

Logistics Investment and Economic Growth in Arab Countries and OECD Countries: A Mediation Analysis Approach

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Abstract:

This study aims to investigate the relationship between logistics investment and economic growth by determining the direct and indirect impact of investment in the entire logistics sector along with the classified one on economic growth. The panel data is used for two groups of countries: six Arab countries for the period 2007-2016 and 31 OECD countries for the period 2007-2018. This study adopts a path analysis approach based on the mediation analysis using the product of coefficients method combined with the bootstrapping method to test the direct and indirect effects of the relationship between total logistic investment and economic growth based on three mediators. This study contributes to the literature by filling the gap of determining the indirect impact of logistics investment on economic growth (whether for the entire logistics sector or classified for several areas) and it is unlike other studies that focused on the direct impact only. The present study proves that the relationship between logistical investment and economic growth, whether directly or indirectly, was not clear in the Arab countries, in contrast to the situation in the OECD countries, which has a direct and indirect effect between logistical investment and economic growth through logistics efficiency, competitiveness and trade openness as mediators in this relationship. The study also confirmed that investment in the quality of roads had the largest role in achieving economic growth in the Arab countries, while investment in the quality of roads, railways, and the internet had the largest role in achieving economic growth in the countries of the OECD.

Keywords:

Logistics investment, economic growth, mediation analysis, Arab countries, Organization for Economic Cooperation and Development (OECD), Product of coefficients approach.

1. Introduction

The logistics sector is an important interface for intervention to improve the country's foreign trade services considering globalization. Improving the efficiency of the logistics sector would facilitate the flow of the country's foreign trade and increase its competitiveness. Thus, logistics is one of the most important determinants of sustainable growth and development (Hailu & Zenaselassie, 2016; Sezer & Abasiz, 2017). Navickas, Sujeta, and Vojtovich (2011) argue that the activity of logistics systems and the use of their infrastructure to achieve economic growth has become a necessity in the global economy. The scope and objectives of logistics systems and the use of their infrastructure have become limited due to the impact of the economic policy pursued by the state, which focuses on stable economic growth and the long-term competitiveness of the state. Logistics investments are the allocation of capital to improve the efficiency of freight forwarding through infrastructure (stations, real estate, communications), operations (transportation and equipment), and human resources (labor, management, governance, research, and development). Therefore, the results of investing in logistical capabilities are multiple and are mainly related to increased integration with global trade and supply chains, better use of national transportation assets, increased competitiveness of exports, lower import costs, and increased employment opportunities (Rodrigue, 2012).

The development of the logistics industry has facilitated production, distribution, and marketing, providing serious global competitive advantages for the nation that has invested in this field. Effective and accurate planning of logistics activities has become an important tool for countries to obtain advantages in both costs and efficiency (Kuzu & Önder, 2014; Sezer & Abasiz, 2017). Efficient logistics enables border agents to take a comprehensive approach to border management to reduce duplication and delays, thus reducing costs for both producers and consumers related to the supply of goods and services. Therefore, the

competitiveness of the country and the growth of the economy directly depend on the investment in the logistics infrastructure, which is the main factor that ensures the movement of flows and a measure of improving business conditions. Thus, the availability of resources necessary for the economic growth of the state is an excuse for expediency in shaping logistics systems and for using their infrastructure (Navickas et al., 2011).

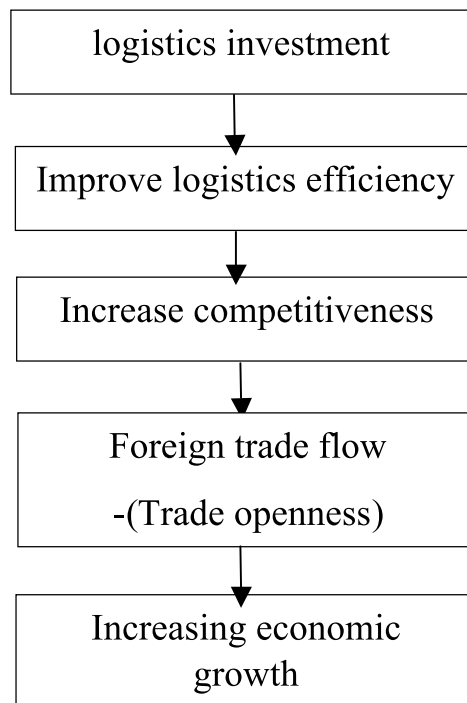
Logistics is a rather comprehensive concept, it is linked to many different activities, and a widely accepted definition of the logistics industry at the national and regional levels is extremely difficult. This is due to the relative lack of analyzes that determine the direct impact of this sector on foreign trade and economic growth (Bensassi, Márquez-Ramos, Martínez-Zarzoso, & Suárez-Burguet, 2015). However, CSCMP (2017) defines logistics as that a part of supply chain management that plans, implements, and controls the forward and reverse flow and storage of goods, services, and related information efficiently and effectively between the point of origin and the point of consumption to meet the requirements of clients. Rodrigue (2012) defines logistics as “comprising a wide range of activities dedicated to the transformation and distribution of goods from raw material sources to distribution in the final market, including related information flows”. Accordingly, logistics is the ability to move goods quickly, reliably, and at a low cost (Hollweg & Wong, 2009). Thus, logistics services include transportation, customs clearance, warehousing and handling, insurance and packaging, warehouse and inventory management, customer relationship management (CRM), and customer services (Sezer & Abasiz, 2017).

