with respect to sustainable logistics and regulations that could help promote sustainable initiatives.

Barykin et al. (2021) explore the effectiveness of economic interaction within the BRICS countries, focusing on trade and logistics services. The study introduces the concept of the BRICS Digital Logistics Platform (DLP) as a potential tool to enhance these interactions. Using various

analytical methods, a case study of DLP development within BRICS nations, the research delves into the trade and logistics dynamics among the BRICS countries. It identifies the challenges posed by logistics infrastructure gaps and suggests that opportunities of applying DLP as a key tool for overcoming such obstacles, thereby enhancing trade interactions. Furthermore, the authors propose an analytical framework for the proposed DLP, aimed at simplifying and increasing the transparency of trade and economic interactions, while also mitigating economic and logistics risks.

Bugarčić et al. (2023) identify new pathways for economic growth, development, and enhanced competitiveness, emphasizing the need for a more detailed examination of logistics' role. The study investigates and compares the impact of logistics performance across three nations unions; EU, ASEAN, and BRICS countries, evaluating the importance of logistics components, using panel data with fixed effects regression. The findings confirm the significance influence of logistics on economic growth and competitiveness, particularly in the overall and EU countries. However, LPI does not show significant results in ASEAN and BRICS alliances, primarily due to observations' few numbers. Nevertheless, logistics is shown to enhance competitiveness in BRICS countries. The study highlights the specific contributions of LPI components, emphasizing their importance for economic growth and national competitiveness. It also points out China's dominant position within BRICS, its economic partnerships with Brazil and South Africa, and its strategic efforts to maintain influence and counterbalance global competition. The results further explore the challenges and opportunities faced by BRICS, including potential group expansion and economic distress in member countries. A major contribution of this study is the presentation of the impact of logistics within specific country groups, highlighting the significance role of the logistics sector and its effectiveness while providing recommendations for policymakers.

Nekhoroshkov, et. al (2021) Examine the logistics performance of BRICS countries by evaluating their ratings in two indices, first is the Logistics Performance Index and the second is the Emerging Market

Logistics Index (EMLI). The study employs the diagnostic matrix method to characterize each country according to various criteria and calculate the change in indicators over a selected study period. The LPI, calculated biennially by the World Bank, serves as the primary information source for this analysis. The findings reveal significant disparities in logistics development among the BRICS countries. China emerges as the clear leader within the BRICS group, surpassing other countries in infrastructure development and logistics service quality. This is evidenced by substantial financial investments in infrastructure, superior customs and border clearance, efficient international transport, cargo tracking, and goods delivery on time.

Research Methodology

Our study aims at investigating the contribution of logistics sector in BRICS countries economic growth. The study relies on a panel data analysis that covers all 10 countries joining BRICS, using LPI scores for the years 2007, 2010, 2012, 2014, 2016, 2018 and 2023. The World Bank Development Indicators database is the source of data.

The current study main hypothesis is that overall LPI has significant positive impact on economic growth in BRICS alliance. Hypothesis is extended to state a significant and a positive impact of each individual LPI on economic growth of BRICS countries.

Our hypothesis is tested using panel data model, which is represented as follows:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$$

Where; Y is the dependent variable, while Xs are the independent or explanatory variables, α and β are the model coefficients, i indicates the individual country, t is the time period and ε is the error term. Table (3) shows the correspondent dependent variable and independent variables.

Panel data can be tested using fixed effects and random effects models. The Fixed Effects model enables the consideration of individual variation across different cross-sections or different countries, i.e. each country has its own intercept, that takes the same value over time. The

fixed effects reflect unique attributes of countries that do not vary across time but are correlated with the independent variables.

The expression for the Fixed Effects can be represented as:

$$Y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

Where α_i is the unknown intercept for each country it reflects the unobserved time-invariant individual effect, i.e. historical and institutional factors for countries. The ε_{it} is the overall error term.

Alternatively, in the Random Effects model allows for heterogeneity across countries that are time invariant, but is assumed to have no correlation with the independent variables.

The Random Effects model can be formed as: $Y_{it} = \alpha + \beta X_{it} + Z_i + \varepsilon_{it}$

In the Random Effects (RE) model, the error term is made up of two parts. The first is the individual-specific error term (Z_i), which represents unobserved, time-invariant heterogeneity across countries. This component is assumed to have no correlation with the independent variables. The second part is the time-varying error component (ε_{it}), which captures the variations in GDP per capita within a country over time. The time-varying error component can be correlated within each country, they are assumed to be uncorrelated between various countries.

