

## Competitiveness, Logistics Performance, and GDP: Evidence from Global Data and Arab Countries

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**Abstract.** This study investigates the interactions between the Global Competitiveness Index (GCI), Logistics Performance Index (LPI), and Gross Domestic Product (GDP) on a global scale, with a specific focus on Arab countries. Using data from 2007-2022, correlation analysis and the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) were employed. The findings reveal a direct interaction between LPI-GDP and GCI-GDP for the same year, while a two-year gap is necessary to understand the LPI-GCI interaction. The study also clusters Arab countries into three groups based on their logistics performance using the TOPSIS technique. The results highlight the need for comprehensive development plans that simultaneously focus on LPI and GCI to support GDP growth in Arab countries. This study contributes to the limited research on the interactions between competitiveness, logistics performance, and GDP in the context of Arab countries and provides valuable insights for policymakers and practitioners.

**Keywords:** Logistics Performance Index; Global Competitiveness Index; Gross Domestic product; Arab Countries; TOPSIS.

## 1. Introduction

The increasingly competitive global business environment raised the importance of logistics and supply chain management (L&SCM), especially after the COVID-19 pandemic and its massive disruptions worldwide (Almufleh & Alkhatib, 2023; Cahyono et al., 2023). The pressure on countries to improve their L&SCM performance as a significant element of their economic development and competitiveness is increasing. Logistics capability and performance are crucial in social and economic development (Civelek et al., 2022). Economic development, competitiveness, and gross domestic product (GDP) depend heavily on the countries' infrastructure and L&SCM capabilities. In this context, the L&SCM capabilities are essential in developing social, economic, and competitiveness (DEMİRCİ & KESKİN, 2021). Moreover, logistics system performance is critical to sustainable economic growth (ÇELEBİ, 2021; Bizoi et al., 2015). Many studies have researched the relationship between the countries' economic development efforts and their logistics performance at an aggregate or sub-element level (DEMİRCİ & KESKİN, 2021; ÇELEBİ, 2021; Sharipbekova & Raimbekov, 2018; Bizoi et al., 2015). According to ÇELEBİ (2021), a significant indirect relationship exists between the logistics performance index (LPI) and GDP; foreign direct investment and patents fully mediate LPI and GDP relationships. Therefore, countries that improve their LPI are expected to get higher levels of Global Competition Index (GCI) and GDP. Moreover, other studies tried to link logistics performance and economic competitiveness (Kálmán, & Tóth 2021; Sergi et al., 2021), while other studies tried to analyze the impact relationship between logistics performance, ease of doing business, and logistics cost (Saini & HRUŠECKÁ, 2021) or the logistics performance and the global competitiveness (Yildiz, 2017). Therefore, a critical issue to consider is the absence of a comprehensive study exploring the nexus between GCI, LPI, and GDP based on global data. Different approaches and contrasted results (DEMİRCİ & KESKİN, 2021; ÇELEBİ, 2021; Sharipbekova & Raimbekov, 2018; Bizoi et al., 2015) motivate more research to understand the GCI, LPI, and GDP interactions, especially for developing economies that attempt for economic and competitiveness developments such as Arab ones. This study aims to advance business research on logistics and its expected impact in two ways. First, it argues that it is essential to consider multiple perspectives in analyzing the impact of LPI on the GCI and GDP to provide practical evidence that shows how some Arab countries managed to provide the right level of harmony among the LPI-GCI-GDP interactions and then to provide practical suggestions for other Arab countries to do so. Therefore, the following questions can be raised:

- What are the expected correlations based on global datasets between the GCI, LPI, and GDP indexes?
- What are the levels of GCI, LPI, and GDP indexes based on Arab countries datasets? and
- How can Arab countries improve their GCI, LPI, and GDP performance and economic development based on these correlations and levels?

This study aims to answer these questions, fill the literature gap, and provide an in-depth analysis of the Arab region by exploring the LPI-GCI-GDP relationships based on formally published datasets. More specifically, it aims to (i) address the issue of how the LPI, GCI, and GDP relate to each other globally and within the Arab region context, (ii) analyze the LPI, GCI, and GDP indexes for the Arab region countries, and (iii) to identify the strength and weakness points under each index for each country and suggest applicable recommendations.

In addition to the introduction, Section (2) presents a general background about the three indexes, their history, structure, and uses. Section (3) summarizes relevant literature and highlights the main gaps. Section (4) explains the methodology, population and sampling, data collection, preparation, and analysis methods. While Section (5) presents the results, Section (6) discusses them, and Section (7) concludes this work. Finally, Section (8) summarizes the study limitations and sets the future research agenda.

## **2. Background**

Logistics plays a crucial role in any country's economy, and economic development supports logistics development (Reza, 2013). The insight that could be gained from research on LPI-GCI-GDP interactions is essential. Research on such interactions has the potential to identify new explanations for the attractiveness and development efforts worldwide, especially for the Arab region. Research on how LPI outcomes for different countries across different periods experience a better fit between their logistics efforts and development plans, act more assertively in responding to global changes, and implement GCI and GDP strategies and approaches more effectively. Research on LPI could suggest ways to rectify mismatches in development efforts through interventions that reduce the inappropriate coordination between LPI-GCI-GDP. Moreover, research on logistics performance issues could provide a more comprehensive understanding of the factors that drive competitiveness and gross production in the Arab world. To the extent that logistics performance outcomes influence the countries' competitiveness and GDP, this research helps stakeholders understand why some countries obtain better competitiveness and GDP outcomes than others. The logistics sector accounts for over 5% of the gross domestic product (GDP) worldwide. Due to the increasing level of international trade, the importance of the logistics sector and its relative contribution to national and international outputs are expected to accelerate (Gani, 2017). The World Bank initiative 'Logistics Performance Index (LPI)' provides trusted logistics data worldwide. This index uses a 5-point scale to provide a weighted average index for each country. This weighted average covers six main dimensions (the ability to track and trace consignments; the competence and quality of logistics services; the ease of arranging competitively priced shipments; the efficiency of the customs clearance process; the frequency with which shipments reach consignee within scheduled or expected time; and the quality of trade and transport related infrastructure). The World Bank report clusters the outcomes of this index into four main groups: high-income, upper-middle-income, lower-middle-income, and low-income countries. This classification aims to provide a benchmark for these countries to identify their strengths and weaknesses in a fair approach. Although international merchandise exports continuously increase, the LPI classification outcomes presented a clear gap between upper-income and upper-middle-income countries (Gani, 2017). The need to study the impact of several factors on the countries' LPI, specifically global trade, is a crucial issue to consider.

### **2.1. Global Indexes under study**

The World Bank and the World Economic Forum provided several economic and development tools that help countries understand and improve their economic performances. Among these tools:

- **LPI:** The International LPI is a summary indicator of logistics sector performance and is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance. LPI combines data on six components (Customs, infrastructure, international shipment, logistics quality and competence, tracking and tracing, and timeliness) into a single aggregate measure (World Bank, 2018). The LPI is reported by the World Bank every two years, with the latest being published in 2023 as of 2022.

The LPI consists of logistics and supply chain qualitative and quantitative measures for each country to measure performance and offers international and domestic assessments. The LPI is based on an international survey of operators on the ground (global freight forwarders and express carriers). The operators combine their in-depth country knowledge with informed qualitative assessments of other countries where they trade and experience the global logistics environment. Operators' feedback is accompanied by other quantitative logistics data to estimate the LPI for each country. In addition to logistics performance assessment, the LPI qualitative and quantitative measures build profiles of logistics friendliness for these countries.

- **GCI** is a yearly competitiveness report published by the World Economic Forum that has been published since 2004. This report ranks countries based on the GCI developed by Xavier Sala-i-Martin and Elsa V. Artadi (Schwab, 2018)

The GCI is an extension of Jeffrey Sachs's Growth Development and Michael Porter's Business Competitiveness Indexes that focus on countries' ability to provide higher prosperity and productive use of resources. During the last three decades, the GCI report published by the World Economic Forum (WEF) emerged as one of the leading reports that provide an international comparison of national competitiveness (Dudá & Cibul'a, 2018). During the 1990s and the early 2000s, the concept and the assessing methodology were still evolving. Then, the new complex index of national competitiveness called the Global Competitiveness Index was introduced in 2004-2005.

The GCI measures the institutions, policies, and factors that set the sustainable current and future levels of prosperity. The GCI report consists of 114 indicators sorted into twelve competitiveness pillars: Institutions, Appropriate infrastructure, Stable macroeconomic framework, good health and primary education, Higher education and training, Efficient goods markets, Efficient labor markets, developed financial markets, ability to harness existing technology, Market size (domestic and international), production of new and different goods using the most sophisticated production processes, and innovation. The twelve pillars were divided into three main groups: basic requirements, efficiency enhancers, and innovation and sophistication factors. Different weights were applied for the 12 main pillars for each group of countries to get a better picture of national competitiveness (WEF, 2023). For example, in the case of less developed countries, more weight is given to the basic requirements than in the case of modern innovation-based economies. The GCI used hard and soft data from international organizations collected via the global executive opinion survey (World Economic Forum) and local partners.

The new version of the GCI (2018), called the GCI 4.0, has many changes (WEF, 2023; Olczyk et al., 2022): many of the 12 pillars have been changed in their label and content; almost all pillars have been modified with individual indicators being added, deleted, modified or reshuffled; four new groups have been introduced instead of the old three (named enabling environment, human capital, markets, and innovation ecosystem); uses a system, where all the pillars are weighted equally (8.3 %) each, and therefore it discontinues the three stages of economic development on the weighting process; finally it emphasizes more on hard data in a try to minimize the objectivity of the global survey data.