Hayaloglu (2015), Navickas et al. (2011) shows that there is a relationship between logistic investment and economic growth, as logistic investment increases competitiveness by improving the efficiency of logistics services. Improving logistics efficiency contributes to increasing the value-added of logistics by reducing logistics costs, shortening transit time, and creating suitable working conditions for business, which is reflected in an

increase in the competitiveness of the country in the form of facilitating foreign trade and increasing trade opportunities for the country. Finally, the rise in economic growth in the country is the result of increased trade openness driven by the improvement in its competitiveness, which can be illustrated in Figure (1).

Figure (1)

The relationship between logistics investment and economic growth



Source: Adjusted from:

- Navickas, V., Sujeta, L., & Vojtovich, S. (2011). Logistics systems as a factor of country's competitiveness. *Ekonomika ir vadyba* (16), 231-237.
- Hayaloglu, P. (2015). The impact of developments in the logistics sector on economic growth: The case of OECD countries. *International Journal of Economics Financial Issues*, 5(2), 523-530.

The total global market for logistics is estimated at more than 320 billion US dollars annually with an annual growth rate that is continuing and ranging between 3% and 10%. Some sources also estimate the total value of logistics activities at between 15% and 20% of the cost of producing manufactured goods (Center, 2008). Forum (2013) estimates that improving the efficiency of only two components of logistics services, namely border management and logistics infrastructure for transport and communications. In addition, it achieves an increase in GDP by up to six times the removal of customs barriers, as these improvements contribute to achieving an increase of \$ 2.6 trillion US dollars of the world GDP, equivalent to 4.7%. Moreover, an increase in global trade by 1.6 trillion US dollars, equivalent to 14.5%, compared to an increase of 400 billion US dollars of global GDP, equivalent to 0.7%. Additionally, in world trade, it increased by 1.1 trillion US dollars, equivalent to 10.1% in the case of the abolition of global customs tariffs.

The contribution of this study is to fill the gap of the scarcity of studies that conducted an empirical test to show and prove the indirect effect of logistic investment on economic growth using mediation analysis. Some studies set the determinants of economic growth focusing on the intervening variables i.e., the direct factors alone without taking the indirect driving factors that are incomplete. Much recent scientific evidence has emerged in the support of this approach, as (Preacher, 2015) clarified that mediation analysis is essential for many classic and modern models and theories considering the developments in mediation analysis. In addition, this study is one of the few studies that used total investment in the entire sector instead of multiple or individual proxy indicators. Different types of logistics investments cause different effects on economic growth because of (1) the marginal contribution of different types of logistics investments to economic growth that varies from one type to another (2) the different means of transportation and communications that are partial alternatives, but they are not complete alternatives. (3) The different modes of transportation and communication that have different effects on foreign direct investment, industrial concentration,

and competitiveness, which are important sources of economic growth in some countries (Lean, Huang, & Hong, 2014). Therefore, this study also used several variables that express the main areas of logistics services and their impact on economic growth through the same mediator variables, namely logistical efficiency, competitiveness, and trade openness. Therefore, the results of the study serve as recommendations stated to help governments to allocate funds more efficiently according to the field of logistics investment. The present study is characterized by making a comparison between two distinct groups of countries, namely, the Arab countries and the countries of the OECD.