Table (3): Model Variables Description

Syl	Var_name	Description
Y	GDPpc	GDP per capita (2015 US$ in constant terms) is the dependent variable, used as a proxy for economic growth.
X1	GFCF	Gross fixed capital formation (constant 2015 US$) that represents current capital stock as a proxy for infrastructure investment.
X2	FDI	Foreign direct investment, represented by net inflows (current US$, BoP) that expresses capital inflows.
X3	Emp	Number of labor force that are employed (millions).
X4	Trade	Trade value (constant 2015 US$) as a proxy for trade flows within country and across borders
L0	LPI_ovr	Logistics Performance Index (LPI) overall score as a proxy for logistics sector performance (1=low to 5=high)

Syl	Var_name	Description
L1	LPI_cstm	LPI: Efficiency of customs clearance process (1=low to 5=high)
L2	LPI_infra	LPI: Quality of trade and transport-related infrastructure (1=low to 5=high)
L3	LPI_qulty	LPI: Competence and quality of logistics services (1=low to 5=high)
L4	LPI_ship	LPI: Ease of arranging competitively priced shipments (1=low to 5=high)
L5	LPI_time	LPI: Frequency with which shipments reach consignee within scheduled or expected time (1=low to 5=high)
L6	LPI_track	LPI: Ability to track and trace consignments (1=low to 5=high)

NB: All the variables are log-transformed except for LPI overall and LPI individual indicators.

Source: World Bank database. (2024), World development indicators, https://databank.worldbank.org/source/world-development-indicators#

Stationary of panel variables are checked using Levin-Lin-Chu unit-root tests. The null hypothesis reflects the existence of unit root in the panel variables contain. The alternative hypothesis indicates panel variables are stationary. The test results show that all panel variables are stationary in the first differences, except for the overall LPI which is stationary at the level.

Table (4): Panel Unit Root Test Results using Levin-Lin-Chu test

Syl	Var_name	Stationary at	t-statistics	P-value
Y	Ln_GDPpc	1st difference	-6.72869	0.0000
X1	Ln_GFCF	1st difference	-12.9805	0.0000
X2	Ln_FDI	1st difference	-21.5614	0.0000
X3	Ln_Emp	1st difference	-2.62045	0.0044
X4	Ln_Trade	1st difference	-7.41149	0.0000
L0	LPI_ovr	Level	-3.56779	0.0002

NB: Number of panels: 10; Number of periods: 7 (2007, 2010, 2012, 2014, 2016, 2018 and 2023), Panel means: included; Time trend: not included; ADF regressions: one lag

-

Table (5): Model Variables Descriptive analysis

Syl	Var_name	Mean	Std	Min	Max
Y	Ln_GDPpc	0.030196	0.041141	-0.149932	0.127829
X1	Ln_GFCF	0.054691	0.118906	-0.281623	0.381932
X2	Ln_FDI	0.089478	0.648090	-1.486576	2.357807
X3	Ln_Emp	0.016817	0.026184	-0.087593	0.069414
X4	Ln_Trade	0.050194	0.090868	-0.164988	0.277842
L0	LPI_ovr	3.099027	0.469192	2.240000	4.000000

Panel data model is regressed to elaborate the contribution of logistics sector in BRICS alliance economic growth. Table (6) shows model estimation using Independently Pooled OLS, and both fixed effects and random effects models.

Table (6): Overall LPI and Economic Growth Panel Model in BRICS Countries

Syl	Var_name	Pooled OLS	Fixed effects	Random effects
C	Constant	0.053441*** (0.009770)	0.021951 (0.068532)	0.053441* (0.026400)
X1	Ln_GFCF	0.204859*** (0.013705)	0.236738 *** (0.045293)	0.204859*** (0.137335)
X2	Ln_FDI	0.001253 (0.001913)	0.000903 (0.005459)	0.001253 (0.005169)
X3	Ln_Emp	-0.128928*** (0.050823)	-0.099196 (0.165230)	-0.128928 (0.037034)
X4	Ln_Trade	0.043721*** (0.014118)	0.006207 (0.044983)	0.043721 (0.038149)
L0	LPI_ovr	-0.013735*** (0.003139)	-0.003224 (0.022607)	-0.013735 (0.008483)
	R-squared	0.571597	0.643278	0.571597
	Prob (F-statistic)	0.000000	0.001759	0.000022

Standard errors are between brackets, * p<0.1, ** p<0.05, *** p<0.01,

The results indicate that overall logistics performance index has a statistically significant negative effect on economic growth when using pooled OLS estimators. However, in both the Fixed Effects and Random

Effects, overall LPI is found to be a negative but insignificant factor in determining economic growth.