- GDP is "the total monetary or market value of all the finished goods and services produced within a country's borders at a specific time. As a broad measure of overall domestic production, it is a comprehensive scorecard of a country's economic health." (Goossens et al., 2007). It is the country's total annual output, and it is equivalent to what the country spends.

The GDP consists of four components of gross domestic product: personal consumption, business investment, government spending, and net exports.  $GDP = private\ consumption + gross\ private\ investment + government\ investment + government\ spending + (exports - imports)$ . The country's national statistical agency usually calculates GDP following the international standard. According to the World Bank, there is noticeable global growth, but it is declining. According to the IMF, after the COVID-19 pandemic, growth slowed from 2019 (6.1%) to 3.2 percent in 2020 and 2.9 percent in 2022 amid a gloomy and more uncertain outlook (Gourinchas, 2022). In the last ten years, the average growth rate has been less than 2 percent compared to the previous period, which was raised by about 5%. Economic growth is directly connected to the UN development goals, especially ending poverty. Several positive examples can be noticed during the 2007-2022 period: The share of the world's workers living in extreme poverty fell by half over the 2010-2019 period to reach 7.1 percent and increased again up to 11.2% for 2019-2021 due to the COVID-19 pandemic (UN, 2023). Therefore, studying the impact of GDP and other indexes such as LPI and GCI can be crucial to understanding the impact of these issues on critical global issues such as poverty.

## 2.2. Arab Countries

The Arab World gathers twenty-two countries: Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria\*, Tunisia, the United Arab Emirates, and Yemen (UN, 2023). Arabs are not a race; it refers to those who speak Arabic as a first language. Therefore, the Arab world has a rich diversity of ethnicities and communities. With more than 465 million and about a 2% annual increase, the Arab population represents more than 5% of the world population (O'Neill, 2023).

The Arab region is not an exception. According to Pesce's (2017) "The Economic Competitiveness in the Arab Region: Performance and Challenges" report, few studies have analyzed the index results and its implications for Arab countries. The latest GCI shows that Arab countries have weaknesses in four economic competitiveness Pillars: Labor Market Efficiency, Macroeconomic Environment, Higher Education and Training, and Innovation. Although some Arab countries have improved their logistics performance and related matters, their competitiveness levels and GDP need more work. As a hypothesis, it is assumed that there is a relationship between a country's LPI, its GCI, and its GDP in both the aggregate and sub-element levels. The nature of this relationship is still being determined; some studies take the LPI as the dependent variable, while others handle it as independent. More studies are needed to understand the impact of the relationship between the countries' logistics performance, competitiveness, and economic development (in terms of GDP), especially for developing economies such as the Arab region. In addition to the well-known resources, oil, petroleum, and natural gas, several Arab World countries are rich in phosphate rock, barite, copper, silver, and gold. Others have significant reserves of tin, zinc, iron, cobalt, col, and manganese (Reda, 2021). Despite these valuable reserves, several Arab economies heavily rely on external funding sources with low GDP rates. In contrast, others showed remarkable improvements in several economic areas and, therefore, increased their long-run growth. According to the United Nations Economic and Social Commission for Western Asia (ESCWA, 2023) survey of economic and social development in the Arab region, the Arab region's economy is continuing to recover in 2022. The poverty rates are expected to decrease to 26% in 2023. The survey expects the GDP to grow by 4.5% in 2022 and about 7% in 2023, with differences among some regions. Even in the Arab least developed economies, the survey is expected to grow by 2% in 2022 and 2.6% in 2023. At the aggregate level, the growth rate that started in 2021 with 4.1% is expected to continue in 2023 for the baseline scenario with 3.6% and for the alternate scenario with 3.9%.

The Arab economies were divided into three groups: High-income economies in the Gulf Cooperation Council (GCC), Middle-income economies (that depend on taxes as a significant source of public revenues), and low-income economies (least developed ones). Middle-income economies can be divided into upper-middle-income economies, such as Algeria and Iraq, and lower-middle-income economies, such as Morocco and Jordan (Table 1).

Table 1: World Bank Income Groups – Arab Countries

High-Income Economies	Upper-Middle-Income Economies	Lower-Middle-Income Economies	Low-Income Economies
Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates	Iraq, Jordan, Lebanon, Libya	Algeria, the Comoros, Djibouti, Egypt, Mauritania, Morocco, Palestine, Tunisia	Somalia, the Sudan, the Syrian Arab Republic, Yemen

Source: available at [World Bank help desk](#).

During the past ten years, the United Arab Emirates, Egypt, Qatar, Saudi Arabia, and India were among the fastest-growing economies and displayed notable economic development rates (World Bank, 2023). Four out of the five fastest-growing economies are from the Arab world. Unfortunately, several Arab and non-Arab economies did not achieve these growth and development rates. The Arab world aggregate GDP rates (Figure 1) follow the same patterns as the Global rates. Despite the favorable and

growing GDP rates, sustaining a high economic growth rate is the central issue facing Arab countries.

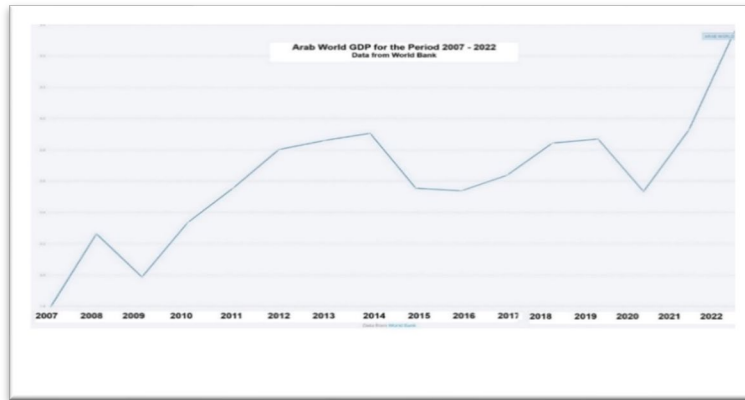


Fig.1: Aggregate GDP – Arab World for the Period 2007-2022

Source: [World Bank Group](#).

According to the world economic outlook - of the International Monetary Fund (IMF, 2023), Table 2 summarizes the Arab GDP at nominal and per capital values.

Table 2: Arab Countries GDP: Nominal and Per Capital Values\*

Rank	Country/ Territory	2022 GDP (US\$ Million)	2022 GDP Per Capital (US\$)*
--	World	101,560,901	13,400
--	Arab League	3,486,319	7,722.731
1	Saudi Arabia	1,010,588	27,941.49
2	UAE	503,913	47,792.94
3	Egypt	469,094	4,504.37
4	Iraq	282,876	6,695.85
5	Qatar	221,369	82,886.79
6	Algeria	187,155	4,151.44
7	Kuwait	183,568	38,123.22
8	Morocco	142,874	3,896.21
9	Oman	108,969	23,541.51
10	Syria	60,043 (2010)	2,806.685 (2010)
11	Jordan	48,066	4,666.20
12	Tunisia	46,282	3,815.82
13	Bahrain	43,544	28,691.77
14	Sudan	42,762	916.033
15	Libya	40,836	6,025.68
16	Yemen	27,594	873.903
17	Lebanon	24,494 (2020)	3,588.705 (2020)
18	Palestine	18,818	3,517.36
19	Mauritania	10,091	2,328.25
20	Somalia	8,416	539.001
21	Djibouti	3,725	3,665.83
22	Comoros	1,242	1,299.682

\*Source: compiled by the International Monetary Fund’s World Economic Outlook.

Internally, in 2022, Saudi Arabia, UAE, and Egypt represent about 51% of the Arab League GDP (Figure 2). Pie chart showing the share of nominal (GDP) of Arab League member countries.

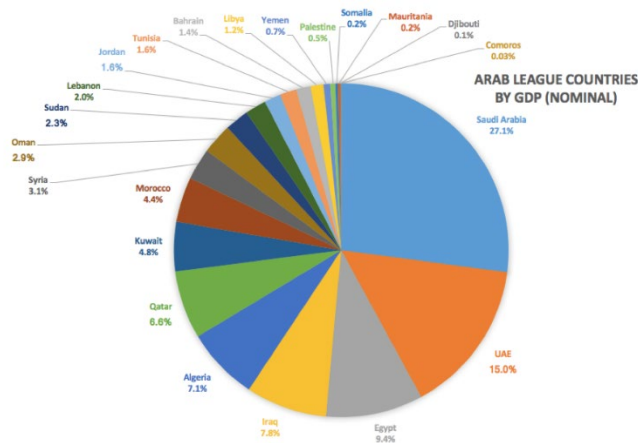


Figure 2: The Share of Arab Countries Nominal GDP

Source: Estimates compiled by the International Monetary Fund's World Economic Outlook

In addition to the GDP ranking, the World Bank provides the following groupings for other information purposes: (1) Arab countries (Low-development countries): The Comoros, Djibouti, Mauritania, Somalia, the Sudan, Yemen. (2) Conflict Countries: Iraq, Libya, Somalia, the Sudan, the Syrian Arab Republic, Yemen. (3) Non-Conflict Countries: Algeria, Bahrain, Comoros, Djibouti, Egypt, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates. Regarding Arab countries' growth rates, the GDP is one of the most used indicators, and several factors can affect a country's growth rate measured by its GDP (Al Rahamneh, 2023). In addition to the economic indicators, such as individual and firm credit, logistics, and competitiveness performance are also expected to have a crucial interaction. Although these countries' sizeable economic gains from oil, gas, and labor forces, their superb GDP levels can also be linked to their excellent LPI and competitiveness. Table 3 summarizes the average scores and Arab ranking of the LPI and GCI outcomes for Arab countries.