The rest of the study is organized as follows, the second section reviews the theoretical and experimental literature. The third section explains the study methodology, variables, and data sources. The fourth section presents the results and discussion, while the sixth and final section presents the conclusions and policy implications.

2. Literature Review

Much theoretical and experimental literature emphasized the role of investment in logistical infrastructure in achieving economic growth. The neoclassical and Endogenous growth theory emphasized the impact of the logistical infrastructure as an external factor in the first or an internal factor in the second in achieving economic growth. It prompted Romer (1986), Lucas (1988) and Barrow (1990) to endogenize infrastructure in the total production function (Yones, 2018). Krüger (2003) has shown that in the past years, empirical growth research has taken three different main approaches. The first: represents the largest section of the literature by performing linear regressions to explain the growth rate of real GDP per capita through many different factors driving growth and trying to estimate the rate of convergence between countries in a stable situation. Perhaps, the emergence of the theory of endogenous growth contributed to the division of this approach into two main approaches:

the first is based on the hypothesis of absolute convergence (Solow, 1956; Swan, 1956) and the second is based on identifying the main sources of economic growth according to Conditional convergence hypothesis through a set of determinants. They act as conditioning factors according to (Barro & Sala-i-Martin, 1992; Barro, Sala-i-Martin, Blanchard, & Hall, 1991; Datta & Agarwal, 2004; Madden & Savage, 1998; Sala-i-Martin, 1996). The second: is based on making new estimates of the growth of the total productivity of the factors of production (direct factors) on a large scale of the economy (Datta & Agarwal, 2004; Madden & Savage, 1998). The third: examines the dynamics of the full distribution of real GDP per capita or the worker's share of real GDP.

Most studies of logistics services have adopted the first approach considering that logistics services are one of the most important determinants of economic growth considering the phenomenon of globalization through several directions. Where the first trend adopts the expression of logistics services through the efficiency or effectiveness of the performance of logistics services using the Logistics Preference Index provided by the World Bank (Hailu & Zenaselassie, 2016; Rizkallah, 2014; Sharipbekova & Raimbekov, 2018). Hailu and Zenaselassie (2016) investigated the relationship between logistics performance and economic growth in sub-Saharan Africa during the period from 2007 to 2014 for 19 countries using the random effects estimation technique for panel data. The study proved the positive impact of logistics and human capital on economic growth, in contrast to inflation, which had a negative impact on economic growth as expected. Sharipbekova and Raimbekov (2018) investigated the impact of logistics efficiency on economic growth in the CIS countries from 2007 to 2016. They used Factor Analysis for a large group of variables up to 16 variables that reflect the performance of the logistics sector. These independent variables were combined into four main factors, where the regression of these factors was carried out with the addition of the logistic performance index to economic growth. The study found that there is a strong relationship between the logistic

performance index and the gross domestic product in the CIS countries. The growth of indicators of transport, communications, services, and exports has a positive impact on economic growth in the CIS countries.

As for the second trend, it depends on focusing on one of the logistics services sectors, such as transportation or communications, or integrating them using a set of indicators that reflect its performance or investments directed to each sector (Datta & Agarwal, 2004; Hayaloglu, 2015; Lean, Huang, & Hong, 2014; Madden & Savage, 1998; Sezer & Abasiz, 2017). The Hayaloglu study (2015) relied on a set of indicators related to transportation, communications, and telecommunications to investigate the impact of developments in the logistics sector on economic growth using the panel data for 32 OECD countries during the period from 1995 to 2011 using fixed effects method. The results of the study showed that the relationship between the development of the logistics sector and economic growth changes according to the variable that is used as a proxy for logistics services. Investments in internal transport infrastructure positively affect economic growth in all models in which they are used. In addition, the coefficients of land transport variables, air transport, mobile cellular subscription, broadband Internet subscribers per 100 people, and Internet users are positive, while the fixed-line telephone variable coefficient is negative. There is no significant relationship between rail transport and economic growth.