However; pooled OLS specification neglects unique characteristics of individual countries and doesn't take into account the data cross section or the time series nature. Thus, testing for fixed and random effects are required. Torres-Reyna (2007).

Fixed Effects model brings the highest R-Squared value (0.64). It assumes that countries' economic performance is affected by their own internal characteristics. The gross fixed capital formation variable is the only statistically significant variable in this model, while the overall logistics performance variable is insignificant. According to Fixed Effects model, if gross fixed capital formation is raised by 1% over time, GDP per capita is expected to increase by 0.23%. Redundant fixed effects tests show that fixed effects are not statistically significant.

Table (7): Redundant Fixed Effects Tests for Overall LPI and Economic Growth

Test cross-section fixed effects			
Effects Test	**Statistic**	**d.f.**	**Prob.**
Cross-section F	**0.746359**	**(7,26)**	**0.6356**
Cross-section Chi-square	**7.141171**	**7**	**0.4143**

Furthermore, the Random Effects model has an R-Squared value (0.57) indicating that countries' own internal characteristics have no effect on the independent variables. Gross fixed capital formation, as a proxy for infrastructure investment, is statistically significant while the overall logistics performance variable is insignificant in this model as well. According to Random Effects model, if gross fixed capital formation increases 1% over time, the GDP per capita will raise by 0.20%.

The Correlated Random Effects-Hausman Test is used to assess whether the estimates of β from the fixed effects and random effects models differ significantly. The null hypothesis indicates that estimates of β have zero correlation with the independent variables (Random Effects model is preferred due to consistency and efficiency). The alternative hypothesis

indicates estimates of β have non zero correlation with the independent variables. The Random Effects model is found to be inconsistent, making the Fixed Effects model the preferred choice. Table 8 shows that probability value in Hausman test is 0.6623 which is greater than 0.05. Thus, it can be deduced that the null hypothesis is not rejected and the random effects model estimates is preferred.

Table (8): Correlated Random Effects - Hausman Test for Overall LPI and Economic Growth

Test cross-section random effects			
Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	**3.244835**	**5**	**0.6623**

More in-depth analysis is presented in Table (9) for logistics influence on economic growth in BRICS countries. The individual logistic performance indicators are regressed on GDP per capita using Random Effects model.

Table (9): Individual LPI and Economic Growth Random Effects Model in BRICS Countries

Syl	Var_name	M_lPI_cstm	M_lPI_infra	M_lPI_qulty	M_lPI_ship	M_lPI_time	M_lPI_track
C	Constant	0.044294* (0.022215)	0.043452* (0.022913)	0.046864* (0.027374)	0.041018 (0.027473)	0.079221* (0.032119)	0.056978** (0.023214)
X1	Ln_GFCF	0.204073*** (0.037004)	0.202332*** (0.036937)	0.204660*** (0.036562)	0.206678*** (0.037417)	0.214035*** (0.036762)	0.201683*** (0.036750)
X2	Ln_FDI	0.001446 (0.005164)	0.001178 (0.005160)	0.001060 (0.005112)	0.001660 (0.005172)	0.001056 (0.005055)	0.001331 (0.005129)
X3	Ln_Emp	-0.129542 (0.137563)	-0.120642 (0.136598)	-0.126731 (0.136156)	-0.116251 (0.138686)	-0.126954 (0.134921)	-0.136216 (0.136272)
X4	Ln_Trade	0.046983 (0.038091)	0.045244 (0.038033)	0.040256 (0.037921)	0.044875 (0.038315)	0.037599 (0.037573)	0.041769 (0.037901)
L1	lPI_cstm	-0.012131 (0.008003)					
L2	lPI_infra		-0.010670 (0.007462)				

Syl	Var_name	M_lPI_cstm	M_lPI_infra	M_lPI_qulty	M_lPI_ship	M_lPI_time	M_lPI_track
L3	lPI_qulty			-0.011408 (0.037921)			
L4	lPI_ship				-0.009908 (0.009058)		
L5	lPI_time					-0.019728** (0.009249)	
L6	lPI_track						-0.014618* (0.007293)
	R-squared	0.567119	0.563559	0.558775	0.554525	0.597887	0.589946
	Prob (F-statistic)	0.000026	0.000029	0.000034	0.000040	0.000008	0.000011

Standard errors are between brackets, * p<0.1, ** p<0.05, *** p<0.01,

The results for individual LPI indicators reveal that two statistically significant components of LPI contribute to economic growth in BRICS countries: the frequency with which shipments arrive at their destination within the expected timeframe (LPI_time) and the ability to track and trace such consignments (LPI_track). Thus; reflecting the importance of finishing border compliances at expected time, as well as the importance of tracking and tracing information systems that would raise the efficiency and accuracy of operations. This comes in accordance with Arvis, et. al (2023), which shows that reducing time customs clearance and port dwell time is critical for improving logistics performance.