Table 3: LPI and GCI Rankings – Arab Countries

Country	GCI - Avg	Arab Rank	LPI - Avg	Arab Rank
<b>Qatar</b>	5.095	1	3.334	2
<b>United Arab Emirates</b>	5.032	2	3.797	1
<b>Saudi Arabia</b>	4.911	3	3.163	4
<b>Kuwait</b>	4.524	4	3.046	6
<b>Bahrain, Kingdom of</b>	4.507	5	3.199	3
<b>Oman</b>	4.487	6	3.054	5
<b>Jordan</b>	4.249	7	2.785	8
<b>Tunisia</b>	4.213	8	2.732	10
<b>Morocco</b>	4.133	9	2.655	11
<b>Algeria</b>	3.906	10	2.457	12
<b>Lebanon</b>	3.867	11	2.743	9
<b>Syrian Arab Rep.</b>	3.85	12	2.164	18
<b>Egypt, Arab Rep. of</b>	3.825	13	2.861	7
<b>Libya</b>	3.6575	14	2.23	16
<b>Yemen, Rep. of</b>	2.827	15	2.402	13
<b>Iraq</b>	na	na	2.217	17
<b>Mauritania</b>	na	na	2.272	15
<b>Somalia</b>	na	na	1.814	19
<b>Sudan</b>	na	na	2.363	14
<b>West Bank and Gaza</b>	na	na	na	na

\*na: Not Available

According to Table (3), a clear relationship between a country's GCI and LPI can be noticed. The top six countries (Qatar, United Arab Emirates, Saudi Arabia, Kuwait, Bahrain, and Oman) are the same in both indexes, with minor ranking differences. The high-income level due to petroleum and liquidated natural gas supports the development process of these countries and enhances their logistics and competitiveness performances. Although Jordan, Tunisia, and Morocco did not have the same level of national income as the first six countries, their logistics, competitiveness performances, and Arab ranking are noticeable. Jordan has a moderate level of performance in both indexes, while Tunisia and Morocco have a moderate ranking in the GCI with a low-ranking level in the LPI. Lebanon and Egypt have a moderate ranking level in terms of LPI and a low-ranking level in the GCI. Finally, due to data problems and war status, Syria, Libya, and Yemen are in the last ranking order of the GCI. Meanwhile, Libya, Iraq, Syria, and Somalia are in the last ranking order of the LPI. Due to the same problems, several Arab countries are not included in one or both of these indexes. Analyzing the interactions between these indexes and the country's GDP is crucial for all Arab countries.

### **3. Literature Review**

Logistics, competitiveness, and GDP are concepts familiar to economic and business literature. The mounting interest in how logistics performance outcomes influence the decisions of policymakers and organizational members is evident from the recent surge in reviews (Larson, 2021; Paul & Dhiman, 2021; Lin & Cheng, 2019) and case studies (Mešić et al., 2022; Yusufkhonov et al., 2021; Bugarčić et al., 2020).

#### **3.1. Logistics Performance and Economic Development**

Theoretically, logistics performance and economic development are strongly related. The availability and quality of logistics services in these countries and others influence the trade volume between countries. As an indicator of economic development, the volume of international trade is also strongly related to these countries' logistics services. Several studies try to explore the impact of LPI and GDP on international trade (Le, 2022; Yingfei et al., 2022; Song, 2022; Bugarčić et al., 2020; and Gani, 2017), but few studies investigate the impact of LPI on the GDP and GCI (Kabak et al., 2020; Ekici et al., 2019; and Reyes & Useche, 2019). Gani (2017) explored the effect of logistics performance on international trade. He estimated the standard export and import equations incorporating measures of logistics performance. A positive significant correlation between logistics performance and exports and imports has been supported. Therefore, more investments and improvements in the logistics sector can positively impact international trade.

Jayathilaka et al. (2022) tried to take a different direction by exploring the impact of GDP and LPI on international trade worldwide. A combination of Panel regression with a random effect (RE) model was chosen based on the results of the Hausman tests and Breusch–Pagan Lagrange Multiplier test. Regarding net exports, LPI has a positive relationship, while GDP has a significant negative impact within some regions and a significant positive impact within others. Bugarčić et al. (2020) assessed the level of the impact of logistics performance on trade volume in the Central and Eastern European countries (CEECs) and Western Balkans. The impact of the Logistic Performance Index (LPI) on international trade in 2007 and 2018 is investigated using the gravity model approach focusing on overall LPI and its components. Based on their findings, improving logistics performance and services positively impacts international trade volume, increases bilateral trade, and reduces trade costs. Le (2022) employed the trade gravity model to study the relationship between seafood export, logistics performance, and regional economic integration in the case of Vietnam.

Meanwhile, Song (2022) takes the South Korean industrial sector as a case study to investigate the relationship between international trade and logistics performance. According to Song's findings, the LPI components are significantly relevant to international trade; the LPI illustrates different influences by international trade commodities; the priorities of logistics performance factors have different effects depending on import and export items; and therefore, to promote international trade improving logistics

services should be prioritized. Similar to Gani's (2017), Bugarčić et al. (2020), and Song's (2022) findings, Yingfei et al. (2022) results demonstrate a positive influence of infrastructure and green logistics performance on services trade and environment.

### **3.2. Logistics Performance and Competitiveness**

In terms of logistics performance and competitiveness, Kabak et al. (2020) analyzed the two-way interaction between competitiveness and logistics performance using a hybrid approach (Bayesian net, Partial Least Square, and Importance-Performance map analysis). According to the results, the most critical GCI pillars that affect the logistics performance of a country are determined to be "Business Sophistication," "Financial Market Development," "Infrastructure," "Good Market Efficiency," and "Higher Education and Training." On the other hand, the improvement in the logistics performance index, in turn, will significantly influence the Market Size pillar of a country. Similarly, Ekici et al. (2019) believe that reforming the GCI's pillars can improve logistics performance, directly affecting economic development. Specifically, they found that more focus on technological readiness, higher education and training, innovation, market size, and infrastructure can improve logistics performance. Reyes and Useche (2019) analyzed the relationship between competitiveness, GDP, and human development in 20 countries in the Latin America and Caribbean region from 2006 to 2015. Although all the studied countries have made progress in human, economic, and social development, not all countries have the same level or type of correlation. Some countries showed an inverse relationship between competitiveness and economic growth, while others showed inverse relationships between competitiveness and human development. Additionally, no statistically significant relationship between economic growth and human development was detected. Meanwhile, using hierarchical regression analysis, Civelek et al. (2015) found a statistically meaningful mediator effect of the LPI on the relationship between the GCI and GDP. Therefore, a country's logistics performance dominates and interacts with the country's competitiveness, economic growth, and prosperity. However, more research to provide a better understanding of these interactions is highly recommended.

### **3.3. Arab Countries Studies**

In terms of Arab countries, despite their importance and strategic role, they suffer from several business research problems, especially in logistics, supply chain, and economic growth (Alalawneh & Alkhatib, 2023). In most cases, studies take one of the GCI, LPI, or GDP dimensions to study their impact on different factors. For example, Sindakis et al. (2022) discuss how the cultural characteristics in the Arab world shape family enterprises and enable family firms to establish good competitiveness. While Elgazzar and Ismail (2021) proposed a framework to enhance the container terminals' performance by evaluating efficiency and competitiveness in Egypt, Gómez-Miranda et al. (2015) analyzed the impact of organizational culture on competitiveness, effectiveness, and efficiency in Morocco. Meanwhile, Ekram et al. (2023) developed a framework to achieve resilience in the oil and gas supply chain during logistics disruptions based on Arab countries as a case study. The clear gap in Arab countries' competitiveness, logistics performance, and GDP literature increases the importance of such research. This study contributes to the comparatively sparse literature on competitiveness, logistics performance, and GDP literature for Arab and global.

### **3.4. Research Gap**

The multidimensionality of Logistics, Competitiveness, and Gross Domestic Product motivates academia, managers, and policymakers to investigate their interactions. A large amount of literature in the economic and business sciences investigates the direct relationships between logistics performance and competitiveness (Song & Lee, 2022; Yingfei et al., 2022; Yusufkhonov et al., 2021; Kabak et al., 2020; Mendes et al., 2020; Ekici et al., 2019; Tang & Abosedra, 2019) and between competitiveness and gross domestic product (Hakhverdyan & Shahinyan, 2022; Matkovski et al., 2019; Reyes & Useche, 2019). In contrast, indirect and cross-sectional relationships have received less attention in management research. The need to investigate the complex interactions between the LPI, GCI, and GDP worldwide especially for developing economies such as Arab countries, is an issue to consider. This

study contributes to understanding the interactions between LPI, GCI, and GDP, with a particular focus on Arab countries.

## 4. Methodology

This study examines the expected interaction of the three indexes (GDP, GCI, and LPI) worldwide, particularly for the Arab countries. Therefore, needed data were collected from different sources, and two analysis approaches were used. Person correlation was implemented for the three index interactions, and the technique for order performance was similar to the ideal solution (TOPSIS) for Arab countries' analysis. The TOPSIS approach has an advantage over other multi-criteria techniques in that it is based on a complementary analysis to evaluate and rank alternatives against weighted criteria based on their geometric distance from the positive and negative ideal solutions.