As for Sezer and Abasiz (2017), in their study of the impact of the logistics industry on economic growth, they focused on the impact of transport and communications logistics variables on economic growth in 34 OECD countries during the period from 1970-2014. The first transport model found a positive relationship between airfreight transport, the length of the highway network, the length of the rail network and economic growth. As for rail transport, it had no significant association with economic growth. As for the second model of communications and networks related to the logistics industry, it found that landlines,

cellular subscriptions, public investments in telecommunications, and the number of Internet users all had a positive, statistically significant relationship with economic growth. Lean et al. (2014) investigate the causal relationship between logistic development and long- and short-term economic growth in China focusing on the transportation sector, using a structural model during the period from 1980 to 2009. The paper examines the relationship between logistics development and economic growth from the perspective of the total product of logistics services, the demand for logistics, and the product classified according to the different types of transport services. This study concluded that there is a long-term relationship between the development of logistics services and economic growth in total product and the classified product. In addition, there is a short-term causal relationship in one direction from the logistic product to the real GDP in the total product model. There is a feedback relationship between rail and road transport with the long-run economic growth of the detailed product model. One-way railway transportation according to Granger's causality causes the development of roads, water transportation network and ports referring to railways that still play a key role in China's transportation network. The study concluded that improving transportation conditions helps in developing the economy and achieving economic growth.

Several studies have used freight turnover volume to reflect the social demand for transportation (Kuzu & Önder, 2014; Wang, 2010). where Wang's (2010) study investigated the Granger causality test to analyze regional GDP growth in Anhui Province of China according to domestic and regional freight turnover. The study concluded that there is a one-way Granger causal relationship from the turnover of goods to the gross domestic product. The results of logistics models show that regional logistics services have an important role in promoting the regional economic growth of Anhui Province. The marginal analysis shows that

each additional unit of cargo turnover (billion tons-km) leads to an increase in the corresponding GDP by 2.217 units (billion). Kuzu and Önder (2014) examined the long-term relationship between logistics development and economic growth in Turkey during the seasonal periods from 2005 to 2013. The study relied on the Granger causality test, through which the study concluded that there is an integration between transport turnover, storage, and the growing economy in Turkey. There is a long-term one-way causal relationship extends from economic growth to logistical development.

The study of Datta and Agarwal (2004) examined empirically the long-term relationship between communication infrastructure and economic growth for a sample of 22 OECD countries during the period from 1980 to 1992. The study concluded that there is a positive and statistically significant relationship between telecommunications infrastructure, growth, and economic development. Results of the study indicate that investment in telecommunications is subject to diminishing returns indicating that countries at an early stage of development benefit more from investment in telecommunications infrastructure.

As for the third trend in the literature of logistics services, which is characterized by scarcity is based on the use of total investment in the entire logistics sector including transport, warehousing, post, and communications. This is due to expressing the role that the entire logistics sector contributes to economic growth (Chu, 2012; Hu, Gan, & Gao, 2012). Chu (2012) investigated the long-term relationship between logistics investment and economic growth in 30 provinces in China from 1998 to 2007. The study adopts the conditional convergence model with the generalized moment method (GMM) to test the conditional convergence between Chinese provinces and to determine the factors that lead to economic growth. The study results indicate that the logistical investment has a statistically significant and positive effect on the regional growth of the real GDP per capita in China. The contribution of logistical capital

to regional economic growth is higher in the developing interior regions than in the developed coastal regions. This confirms the realization of the hypothesis of convergence between the inland provinces, in contrast to the developed coastal provinces in which the per capita income does not tend to converge.

Hu et al. (2012) examined the measure of co-integration between total logistic investment and regional economic growth in central China during the period from 1986 to 2007. Using Granger's co-integration, the study concluded that there is co-integration between investment in logistical infrastructure, logistics value-added and GDP in Central China Province. The study also found that logistic investment is the cause of the granger of GDP. There is a two-way causal relationship between logistic investment and logistics value-added.

There is a recent trend based on mediation analysis to determine the direct and indirect impact (D'Aleo & Sergi, 2017; Yeo, Deng, & Nadiedjoa, 2020). D'Aleo and Sergi (2017) try to develop a new economic model that reflects the relationship between competitiveness and economic growth through a mediation variable, which is logistics. The study covered 41 European countries in the periods 2007, 2010, 2012 and 2014. This study followed the mediation model presented by Baron and Kenny (1986) through an explanatory linear regression model. After that, panel data analysis using the fixed effects model was used, and the simultaneous equations system was applied to ensure the consistency of the mediation model to overcome endogeneity problems. The results show that the effect of the logistic performance index as a mediating variable between the competitiveness index and the gross domestic product is statistically significant. The results of estimating the simultaneous equations and fixed effect analysis confirm the validity of the Global Competitiveness Index as a predictor of economic growth, and its impact is higher when the model takes the logistic performance indicator variable into account. Yeo et al. (2020) investigates the impact of infrastructure and logistics

performance on economic performance through international trade as a mediator variable. The study relies on generalized structural components analysis (GSCA) as a component-based approach to structural equation modelling (SEM). The study covers 62 middle-income countries during the period from 2010 to 2018. The study found that international trade partially mediates the relationship between infrastructure, logistical performance, and economic performance. The study also emphasized that infrastructure improvements and logistical services promote sustainable economic growth by increasing the volume of international trade in middle-income countries.