Results and Conclusion

BRICS countries are key players in global logistics and development. The relationship between economic growth and logistics is fundamental in understanding how economies evolve and progress. Relying on Logistics Performance Index produced by the World Bank, a panel data analysis is held to test significance and positive influence of logistics on economic growth in BRICS countries through the years 2007, 2010, 2012, 2014, 2016, 2018 and 2023.

Results indicate that overall LPI impact on economic growth in BRICS countries is not proven positive nor statistically significant during the

tested years, a similar result to Bugarčić, et. al (2023) and Khadim, et. al (2021). The Random Effects model is consistent, efficient and significant model. It highlights the importance of changes that happen in each country over various time periods, while taking into account disparities across countries. This may be attributed to the wide differences of LPI overall scores in BRICS countries, that ranges from 4 points in United Arab Emirates to 2.3 points in Iran Islamic Republic. As well as, their wide range in TAB scores which ranges from 86.5 points in China to 42.2 points in Egypt.

Results also reveal that Gross fixed capital formation, as a proxy for infrastructure investment, is the main statistically significant variable affecting GDP per capita in BRICS countries. Which comes in accordance with Hayaloglu (2015). Enhancing infrastructure and digitalization in BRICS countries would accelerate economic growth and raise capital stock. According to the results of Random Effects model, if gross fixed capital formation raises by 1%, the GDP per capita is expected to raise by 0.20%.

The analysis of the individual LPI influence on economic growth in BRICS alliance shows that the two most significant variables are the timely arrival of shipments and the ability to track and trace consignments. This highlights the critical role of efficient service delivery in fostering economic growth in these countries, as emphasized by Awad (2021).

Robust investment in logistics infrastructure is crucial for economic development and competitiveness that would lead to higher economic growth in BRICS countries. Efficient logistics system in relation to time and cost is critical in facilitating trade, connecting producers, and deeply integrate global value chains with local economies. Wide opportunities exist to share knowledge and exchange experiences in developing logistic sector among BRICS countries, in addition to promoting efficient regional logistics networks, up leveling collaboration and resource use in these countries. BRICS Digital Logistics Platform (DLP) proposed by Barykin, et. al (2021), provides a strategic solution to overcome current limitations in logistics sector and enhance trade cooperation.

References

AliAden, W., Zheng, J.-F., Almoshaogeh, M., Ullah, I. (2022), Dynamic association between socio-economic, environmental and logistic operations: Evidence from SSA BRI host countries, *Frontiers in Environmental Science*, 10:1024180, DOI:10.3389/fenvs.2022.1024180.

Arvis, J. F., Ojala, L., Shepherd, B., Ulybina, D. and Wiederer, C. (2023), Connecting to Compete, 2023, Trade Logistics in an Uncertain Global Economy: The Logistics Performance Index and Its Indicators, *The World Bank*, Washington, USA https://lpi.worldbank.org/sites/default/files/2023-04/LPI_2023_report_with_layout.pdf.

Awad E. M. H. (2021), Measuring logistics performance in ports: a case of Alexandria in Egypt, *The Maritime Commons: Digital Repository of the World Maritime University Dissertations*, World Maritime University.

Barykin S. E., Kapustina I. V., Korchagina E. V., Sergeev S. M., Yadykin V. K., Abdimomynova A., and Stepanova D. (2021), Digital logistics platforms in the BRICS countries: Comparative analysis and development prospects, *Sustainability, MDPI*, Vol. 13, Issue 20, 11228, https://doi.org/10.3390/su132011228 .

Bugarčić, F. Ž., Mićić, V., Stanišić, N. (2023), The role of logistics in economic growth, *Preliminary Communication*, Vol. 41, No. 2, 499-520, UDC: 330.34:658.7, https://doi.org/10.18045/zbefri.2023.2.499.

Chu, Z. (2012), Logistics and economic growth: A panel data approach, *The Annals of Regional Science*, 49(1):1-16, Doi:10.1007/s00168-010-0434-0.

D'Aleo, V. and Sergi, B. S. (2017), *Does logistics influence economic growth? The European experience*, Emerald Publishing Limited, www.emeraldinsight.com/0025-1747.

Duranton, G., and Kerr, W.R. (2015), The logic of agglomeration, *Harvard Business School, working paper*, 16-037.