### 4.1.Data Sources

In this study, several sources and types of data were used. These data are drawn from the World Bank, World Economic Forum, Global Competitiveness Index, and the International Monterey Fund databases. Not all countries are included in the three indexes dataset. Due to missing information and incomplete datasets, only 142 countries have been included in the aggregate level, and 14 Arab countries have been included in the Arab countries analysis. Only countries with complete datasets have been included in the aggregate level. For the GDP, the panel data covers the 2007-2021 periods; for the GCI, data covers the 2008-2021 periods; and for the LPI, data covers the 2010-2018 periods.

### 4.2.Correlation Analysis

Due to different methodologies, measures, and dimensions under each index, the total published score for each country has been used. However, each index's aggregate score is not comparable due to the different scales and issuing times. Therefore, the percentage of change between two scores for each index has been used to generate data for analysis as follows (Eq. 1):

$$P1_t = \frac{I_t - I_{t-1}}{I_{t-1}} \dots\dots\dots \text{Eq. 1}$$

Where,

$P1_t$  is the percentage of change in Index 1 for the current year ( $t$ )

$I_t$  is the Announced Index Score for year ( $t$ )

$I_{t-1}$  is the Announced Index Score for the previous year ( $t - 1$ )

At the aggregate level, 169 countries have been reviewed to ascertain needed data. A total of 142 countries has a complete set of data (GDP, GCI, and LPI) together: 159 countries with GDP and LPI data, 151 countries with GDP and GCI data, and 143 countries with GCI and LPI data (Table 4).

Table 4: Number of Correlations Based on Data Availability

Indexes Interaction	Alone	All Together
GDP and LPI	159	142
GDP and GCI	151	
GCI and LPI	143	
<b>Total number of countries</b>	<b>169</b>	

Person correlation has been applied to test the interaction among these indexes at this level. Due to different announcement years (GDP: yearly from 2008-2021; GCI: yearly from 2008-2020; and LPI:

every two years 2010, 2012, 2014, 2016, 2018), these differences resulted in the gaps in the year analyzed, and therefore it is not acceptable to conduct the correlation test for the same year only. The different methodologies, measures, and announcement years are expected to extend the impact of specific indexes for other years. For example, the GDP and GCI scores for 2007, 2008, 2009, and 2010 are expected to correlate (s) with the LPI score for 2010. For the same logic, the LPI 2010 score may correlate with the GDP and GCI scores for 2010, 2011, and 2012. Opposite to previous studies, this study conducted the correlation test five times and only for years with a complete set of data under each correlation, as follows: let  $P1_t$  be the percentage of change in Index 1 in period t, and  $P2_t$  be the percentage of change in Index 2 for the same period. Then, the five correlations will be:

$P1_t$  and  $P2_t$  (the direct relations for the same year)

$P1_t$  and  $P2_{t-1}$  (indirect with the previous year)

$P1_t$  and  $P2_{t-2}$  (indirect with previous two years)

$P1_t$  and  $P2_{t+1}$  (indirect with next year)

$P1_t$  and  $P2_{t+2}$  (indirect with next two years)

These tests help analyze the impact of each index over other indexes' scores, not just for the same year but also for previous and subsequent years.

### 4.3. TOPSIS Analysis

This stage aims to analyze the Arab countries' logistics performance using the TOPSIS technique. The advantages of TOPSIS lie in its ability to identify the best alternative quickly and integrate it with several weighted methods (Alkhatib & Migdadi, 2021). The compensatory aggregation method allows policymakers to trade-off between alternatives based on their performance under multi-criteria, where the good scores of some criteria compensate for the bad scores of other criteria. The trade-off outcomes allow for sorting alternatives based on their final scores, where the best alternative should have the shortest geometric distance to the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS). Therefore, there is no need to take the percentage of change under each index; the original data and their averages can be used.

At the Arab countries level, in addition to the correlation's outcome, more in-depth analysis will be conducted using the TOPSIS technique (a technique for order performance by similarity to ideal solution). The study will use the example of the Arab region countries to analyze the LPI data for the last 15 years (2007-2022). The TOPSIS technique analyzes, sorts, and ranks countries under each index based on their distances to/from the ideal positive and negative solutions. This analysis will provide a new understanding of each Arab country's performance under each index, its strengths and weaknesses and development potentials. The average rank for each country under each index will be used as a comparison base. The TOPSIS technique consists of the following steps (Alkhatib & Migdadi, 2021):

- (1) Create an evaluation matrix of m alternatives and n criteria.
- (2) Normalize the evaluation matrix using the normalization method, such as vector normalization (Hwang & Yoon, 1981).
- (3) Calculate the weighted normalized decision matrix (T) by multiplying each criterion column by its weight (if weights are known).
- (4) Determine the Positive Ideal Solution (PIS) and the Negative Ideal Solution (NIS).
- (5) Calculate the distance between the target alternative (i) and the NIS ( $d^-$ ) and the distance between the alternative (i) and the PIS ( $d^+$ ).
- (6) Calculate the Closeness Coefficient (CC) by dividing ( $d^-$ ) by the sum of ( $d^+$ ) and ( $d^-$ ).
- (7) Rank the alternatives according to their  $CC_i$  values. An alternative to the highest value is the best value (the longest distance from the NIS and the shortest distance to the PIS).

This approach required weighted criteria. Benítez and Liern (2020) presented a new unweighted TOPSIS (uwTOPSIS) technique, in which the criteria did not need to be weighted and fixed, and the results were presented as intervals for each alternative (relative proximity). This technique can help decision-makers conduct their analysis and make their decisions without determining the relative importance (weight) of each criterion, especially for development and sustainability issues. According to Benítez and Liern (2020) and Liern and Pérez-Gladish (2022), the first two steps remain the same in both techniques (classical and uwTOPSIS). The PIS and NIS solutions are determined without considering criteria weights. These weights will be introduced as ‘unknown’ in step 4, and their estimated values will be determined in step 5, solving two groups of mathematical programming problems that maximize and minimize the separation of each alternative to the PIS and NIS, respectively. The constraints for these two problems are the same as for the classical TOPSIS technique, where all weights should be positive and sum up to 1. Although this technique can help decision-makers make decisions without determining the criteria weight, its complexity reduces its attractiveness and applicability. For the LPI approach, equal weight settings of the index's six components are applied to find the country's LPI score. Aboul-Dahab and Ibrahim (2020) set a new entropy weighting approach for the LPI components to test whether the current LPI approach that assumes equal component weight provides enough explanation for the country's logistics performance. Due to the slight differences in the overall scores using both approaches, the LPI approach is good enough to explain the LPI performance, and the country's GDP is a good predictor for its logistics performance. Theoretically, using different weight settings can lead to different ranking outcomes. However, based on more than 1000 multi-attribute decision-making problems with equal attribute weight settings, Chakraborty (2022) found that for each problem, the TOPSIS and the modified TOPSIS methods produce the same ranking results. The purpose of applying the TOPSIS method is to find the distances from and to NIS and PIS and therefore, to find areas of improvement for each country based on their LPI scores. Additionally, the LPI scores are already weighted based on the LPI approach, and therefore, there is no need to reweight the LPI components again. For the purpose of this study, an equal weight will be given for comparison purposes.

## 5. Results

### 5.1. Correlation Outcomes

Processed data of the three indexes have been tested using the five Person correlation scenarios. Table 5 summarizes the outcomes of these tests.

Table 5: Correlation Tests Outcomes

		Scenario 1 Correlate with two previous years	Scenario 2 Correlate with one previous year	Scenario 3 Correlate with the same year	Scenario 4 Correlate with one year ahead	Scenario 5 Correlate with two years ahead
P1	P2	$P1_{t-2}$ with $P2_t$	$P1_{t-1}$ With $P2_t$	$P1_t$ with $P2_t$	$P1_{t+1}$ with $P2_t$	$D_{t+2}$ with $C_t$
GDP	GCI	-0.01421	-0.01617	<b>0.08171</b>	-0.01039	-0.04399
GDP	LPI	-0.12589	-0.10491	<b>-0.18031</b>	-0.05461	-0.05605
GCI	LPI	-0.07119	-0.07998	0.05617	-0.02327	<b>0.15138</b>

### 5.2. Global Competitiveness Index (Old and New GCI) – Arab Countries

Due to data availability and validity problems, not all countries are included in the annual GCI reports. Appendix 1 summarizes the GCI scores and ranks for most Arab countries for both old and new GCI. Based on the GCI dataset, most countries worldwide have almost a steady level of competitiveness. For

the Arab countries, the case is the same; most of them had almost steady levels and rankings during the 2007-2017 period, while there are some small ranking differences for some countries after 2018 (the new GCI 4.0). Table (6) summarizes the averages of the Arab countries GCI scores for both old and new GCI.