Based on the above, few studies are dealing with the multi-dimensional logistical investments (Hayaloglu, 2015; Sezer & Abasiz, 2017). Most studies focus on infrastructure indicators in the transport or communications sectors as representatives of the logistics sector, however, they are not the only determinant of the development of logistics services, and therefore they cannot obtain quality and efficiency in the logistics infrastructure. In addition, the studies that dealt with the entire logistics sector are very few. The studies that investigated the direct and indirect relationship between logistics services and economic growth are rare. While some studies investigated the relationship between logistics services and economic growth. The precise economic mechanism through which improving logistics services leads to economic growth needs further investigation and study.

3. data and methodology

3.1 data

Given the absence of statistical data for the logistics industry within the statistical standards of most developing countries, including the Arab countries. The current study is limited to six Arab countries. They are Egypt, the Emirates, Jordan, Tunisia, Kuwait, and Oman. To get a clearer view of the relationship between logistics investments and economic

growth based on the mediation methodology, the current study investigates this relationship in 31 OECD countries. They are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States of America. By comparing the results of the Arab countries with the OECD countries, the present study determines how the impact of logistics investment transmitted to economic growth.

Therefore, the study is based on available statistics on the gross fixed capital formation of transport, warehousing, postal, telecommunications, wholesale, and retail trade. The study uses logistical investment to express the entire logistics sector instead of the proxies. It does not reflect the development in logistics services in all fields. The Logistics Performance Index was used to express the level of logistical efficiency achieved in the sector via the investments. Economic growth is expressed by the growth rate of GDP at constant prices, based on the study of (Doran, McCarthy, & O'Connor, 2018).

This study is based on several proxies for each field of logistics investment to express the main areas of the logistics sector. The Road Quality Index (from 1 to 7) issued by the World Economic Forum is used as a proxy for investment inland transport. The railway length index (roads/km) is used as a proxy for investment in rail transport. Internet users index (as a percentage of the population) is used as an indicator for investment in the telecommunications sector, and Liner Shipping Connectivity Index is used as a proxy for investment in maritime transport to identify the key player in achieving economic growth. When conducting a mediation analysis using the four primary areas of logistics investment, five countries were excluded from the OECD due to the lack of data, namely Austria, the Czech Republic, Hungary, and the Slovakia Republic. The study used the logarithmic formula for the four variables of logistic investment and economic growth in both groups of countries.

In contrast to studies that generally used a mediation approach, this study relies on panel data rather than cross-sectional data. Mediation models that rely on cross-sectional data have problems with the quality of the results. Selig & Preacher (2009) states that three main Issues suffer from mediation models based on cross-sectional data; the use of cross-section data referring to instantaneous effect, while the causal relationships that is involved in mediation model take time, the models that depend on cross-sectional data ignore many the main predictors, which are the variables are measured in prior periods. Thus, conclusions based on a causal model that ignores a key predictor can be seriously wrong. When previous levels of variables are not controlled for mediation pathways may be overestimated or underestimated concerning their actual values. The application of the mediation model to cross-sectional data is assumed as the instantaneous of cause and the size of the effect does not depend on the duration for measuring the variables. Although the effects are discovered over time; the magnitude of the causal effect may not be constant for all possible periods. Therefore, mediation models based on cross-sectional data are likely to suffer from severe bias.

The study period from 2007 to 2016 is for the Arab countries, while the study period from 2007 to 2018 is for the OECD countries. The data were mainly obtained from the World Bank, the Organization for Economic Cooperation and Development website, the Arab Monetary Fund, the Jordanian Department of Statistics, the World Economic Forum, and UNCTAD. The linear interpolation method has been adopted to extend and interpolate the missing data in the study (Cox, 2015; Meijering, 2002).

3.2 Model Specification

The study adopts a path analysis-based mediation approach aimed to identify the impact of logistical investments on economic growth directly and indirectly. The mediation analysis is based on building a series of regression models to study the significance of the direct and indirect

impact of total logistics investments on economic growth in Arab and OECD countries. This study uses three mediators: logistics efficiency, competitiveness, and trade openness. The mediators were identified based on a review of the prevailing literature concerning logistics.