Hayaloglu, P. (2015), The impact of developments in the logistics sector on economic growth: The case of OECD countries, *International Journal of Economics and Financial Issues*, Vol. 5(2), 523-530, www.econjournals.com.

Host, A., Skender, H. P., and Zaninovic, P. A. (2019), Trade Logistics the Gravity Model Approach, *Proceedings of Rijeka School of Economics* 37(1):327-342, https://doi.org/10.18045/zbefri.2019.1.327.

IDSC (Cabinet Information and Decision Support Center) (2023), Egypt and the BRICS countries: promising opportunities, *IDSC Information Reports Series*, Cairo Egypt.

Khadim, Z., Batool, I., Akbar, A., Poulova, P., and Akbar, M. (2021), Mapping the Moderating Role of Logistics Performance of Logistics Infrastructure on Economic Growth in Developing Countries, *Economies*, MDPI, 2021, 9(4), 177, https://doi.org/10.3390/economies9040177.

Kuzu S. and Önder, E. (2014), Research into the long-run relationship between logistics development and economic growth in Turkey, *Journal of Logistics Management*, Vol. 3(1): 11-16, http://DOI:10.5923/j.logistics.20140301.02.

McCann, P. (2005), Transport costs and new economic geography, *Journal of Economic Geography*, Oxford University Press, Vol. 5, No. 3, pp. 305-318, doi:10.1093/jnlecg/lbh050.

Mecalux, A. (2023), Logistics history: origin and development, https://www.mecalux.com/blog/logistics-history-origin, 1 Aug 2023.

Muslija, A., Cinac, D., and Šahić, A. (2021), The relationship between economic growth and logistics sector in the case of G-7 countries. *Transportation Research Procedia*, 55(2):326-333, Doi:10.1016/j.trpro.2021.06.038.

Nekhoroshkov V., Aroshidze1A., Majercak P., and Kurenkov P. (2021), Features of Logistics Development in the BRICS countries, *SHS Web of Conferences* 129, 11007: *Globalization and its Socio-Economic Consequences*, https://doi.org/10.1051/shsconf/202112911007.

Nguyen, C. D. T. (2021), The impact of logistics and infrastructure on economic growth: Empirical evidence from Vietnam, *Journal of Asian Finance, Economics and Business*, Vol. 8, No. 6, 0021–00282121, http://doi:10.13106/jafeb.2021.

Panagariya, A. (2013), Comparative Advantage: The Ricardian and Heckscher–Ohlin Theories, https://doi.org/10.1093/acprof:oso/9780199680405.003.0004, 89-102

Porter, M.E. (1990), *The Competitive Advantage of Nations*, Free Press, New York, NY.

Rizkallah, W. (2023), Logistics investment and economic growth in Arab countries and OECD countries: A mediation analysis approach, *L'Egypte Contemporaine*, 114(549):11-54, DOI:10.21608/ESPESL.2022.175266.1036.

Rodrigue, J.P. (2024), *The geography of transport systems*, New York: Routledge, 402 pages. ISBN 9781032380407,DOI: 10.4324/9781003343196

Schumacher, R. (2012), Adam Smith's theory of absolute advantage and the use of doxography in the history of economics, *Erasmus Journal for Philosophy and Economics*, Vol. 5, Issue 2, Autumn 2012, pp. 54-80, University of Potsdam, Germany.

Sharipbekoval, K., and Raimbekov, Z. (2018), Influence of logistics efficiency on economic growth of the CIS countries, *European Research Studies Journal*, Vol. XXI, Issue 2, pp. 678-690.

Sobhy, R. (2023), Transforming Egypt into global trade hub, *IDSC Policy Perspective*, December 2023, No. 43.

Storper, M., and Venables, A. J. (2004), Buzz: Face-to-face contact and the urban economy. *Journal of Economic Geography*, 4(4), 351-370, DOI:10.1093/jnlecg/lbh027.

Torres-Reyna, O. (2007), Panel data analysis fixed and random effects using Stata, http://www.princeton.edu/~otorres/.

Van Soest, D. P., Gerking, S., and Van Oort, F. G. (2006), Spatial impacts of agglomeration externalities, *Journal of Regional Science*, 46(5), 881–899.

World Bank database. (2023), Logistics Performance Index LPI, https://lpi.worldbank.org/international/global.

World Bank database. (2024), World development indicators, https://databank.worldbank.org/source/world-development-indicators#.

World Bank. (2021), Trading Across Border TAB, https://archive.doingbusiness.org/en/data/exploretopics/trading-across-borders.