Table 6: Arab Countries GCI Averages for Both Versions\*

Group	Country	2017	Rank/ 136	Avg. up to 2017	2018		2019		Rank/ 134	2018 & 2019 Avg.	Impact of the new GCI 4.0	
A	United Arab Emirates	5.3	17	22								
	Qatar	5.11	25	19.3	71	4.97	29	72.87	5.1	28	28.5	↓
	Saudi Arabia	4.83	30	25.5	67.5	4.73	38	70.03	4.9	35	36.5	↓
	Bahrain	4.54	44	41	63.6	4.45	49	65.38	4.58	44	46.5	↓
	Kuwait	4.43	52	38.8	62.1	4.35	53	65.10	4.56	45	49	↓
	Oman	4.31	62	44.7	64.4	4.51	46	63.61	4.45	52	49	↓
B	Jordan	4.3	63	61.2	59.3	4.15	72	60.94	4.27	69	70.5	↓
	Morocco	4.24	71	72.5	58.5	4.09	74	60.01	4.2	74	74	↓
	Algeria	4.07	86	88.6	53.8	3.76	90	56.25	3.94	85	87.5	↑
	Tunisia	3.93	95	63	55.6	3.89	85	56.41	3.95	83	84	↓
C	Egypt	3.9	102	96.5	53.6	3.75	92	54.54	3.82	89	90.5	↑
	Lebanon	3.84	105	99.1	57.7	4.04	78	56.29	3.94	84	81	↑
	Mauritania	3.09	132	132.2	40.8	2.85	129	40.92	2.86	128	128.5	↑
	Yemen	2.87	136	140	36.4	2.55	136	35.50	2.49	133	134.5	↑
D**	Iraq,											
	Libya											
	Syria											

\* Old GCI version 2007-2017, new version (2018) GCI 4.0 out of 100 - \*\* No available data

### 5.3.TOPSIS Analysis for LPI – Arab Countries

Based on the TOPSIS approach, the average performance for each Arab country under each LPI criterion/dimension has been calculated for the 2007-2020 period. Then, the normalized matrix was developed by dividing all the values under each LPI dimension by the best value under each dimension (Table 7) to create comparable values.

Table 7: TOPSIS Normalized Matrix – Arab Countries and LPI Dimensions

Normalized	alternative performance under each criterion as a percentage of the best alternative					
	Customs Average	Infrastructure Average	Int. Shipment Average	Logistics Competence / Quality Average	Tracking and tracing average	Timeliness Average
Algeria	0.608	0.568	0.712	0.623	0.660	0.693
Bahrain	0.853	0.816	0.852	0.826	0.871	0.835
Egypt, Arab Rep,	0.706	0.696	0.786	0.767	0.755	0.798
Iraq	0.544	0.509	0.643	0.559	0.559	0.669
Jordan	0.686	0.678	0.808	0.714	0.710	0.788
Kuwait	0.783	0.793	0.808	0.773	0.831	0.822
Lebanon	0.697	0.657	0.745	0.727	0.741	0.757

<b>Libya</b>	0.572	0.522	0.621	0.591	0.554	0.655
<b>Mauritania</b>	0.597	0.532	0.607	0.599	0.609	0.655
<b>Morocco</b>	0.653	0.662	0.786	0.674	0.652	0.757
<b>Oman</b>	0.811	0.788	0.830	0.770	0.763	0.861
<b>Qatar</b>	0.819	0.831	0.893	0.888	0.900	0.927
<b>Saudi Arabia</b>	0.778	0.831	0.835	0.821	0.852	0.876
<b>Somalia</b>	0.450	0.425	0.547	0.484	0.446	0.491
<b>Sudan</b>	0.589	0.537	0.648	0.639	0.623	0.676
<b>Syrian Arab Republic</b>	0.550	0.504	0.588	0.524	0.575	0.659
<b>Tunisia</b>	0.683	0.645	0.772	0.679	0.731	0.791
<b>United Arab Emirates</b>	1.000	1.000	1.000	1.000	1.000	1.000
<b>Yemen, Rep.</b>	0.586	0.552	0.635	0.642	0.646	0.713

The values in this matrix represent how each country performs under each LPI dimension, comparing the best value under this dimension. For example, the Algerian normalized customs performance was (0.608) of the best Arab country in terms of customs (United Arab Emirates). during the period 2007-2020. For the same period, Algeria was better in terms of international shipments, timeliness, tracking and tracing, and logistics competence/quality than in Customs and infrastructure dimensions. The next step is identifying the best and worst performance (IPS and INS) under each LPI dimension. In the Arab case, the best Arab country in terms of all LPI dimensions is the United Arab Emirates, while the last Arab country in terms of all dimensions is Somalia. Therefore, Table 8 summarizes the IPS and INS values.

Table 8: The IPS and INS values

	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>C5</b>	<b>C6</b>
<b>IPS</b>	1	1	1	1	1	1
<b>INS</b>	0.450	0.425	0.547	0.484	0.446	0.491

C1: Customs; C2: Infrastructure; C3: Int. Shipment; C4: Logistics Competence/Quality; C5: Tracking & tracing; C6: Timeliness.

The IPS and INS values were used to find how each country is positioned between the best and worst performance under each LPI dimension. Tables 9 and 10 summarize the distances to the IPS (D+) and from the INS (D-), respectively for each Arab country under each LPI dimension.

Table 9: Distance to the IPS – Arab Countries

<b>D+ Distance to IPS (Smaller is closer and better)</b>							
	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>C5</b>	<b>C6</b>	<b>Sum of D+</b>
<b>Algeria</b>	0.392	0.432	0.288	0.377	0.340	0.307	2.136
<b>Bahrain</b>	0.147	0.184	0.148	0.174	0.129	0.165	0.948
<b>Egypt, Arab Rep,</b>	0.294	0.304	0.214	0.233	0.245	0.202	1.493
<b>Iraq</b>	0.456	0.491	0.357	0.441	0.441	0.331	2.516
<b>Jordan</b>	0.314	0.322	0.192	0.286	0.290	0.212	1.616
<b>Kuwait</b>	0.217	0.207	0.192	0.227	0.169	0.178	1.190
<b>Lebanon</b>	0.303	0.343	0.255	0.273	0.259	0.243	1.676
<b>Libya</b>	0.428	0.478	0.379	0.409	0.446	0.345	2.486
<b>Mauritania</b>	0.403	0.468	0.393	0.401	0.391	0.345	2.401

<b>Morocco</b>	0.347	0.338	0.214	0.326	0.348	0.243	1.817
<b>Oman</b>	0.189	0.212	0.170	0.230	0.237	0.139	1.178
<b>Qatar</b>	0.181	0.169	0.107	0.112	0.100	0.073	0.742
<b>Saudi Arabia</b>	0.222	0.169	0.165	0.179	0.148	0.124	1.007
<b>Somalia</b>	0.550	0.575	0.453	0.516	0.554	0.509	3.157
<b>Sudan</b>	0.411	0.463	0.352	0.361	0.377	0.324	2.288
<b>Syrian Arab Republic</b>	0.450	0.496	0.412	0.476	0.425	0.341	2.600
<b>Tunisia</b>	0.317	0.355	0.228	0.321	0.269	0.209	1.699
<b>United Arab Emirates</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Yemen, Rep.</b>	0.414	0.448	0.365	0.358	0.354	0.287	2.226

C1: Customs; C2: Infrastructure; C3: Int. Shipment; C4: Logistics Competence/Quality; C5: Tracking & tracing; C6: Timeliness.

Table 10: Distance from the INS– Arab Countries

<b>D- Distance from INS (bigger is better)</b>							
	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>C5</b>	<b>C6</b>	<b>Sum of D-</b>
<b>Algeria</b>	0.158	0.143	0.165	0.139	0.214	0.202	1.021
<b>Bahrain</b>	0.403	0.391	0.305	0.342	0.425	0.343	2.209
<b>Egypt, Arab Republic</b>	0.256	0.271	0.239	0.283	0.309	0.307	1.664
<b>Iraq</b>	0.094	0.084	0.096	0.075	0.113	0.178	0.641
<b>Jordan</b>	0.236	0.253	0.261	0.230	0.264	0.297	1.541
<b>Kuwait</b>	0.333	0.368	0.261	0.289	0.385	0.331	1.968
<b>Lebanon</b>	0.247	0.233	0.198	0.243	0.296	0.265	1.482
<b>Libya</b>	0.122	0.097	0.074	0.107	0.108	0.163	0.672
<b>Mauritania</b>	0.147	0.107	0.060	0.115	0.164	0.163	0.757
<b>Morocco</b>	0.203	0.238	0.239	0.190	0.206	0.265	1.340
<b>Oman</b>	0.361	0.363	0.283	0.286	0.317	0.370	1.980
<b>Qatar</b>	0.369	0.407	0.346	0.404	0.454	0.436	2.415
<b>Saudi Arabia</b>	0.328	0.407	0.288	0.337	0.406	0.384	2.151
<b>Somalia</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Sudan</b>	0.139	0.113	0.102	0.155	0.177	0.185	0.870
<b>Syrian Arab Republic</b>	0.100	0.079	0.041	0.040	0.129	0.168	0.558
<b>Tunisia</b>	0.233	0.220	0.225	0.195	0.285	0.299	1.458
<b>United Arab Emirates</b>	0.550	0.575	0.453	0.516	0.554	0.509	3.157
<b>Yemen, Rep.</b>	0.136	0.128	0.088	0.158	0.201	0.221	0.932

C1: Customs; C2: Infrastructure; C3: Int. Shipment; C4: Logistics Competence/Quality; C5: Tracking & tracing; C6: Timeliness.

The final country's performance and ranking should be balanced, considering all the distances (performances). So, aggregate distances will be used to calculate the Closeness Coefficient (CC<sub>i</sub>) by dividing (D-) by the sum of (D+) and (D-) and accordingly ranking the Arab countries based on their CC<sub>i</sub> values (Table 11).