The mediation model aims to identify and explain the relationship between an independent variable and a dependent variable by including a third explanatory variable. The mediator variable explains how the independent variable affects the dependent variable through the mediator variable without having any causal relationship (D'Aleo & Sergi, 2017; Phoong, Phoong, & Tan, 2018). Baron and Kenny (1986) noted that the existence of three conditions are in the consistent mediation model: the independent variable that affects the mediation variable and the independent variable that affects the dependent variable and the mediation variable affects the dependent variable. If all these conditions fall in the expected direction, the effect of the independent variable on the dependent variable should be less in the third equation than in the second equation. Perfect mediation is achieved if the independent variable has no effect when the mediating variable is controlled.

MacKinnon, Lockwood, Hoffman, West, and Sheets (2002) have shown that there are three different general approaches to test the effect of mediation and other overlapping variables, causal steps approach, the difference in coefficients approach, and a product of Coefficients approach. The first approach identifies a series of tests for links in a causal chain. This approach is due to the fundamental of Baron and Kenny (1986), Judd and Kenny (1981b), and Judd and Kenny (1981a) and is used in psychological studies. Despite the widespread of this approach, many criticisms do not use it as it has low statistical power and does not provide a quantitative measure of the indirect effect in a specific way. In addition, it does not directly test the significance of the indirect effect in a specific way, and it does not fit with inconsistent mediation models. It can be difficult with many mediators running in parallel or series.

These constraints lead to misleading results, prohibiting the potential theoretical relationships, and destroying the construction of the future theory (Aguinis, Edwards, & Bradley, 2017; Memon, Cheah, Ramayah, Ting, & Chuah, 2018; Rungtusanatham, Miller, & Boyer, 2014). Therefore, many other methods emerged to overcome the limitations imposed by Baron and Kenny (1986) method. The most important of which is the bootstrapping method, which overcame these problems. One of them correct the abnormal sampling distribution for the specific indirect effect, but it can also accommodate models with multiple mediation processes, whether parallel or sequential (Rungtusanatham et al., 2014).

Regarding the second general approach, it has been developed in many disciplines and refers to the difference in coefficients like the difference between the regression coefficient before and after the adjustment for the nested variable. Coefficient difference procedures are particularly varied with hypotheses about the overlapping variables that differ from what psychologists have traditionally conceived of as mediation. MacKinnon et al. (2002) explained that there is a set of problems facing these methods including unreasonable assumptions and null hypotheses leading the individual to conclude that mediator occurs even when nonexistence of correlation between the mediating variable and the dependent variable. Finally, the third approach is called the Normal theory approach, which is the product of coefficients. The coefficient product approach is based on the same Normal inference method is used to infer the total and direct effect and many inductive tests with an estimate of the standard error of AXB . It is assumed that the sampling distribution of AXB is normal, and the value of P can be derived when given a specific zero default value or $a_{\tau}b_{\tau}$ an interval estimate can be generated (Hayes, 2017, 2018).

Despite the differentiate between Complete (Full) Mediation and Partial Mediation, whether full mediation is achieved in the existence only of an indirect effect, and partial mediation is achieved in the existence of direct and indirect effects, the trend of the contemporary belief that

this distinction must be abandoned. This is due to its low value and the difficulty of measuring variables without errors in the social sciences. Thus, the access to full mediation is scientifically impossible. In addition, the claim of complete mediation makes the researchers neglect other mediators in theory and an unnecessary restriction of theory (D'Aleo & Sergi, 2017; Memon et al., 2018). Zhao, Lynch Jr, and Chen (2010) argue that Barron and Kenny's classification of full mediation, partial mediation, and the nonexistence of mediation is inaccurate because of the one-dimensional concept of mediation. Therefore, mediation can be viewed through a two-way concept. This study can identify three patterns that are consistent with mediation and two patterns with no mediation:

1. **Complementary Mediation:** is achieved when mediating effect (a x b) and direct effect (c) are presented in the same direction.
2. **Competitive Mediation:** happened when mediating effect (a x b) and direct effect (c) are presented in opposite directions.
3. **Indirect-only Mediation:** is achieved when (a x b) effect is presented, but no direct effect.
4. **Direct-only Non-Mediation:** is achieved when the direct effect (c) is present, but there is no indirect effect.
5. **No-effect Non-Mediation:** is achieved when there is no direct effect and no indirect effect.