Table 11: The Closeness Coefficients and Final Ranking – Arab Countries

Country	D+	D-	CC ratio	Arab Rank
United Arab Emirates	0.000	3.157	1.000	1.000
Qatar	0.742	2.415	0.765	2.000
Bahrain	0.948	2.209	0.700	3.000
Saudi Arabia	1.007	2.151	0.681	4.000
Oman	1.178	1.980	0.627	5.000
Kuwait	1.190	1.968	0.623	6.000
Egypt, Arab Rep,	1.493	1.664	0.527	7.000
Jordan	1.616	1.541	0.488	8.000
Lebanon	1.676	1.482	0.469	9.000
Tunisia	1.699	1.458	0.462	10.000
Morocco	1.817	1.340	0.425	11.000
Algeria	2.136	1.021	0.323	12.000
Yemen, Rep.	2.226	0.932	0.295	13.000
Sudan	2.288	0.870	0.275	14.000
Mauritania	2.401	0.757	0.240	15.000
Libya	2.486	0.672	0.213	16.000
Iraq	2.516	0.641	0.203	17.000
Syrian Arab Republic	2.600	0.558	0.177	18.000
Somalia	3.157	0.000	0.000	19.000
Group A	High LPI			
Group B	Moderate			
Group C	Low LPI			

C1: Customs; C2: Infrastructure; C3: Int. Shipment; C4: Logistics Competence/Quality; C5: Tracking & tracing; C6: Timeliness.

## 6. Discussion

### 6.1. Correlation Outcomes

Based on the correlation outcomes (Table 5), it is clear that there is no clear strong correlation between the GDP, GCI, and LPI. Most of the correlation coefficients are around zero. Some positive and negative weak to moderate correlations have been found (bold coefficients). Several GCI measures are related to the country's economic performance, and therefore, a positive correlation between the GDP (as an aggregated economic indicator) and the country's competitive position is expected. The GDP percentage of change has a weak positive correlation (0.08171) with the GCI percentage of change for the same period. Therefore, a positive correlation exists between the GDP and GCI ranking for the same economic period. This result is consistent with the findings of several studies (Hakhverdyan & Shahinyan, 2022; Kabak et al., 2020; and Ekici et al., 2019). For example, Hakhverdyan & Shahinyan (2022) found a positive relationship between GDP, innovation, and competitiveness, Kabadurmuş (2019) found a positive relationship between logistics performance and innovation, while Kabak et al. (2020) found a positive interaction between the competitiveness and logistics performance of countries using two-way analysis. Therefore, these analyses show that economic growth, measured by GDP per capital-growth rates and a country's global competitiveness, are positively related.

Regarding the GDP and LPI interaction, Table 5 shows a negative moderate correlation between the indexes for the same period (-0.18031) and previous periods (-0.12589 and -0.10491, for t-2 and t-1, respectively). This result is inconsistent with other studies that improved a positive relationship between the country's GDP and its logistics performance (Song & Lee, 2022; Larson, 2021; Mendes et al., 2020; Bugarcic et al., 2020; Tang & Abosedra, 2019; and Reza, 2013). Most of these studies take

the long-term relationship between these two variables. In short to moderate terms, the relationship is unclear and may be negative, as in this study. The improvement in the LPI ranking required heavy investments in the country's infrastructure, roads, ports, and IT sectors. These investments are expected to negatively influence the country's GDP in the short to moderate range. In contrast, in the long term, these investments will support the country's logistics performance, which in turn supports the country's GDP. Although this negative relationship, LPI is a good indicator of a country's economic performance overall. According to Saini & Hrušecká (2021), LPI is the core component for displaying positive results on economic development.

For the Arab countries, which can be classified into three groups based on their income level, countries with similar income level and economies with better logistics performance recorded additional GDP and trade growth rates (Jayathilaka et al., 2022). For the GCI-LPI interaction, the results reveal a positive moderate correlation every two years (0.151). This result means it takes two years to see the positive impact of the LPI over the GCI or vice versa. The expected positive impact of this relationship takes time. Countries need to wait to see the impact of improvement of their logistics performance on their competitiveness. The findings of this study are consistent with the study by Jayathilaka et al. (2022), which revealed a statistically significant positive correlation of overall LPI with both competitiveness and GDP levels but in an indirect approach.

## 6.2.GCI - Arab Countries

In terms of GCI, Each country's GCI score and ranking are the same from 2007-2019. Only minor changes in score and ranking can be noticed. According to Dudá & Cibul'a (2018), for the old GCI version (up to 2017) most of the indicators (77 of the 114 total) were obtained by the executive opinion survey; some of the pillars contain no or almost no hard data such as institutions or business sophistication; although the global questionnaire can provide insight into some areas, where the availability of the hard data is scarce, the objectivity of the survey data itself can be objected due to the sample size in each country or if the managers have sufficient experience and knowledge to answer the survey questions. According to Appendix (1) and Table (6), the most competitive Arab countries (Group A) are Qatar, United Arab Emirates, Saudi Arabia, Kuwait, Bahrain, and Oman, respectively (using the old and new GCI versions), representing the Gulf Cooperation Council (GCC). The high level of GDP directly impacts the competitiveness level of the GCC countries and pushes them forward away from other moderate and low-income Arab countries. The second competitive Arab countries (Group B) are Jordan, Morocco, Algeria, and Tunisia.

Meanwhile, Egypt, Lebanon, Mauritania, and Yemen come third in the low competitive level (Group C); Iraq, Libya, and Syria are not listed in this report. On average, Qatar came first with an international ranking of 19.272 using the old version and 28.5 using the GCI 4.0 version. Introducing the new GCI versions (GCI 4.0) impacts the competitiveness assessment process and the countries' scores and rankings. The new version uses a system where all the pillars are weighted equally (8.3 %) each and emphasizes hard data to minimize the objectivity of the global survey data.

The impact of the new GCI version on the competitiveness of Arab countries is not the same. All the high and moderate competitive countries (Groups A and B except Algeria) have declined in their global and Arab ranking. Meanwhile, the global competitive ranking for the low-competitive Arab countries (Group C) has been improved using the new GCI 4.0 version. This unexpected impact came from the new methodology and weighting system. For example, in the old version, more weight was given to the basic requirements than in the case of modern innovation-based economies; therefore, in less developed countries, the global competitiveness ranking will be low. However, using the new approach where all pillars are weighted equally can give all countries an equal chance to compete somewhere, even if their GDP and income levels are low. A considerable record of exporting and importing goods and services is insufficient to be highly competitive. *For the Arab countries, the formula is straightforward: enabling a better business environment, investing more in human capital and markets, and moving forward into a more innovative ecosystem can improve their competitiveness*

level.

### **6.3. Discussion of the TOPSIS Outcomes**

The TOPSIS outcomes can provide more details about the Arab countries' logistics performance than the direct LPI dimensions. Each distance (D+ or D-) quantifies how good or bad each Arab country is compared to the best and worst Arab countries under each LPI dimension (Tables 10 and 11). Some countries are too close to the IPS, and others are too close to the INS. Doing well in some LPI dimensions can be affected by negative performance under other dimensions and vice versa. According to the official LPI scores, the United Arab Emirates has a balanced high performance in all the LPI dimensions. Although the United Arab Emirates ranked first with the highest C<sub>i</sub> value using the TOPSIS method (Table 11), some improvement areas can be noticed based on its D- values (C<sub>3</sub>, C<sub>4</sub>, and C<sub>6</sub>). Adding more attention to the international shipments, logistics competencies and quality, and timeliness issues (lowest D+ distances) can support the superb position among the Arab countries and enhance its international ranking too (on average ranked 17th globally). In terms of other high LPI Arab countries (Group A), several improvement areas can be noticed too. In the case of Qatar, it ranked second among the Arab countries but ranked on average 36th globally. According to the LPI scores, Qatar performed well in terms of customs, tracking & tracing, and timeliness issues. However, it can improve its overall logistics performance and enhance its LPI rank with more emphasis on infrastructure, international shipments, and logistics competencies. However, in terms of the TOPSIS method, Qatar performed well in terms of international shipment, tracking & tracing, and timeliness dimensions compared to the INS, and needs more improvement to reach the IPS in terms of customs and logistics competencies that are somehow far from the IPS. In the case of Bahrain, it ranked on average 43.5th globally and third among Arab countries. Bahrain's logistics performance is moderate to high using the LPI scores and the TOPSIS method in all the LPI dimensions. Bahrain's main strengths are tracking and tracing, and timeliness dimensions. More investment and support to other areas (C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, and C<sub>4</sub>) can support the logistics industry in Bahrain and enhance its Arab and global rankings. The case of Saudi Arabia is too close to the Bahraini one. Moderate to high logistics performance in all the LPI dimensions ranked the kingdom fourth among the Arab countries and, on average, 44.5th globally. The main issue in the Saudi case is the customs dimension, which has the lowest performance level among all the LPI dimensions. Additionally, the international shipment dimension is too close to the INS; therefore, more investment and development are highly recommended to support Saudi logistics performance and enhance its Arab and global rankings.

Oman and Kuwait are almost similar cases regarding aggregate scores and ranking. They ranked globally on average 51.8th and 53.3rd respectively. Although they are close in Arab and global ranking, some internal differences can be noticed regarding LPI dimensions. The main issues for the Kuwaiti LPI sector are customs and logistics competencies and quality, followed by international shipments. These three dimensions scored low in most previous years, and therefore, more focus with direct support can improve Kuwait's logistics performance and support its Arab and global rankings. However, regarding the TOPSIS outcomes, international shipment is the most critical issue that keeps Kuwait away from the IPS and close to the INS. In terms of the Omani case, based on the LPI scores, logistics competence, quality, and tracking and tracing are the most critical dimensions to consider. However, based on the TOPSIS outcomes, international shipment and logistics competencies keep Oman close to the INS and away from the IPS, affecting its Arab ranking.

Moving to Arab countries with moderate logistics performance (Group B), we can notice the moderate positing between the IPS and INS for most of these countries. Although Egypt has a huge population and GDP and moderate LPI score, its GCI is not that good. For example, other countries with lower level of population and GDP such as Jordan, Morocco, Algeria, and Tunisia have better GCI scores (Group B, Table 6). Regarding the LPI scores, Egypt ranked 68.7th globally with moderate scores in timeliness and almost equal low scores in other LPI dimensions. Egypt ranked seventh compared to other Arab countries, thanks to its moderate to good performance in tracking and tracing,

and timeliness (far away from the INS). Regarding other dimensions, Egypt is positioned in the middle between the IPS and INS of the Arab countries. More effort and focus on customs and logistics infrastructure can move it closer to the IPS.

Meanwhile, more effort and focus on these two dimensions and international shipment can move it far from the INS. In terms of Jordan, it ranked 8th among Arab countries and 75.67th on average globally. Despite the small distance to the IPS under international shipment, Jordan has considerable distances from other IPS, such as customs and infrastructure. Crucial improvements in these areas are highly needed to support Jordanian logistics performance and enhance its Arab and global ranking. Lebanon ranked 9th among Arab countries and, on average, 78.8th globally. Like Egypt, Lebanon performed well in timeliness and moderate to low in all other LPI dimension scores. Based on the TOPSIS outcomes, Lebanon is moderately good in terms of tracking and tracing, and timeliness (closest to the IPS) and moderately weak in terms of international shipment, customs, and infrastructure (closest to the INS). Tunisia ranked 10th among the Arab countries and, on average, 81.7th globally, with moderate to weak LPI scores except for timeliness. Based on the TOPSIS outcomes, Tunisia is moderately close to all INSSs, especially in the logistics competence/quality dimension, and far away from all the IPSs. Tunisia needs to work hard on most of its LPI dimensions to support its logistics performance. Morocco and Algeria ranked 11th and 12th, respectively, among the Arab countries, and on average, they ranked 84.7th and 111.4 globally. Although there is a big difference in their global ranking, they ranked close among Arab countries. According to the LPI global scores, both countries have moderate to low logistics performance in all dimensions, except the timeliness dimension for Morocco which supports it a little and pushes it forward by 27 ranks globally and one rank among Arab countries. Several improvements and actions are needed to enhance the logistics performance in these two countries under all the LPI dimensions.

Finally, for the low-performance Arab countries (Group C), all the LPI scores and the TOPSIS outcomes show a weak logistics performance; dimensions are close to the INSSs and far away from the IPSs. Most Arab countries in this group face challenging conditions in terms of wars, corruption, and national conflicts. The absence of government and public systems in the case of Somalia and Yemen and the absence of stability and anti-corruption actions in Iraq and Syria, with continuous wars in some cases, are the main reasons for this low logistics performance and represent a primary challenge for economic development and logistics performance improvement.

## **7. Conclusion**

This study contributes to the understanding of the interactions between competitiveness, logistics performance, and GDP, with a particular focus on Arab countries. The findings highlight the direct interaction between LPI-GDP and GCI-GDP for the same year, while a two-year gap is necessary to understand the LPI-GCI interaction. The TOPSIS analysis reveals three distinct groups of Arab countries based on their logistics performance and identifies specific areas for improvement within each group. The study emphasizes the need for comprehensive development plans that simultaneously focus on LPI and GCI to support GDP growth in Arab countries. Policymakers and practitioners can use these insights to design targeted interventions and strategies to enhance logistics performance, competitiveness, and economic growth in the Arab region. Future research should explore the dynamics of these interactions over longer periods and investigate the impact of specific policy interventions on the LPI, GCI, and GDP nexus.

## **8. Study Limitations and Future Research**

This study analyzed the GCI, LPI, and GDP datasets globally and with focus on the Arab countries. Therefore, future studies can apply the same approach in other regions and conduct more comparative analysis. Additionally, the study is based on Person correlation to investigate the three indexes' interactions; more analysis can be conducted using different techniques. Moreover, multi-criteria

techniques other than TOPSIS can be used to support the outcome of this analysis. This study conducts the analysis regardless of any differences between the studied countries in terms of size, population, monetary system, and currency stability. It is recommended that future studies consider these issues.

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## References

Alalawneh, A. A. F., & Alkhatib, S. F. S. (2023). Business Research in Developing Economies: Evidential MBA Theses Approach—Case of Jordan. *Jordan Journal of Business Administration*, 19(4). <https://doi.org/10.35516/jjba.v19i4.1432>

Aboul-Dahab, K., & Ibrahim, M. A. (2020). Investigating the efficiency of the logistics performance index (LPI) weighting system using the technique for order of preference by similarity to ideal solution (TOPSIS) method. *International Journal of Science and Research*, 9, 269-277. <https://dx.doi.org/10.2139/ssrn.3815764>

Al Rahamneh, S. S. (2023). The Impact of Consumer versus Firm Credit on Economic Growth. *Jordan Journal of Business Administration*, 19(4). <https://doi.org/10.35516/jjba.v19i4.1431>

Alkhatib, S. F., & Migdadi, Y. K. A. A. (2021). A novel technique for evaluating and ranking green airlines: Benchmarking-based comparison. *Management of Environmental Quality: An International Journal*, 32(2), 210-226. <https://doi.org/10.1108/MEQ-04-2020-0065>

Almufleh, N. M. M., & Alkhatib, S. F. (2023). The Impact of Supply Chain Management Practices on the Operational Performance of 5-star Hotels Operating in Jordan. *Jordan Journal of Business Administration*, 19(1). <https://doi.org/10.35516/jjba.v19i1.741>

Benítez, R., & Liern, V. (2021). Unweighted TOPSIS: a new multi-criteria tool for sustainability analysis. *International Journal of Sustainable Development & World Ecology*, 28(1), 36-48. <https://doi.org/10.1080/13504509.2020.1778583>

Bîzoi, C., Popescu, A., Sipos, G., & Sipos, C. (2015). The Transportation and Logistics Sector's Performance and The Social Development-A Comparison Within the European Union. *Studia Universitatis Babeş-Bolyai*, 60(1), 68.

Bugarčić, F. Ž., Skvarciany, V., & Stanišić, N. (2020). Logistics performance index in international trade: Case of Central and Eastern European and Western Balkans countries. *Business: Theory and Practice*, 21(2), 452-459.

Cahyono, Y., Purwoko, D., Koho, I., Setiani, A., Supendi, S., Setyoko, P., ... & Wijoyo, H. (2023). The role of supply chain management practices on competitive advantage and performance of halal agroindustry SMEs. *Uncertain Supply Chain Management*, 11(1), 153-160. <http://dx.doi.org/10.5267/j.uscm.2022.10.012>

ÇELEBİ, Ü. (2021). The impact of logistics performance index upon gross domestic product: Mediating roles of foreign direct investment and patents. *Journal of Global Strategic Management*. <https://ssrn.com/abstract=3904781>

Chakraborty, S. (2022). TOPSIS and Modified TOPSIS: A comparative analysis. *Decision Analytics Journal*, 2, 100021. <https://www.sciencedirect.com/science/article/pii/S277266222100014X>

Civelek, M. E., Uca, N., & Çemberci, M. (2015). The mediator effect of logistics performance index on the relation between global competitiveness index and gross domestic product. *European Scientific Journal* May. Vol 11 No 13 (2015): ESJ May Edition. <https://ejournal.org/index.php/esj/article/view/5658>

DEMİRCİ ÇELİKKOL, C., & Gülcan KESKİN (2021). Logistics Performance Index and GDP – Relationship of Turkey’s Logistics Performance Through Neighbors. *International Journal of Social, Humanities and Administrative Sciences*, 7(37), Open access, pp. 257-265. \_\_\_\_\_

Dudá, T., & Cibul’a, A. (2018). The changing methodology of The Global Competitiveness Index and its impact on Slovakia. *Ad Alta: Journal of Interdisciplinary Research*, 8(2). [https://www.magnanimitas.cz/ADALTA/0802/papers/A\\_dudas.pdf](https://www.magnanimitas.cz/ADALTA/0802/papers/A_dudas.pdf)

Ekici, Ş. Ö., Kabak, Ö., & Ülengin, F. (2019). Improving logistics performance by reforming the pillars of Global Competitiveness Index. *Transport Policy*, 81, 197–207.

Ekram, A., Elmesmary, H., & Sakr, A. L. (2023). Developing a framework to achieve resilience in the oil and gas supply chain during logistics disruptions: an empirical study. *International Journal of Energy Sector Management*. ahead-of-print No. Ahead-of-print. <https://doi.org/10.1108/IJESM-01-2023-0022>

Elgazzar, S., & Ismail, A. (2021). Enhancing Egyptian container terminals’ performance through managing efficiency and competitiveness. *Marine Economics and Management*, 4(1), 59-75. <https://doi.org/10.1108/MAEM-12-2020-0006>

ESCWA (2023) United Nations Economic and Social Commission for Western Asia: Survey of Economic and Social Development in the Arab Region 2021-2022. <https://www.unescwa.org/publications/survey-economic-social-development-arab-region>

Gani, A. (2017). Logistics performance effect in international trade. *The Asian Journal of Shipping and Logistics*, 33(4), 279–288. <https://doi.org/10.1016/j.ajsl.2017.12.012>

Gómez-Miranda, M.E., Pérez-López, M.C., Argente-Linares, E. and Rodríguez-Ariza, L. (2015). The impact of organizational culture on competitiveness, effectiveness, and efficiency in Spanish Moroccan international joint ventures. *Personnel Review*, 44(3), pp. 364-387. <https://doi.org/10.1108/PR-07-2013-0119>

Goossens, Y., Mäkipää, A., Schepelmann, P., Van de Sand, I., Kuhndt, M., & Herrndorf, M. (2007). Alternative progress indicators to Gross Domestic Product (GDP) as a means towards sustainable development. *Beyond GDP*, 305.

Gourinchas, P-O. (2022). Global Economic Growth Slows Amid Gloomy and More Uncertain Outlook. IMF Blog. Available online: <https://www.imf.org/en/Blogs/Articles/2022/07/26/blog-weo-update-july-2022>

Hakhverdyan, D., & Shahinyan, M. (2022). Competitiveness, innovation, and productivity of the country. *Marketing i menedžment innovacij*, (1), 108-123.

Hwang, C.L. & Yoon, K. (1981). Multiple Attribute Decision Making: Methods and Applications. Springer-Verlag, New York. <http://dx.doi.org/10.1007/978-3-642-48318-9>

IMF (2023). World Economic Outlook Database, October 2022". IMF.org. International Monetary Fund. 11 October 2022. Retrieved 13 October 2022.

Jayathilaka R, Jayawardhana C, Embogama N, Jayasooriya S, Karunarathna N, Gamage T, et al. (2022). Gross domestic product and logistics performance index drive the world trade: A study based on all continents. *PLoS ONE*, 17(3): e0264474. <https://doi.org/10.1371/journal.pone.0264474>

Kabadurmuş, F. N. K. (2019). The Relationship Between Logistics Performance and Innovation: An Empirical Study of Turkish Firms. *Alphanumeric Journal*, 7(2), 157-172. <http://dx.doi.org/10.17093/alphanumeric.614170>

Kabak, Ö., Ekici, Ş. Ö., & Ülengin, F. (2020). Analyzing two-way interaction between the competitiveness and logistics performance of countries. *Transport Policy*, 98, 238–246.

Kálmán, B., & Tóth, A. (2021). Links between the economy competitiveness and logistics performance in the Visegrád Group countries: Empirical evidence for the years 2007-2018. *Entrepreneurial Business and Economics Review*, 9(3), 169-190. <https://doi.org/10.15678/EBER.2021.090311>

Larson, P. D. (2021). Relationships between logistics performance and aspects of sustainability: A cross-country analysis. *Sustainability*, 13(2), 623.

Le, D. N. (2022). Export, logistics performance, and regional economic integration: Sectoral and sub-sectoral evidence from Vietnam. *Journal of International Logistics and Trade*, 20(1), 37–56. <https://doi.org/10.24006/jilt.2022.e3>

Liern, V., & Pérez-Gladish, B. (2022). Multiple criteria ranking method based on functional proximity index: Un-weighted TOPSIS. *Annals of Operations Research*, 311(2), 1099-1121. <https://doi.org/10.1007/s10479-020-03718-1>

Lin, P. C., & Cheng, T. C. E. (2019). The diffusion and the international context of logistics performance. *International Journal of Logistics Research and Applications*, 22(2), 188-203.

Matkovski, B., Kalaš, B., Zekić, S., & Jeremić, M. (2019). Agri-food competitiveness in Southeast Europe. *Outlook on Agriculture*, 48(4), 326-335.

Mendes dos Reis, J. G., Sanches Amorim, P., Sarsfield Pereira Cabral, J. A., & Tolo, R. C. (2020). The impact of logistics performance on Argentina, Brazil, and the US soybean exports from 2012 to 2018: a gravity model approach. *Agriculture*, 10(8), 338.

Mešić, A., Miškić, S., Stević, Ž., & Mastilo, Z. (2022). Hybrid MCDM solutions for evaluation of the logistics performance index of the Western Balkan countries. *ECONOMICS-Innovative and Economics Research Journal*, 10(1).

O'Neill, A. (2023). Total Population in the Arab World 2022. *Statista*. <https://www.statista.com/statistics/806106/total-population-arab-league/#:~:text=Total%20population%20in%20the%20Arab%20world%202022&text=The%20total%20population%20in%20the,2022%20with%20464.68%20million%20inhabitants.>

Olczyk, M., Kuc-Czarnecka, M., & Saltelli, A. (2022). Changes in the Global Competitiveness Index 4.0 methodology: The improved approach of competitiveness benchmarking. *Journal of Competitiveness*, 14, 118-135.

Paul, J., & Dhiman, R. (2021). Three decades of export competitiveness literature: systematic review, synthesis, and future research agenda. *International Marketing Review*, 38(5), 1082-1111.

pone.0264474

Pesce, O. (2017). Economic Competitiveness in the Arab Region: Performance and Challenges. ESCWA working paper. [https://archive.unescwa.org/sites/www.unescwa.org/files/page\\_attachments/economic\\_competitiveness\\_in\\_the\\_arab\\_region\\_1.pdf](https://archive.unescwa.org/sites/www.unescwa.org/files/page_attachments/economic_competitiveness_in_the_arab_region_1.pdf)

Popescu, A., & Sipos, C. (2014). Logistics Performance and Economic Development-A Comparison within the European Union. Proceedings of "MAC-EMM." -Prague, Czech Republic, 1-9.

Reda, B. (2021). Arab Mineral Resources. The Arab-British Chamber of Commerce. *MINREX*, [https://issuu.com/benham/docs/economic\\_focus\\_may\\_21/s/12305723#:~:text=Morocco's%20known%20mineral%20resources%20include,%2C%20cobalt%2C%20coal%20and%20manganese.&text=Tunisia's%20mineral%20resources%20are%20iron%2C%20phosphates%2C%20lead%20and%20zinc.&text=Saudi%20Arabia%20with%20its%20huge%20landmass%20possesses%20vast%20mineral%20wealth.](https://issuu.com/benham/docs/economic_focus_may_21/s/12305723#:~:text=Morocco's%20known%20mineral%20resources%20include,%2C%20cobalt%2C%20coal%20and%20manganese.&text=Tunisia's%20mineral%20resources%20are%20iron%2C%20phosphates%2C%20lead%20and%20zinc.&text=Saudi%20Arabia%20with%20its%20huge%20landmass%20possesses%20vast%20mineral%20wealth.)

Reyes, G. E., & Useche, A. J. (2019). Competitiveness, economic growth, and human development in Latin American and Caribbean countries 2006-2015: a performance and correlation analysis. *Competitiveness Review: An International Business Journal*, 29(2), 139-159.

Reza, M. (2013). The Relationship between Logistics and Economic Development in Indonesia: Analysis of Time Series Data. *JTI*, 15(2), 119-124. <https://jurnalindustri.petra.ac.id/index.php/ind/article/download/18849/18545#:~:text=Logistics%20plays%20an%20important%20part,to%20the%20development%20of%20logistics.>

Saini, M., & Hrušecká, D. (2021). Comparative impact of logistics performance index, ease of doing business and logistics cost on economic development: a fuzzy QCA analysis. *Journal of Business Economics and Management*, 22(6), 1577-1592.

Schwab, K. (2018). The Global Competitiveness Report 2018. World Economic Forum. (2019, October)

Sergi, B. S., D'Aleo, V., Konecka, S., Szopik-Depczyńska, K., Dembińska, I., & Ioppolo, G. (2021). Competitiveness and the Logistics Performance Index: The ANOVA method application for Africa, Asia, and the EU regions. *Sustainable Cities and Society*, 69, 102845. <https://doi.org/10.1016/j.scs.2021.102845>

Sharipbekova, K., & Raimbekov, Z. S. (2018). Influence of logistics efficiency on economic growth of the CIS countries. [https://www.ersj.eu/dmdocuments/2018\\_XXI\\_2\\_52.pdf](https://www.ersj.eu/dmdocuments/2018_XXI_2_52.pdf)

Sindakis, S., Kitsios, F., Aggarwal, S. and Kamariotou, M. (2022). Entrepreneurial strategies and family firm culture in the Arab world: a systematic literature review. *Journal of Small Business and Enterprise Development*, 29(7), pp. 994-1016. <https://doi.org/10.1108/JSBED-03-2022-0143>

Song, M. J., & Lee, H. Y. (2022). The relationship between international trade and logistics performance: A focus on the South Korean industrial sector. *Research in Transportation Business & Management*, p. 44, 100786.

Tang, C. F., & Abosedra, S. (2019). Logistics performance, exports, and growth: Evidence from Asian economies. *Research in Transportation Economics*, 78, 100743.

UN (2023). Global Issues: Ending Poverty. Available online: <https://www.un.org/en/global-issues/ending-poverty#:~:text=Poverty%20facts%20and%20figures&text=The%20share%20of%20the%20world's,7.1%20per%20cent%20in%202019.>

WEF (2023). World Economic Forum: Global Competitiveness Reports. Available online: <https://www.weforum.org/reports?query=Global+competitiveness+report>

World Bank (2018). Logistics Performance Indicator: The World Bank. Available online: <https://lpi.worldbank.org/about>

Yildiz, T. (2017). An empirical analysis on logistics performance and the global competitiveness. *Verslas: teorija ir praktika*, 18(1), 1-13.

Yingfei, Y., Mengze, Z., Zeyu, L., Ki-Hyung, B., Avotra, A. A. R. N., & Nawaz, A. (2022). Green logistics performance and infrastructure on service trade and environment-measuring firm's performance and service quality. *Journal of King Saud University-Science*, 34(1), 101683.

Yusufkhonov, Z., Ravshanov, M., Kamolov, A., & Kamalova, E. (2021). Improving the position of the logistics performance index of Uzbekistan. In *E3S Web of Conferences* (Vol. 264, p. 05028). EDP Sciences.