There is an overlap between the classification of Zhao et al. (2010) and Baron and Kenny's (1986) classification as the complementary mediation of Zhao et al. (2010) overlaps with Baron and Kenny's (1986) partial mediation, and indirect mediation by Zhao et al.' (2010) overlaps with Baron and Kenny's full mediation. The other three modes of mediation such as competitive mediation, no direct mediation, and no mediation effect were grouped in no mediation, according to Baron and Kenny (1986) classification.

This study relies on the Product of Coefficients approach to overcome the drawbacks of other approaches. The direct and indirect impact of the relationship between total logistic investment and economic growth has been investigated. To study in-depth the impact of investment in logistics services on economic growth, a model has been formed to use four independent variables that reflect investments in different logistics fields to identify the strength and degree of impact of each on economic growth through the same three mediators. The bootstrapping test is conducted after calculating the value of the indirect effect to calculate the standard error of each indirect effect to determine its significance. The homogeneity of regression needs to be tested to ensure that the direct and indirect effects do not contradict each other, and they are explicable.

Therefore, several regression models have been formed to examine the total effect, direct effect, an indirect effect as follows:

- **Total Effect Model:**

A total effect model is a model in which the dependent variable is a function of the independent variables. Mediators are also excluded from the model. The alpha coefficients (α_i) in this model represents the overall effect of each type of logistic investment on economic growth.

$$\ln Growth_t = i_1 + \alpha_1 LRIAL_t + \alpha_2 LROAD_t + \alpha_3 LINTUSE_t + \alpha_4 LLSCI_t + \varepsilon_{1t} \dots (1)$$

Where t represents the year, i_1 represents the Intercept model (1), and $(\alpha_1), (\alpha_2), (\alpha_3),$ and (α_4) indicate the overall impact of investment in roads, railways, internet, and maritime transport on economic growth, respectively. ε_{1t} Indicates the unexplained variance in the model (1).

- **Direct Effect Model:**

The direct effect model is a model of the dependent variable that acts as a function of all the independent variables with the three mediators. The beta coefficient (β_i) represents the direct effect of each type of logistic investment on economic growth.

$$\begin{aligned} \ln Growth_t = & i_2 + \beta_1 LRIAL_t + \beta_2 LROAD_t + \beta_3 LINTUSE_t + \beta_4 LLSCI_t \\ & + m_1 LPI_t + m_2 COMP_t + m_3 OPENNESS_t + \varepsilon_{2t} \dots (2) \end{aligned}$$

Where i_2 represent the Intercept of the model (2), and $(\beta_1),(\beta_2),(\beta_3), (\beta_4)$ indicate the direct impact of investment in roads, railways, the internet and maritime transport on economic growth, after controlling the effect of the efficiency of Logistics services (the first mediation variable), competitiveness (the second mediation variable) and trade openness (the third mediation variable). In addition, $(m_1), (m_2), (m_3)$ represent the coefficients of mediators, the efficiency of logistics services, competitiveness, and trade openness for economic growth, respectively. ε_{2t} indicates the unexplained variance in the model (2).

• **Indirect Effect Model:**

To study more than one independent variable and its effect on the dependent variable through several mediators, the coefficient-product approach was adopted to study the indirect effect, which is doubling the size of the influence of the independent variables on all mediators individually and to what extent the mediators change the dependent variable. It is represented by the coefficients $(m_1), (m_2), (m_3)$ mentioned in the Model (2). Model (3), (4), (5) show the size of the effect of the independent variables on the mediators respectively as follows:

$$\begin{aligned} LPI_t = & i_3 + \lambda_1 LRIAL_t + \lambda_2 LROAD_t + \lambda_3 LINTUSE_t + \lambda_4 LLSCI_t \\ & + \varepsilon_{3t} \dots \dots \dots (3) \end{aligned}$$

$$\begin{aligned} COMP_t = & i_4 + \gamma_1 LRIAL_t + \gamma_2 LROAD_t + \gamma_3 LINTUSE_t + \gamma_4 LLSCI_t \\ & + \varepsilon_{4t} \dots \dots \dots (4) \end{aligned}$$

$$\begin{aligned} OPENNESS_t = & i_5 + \delta_1 LRIAL_t + \delta_2 LROAD_t + \delta_3 LINTUSE_t + \delta_4 LLSCI_t \\ & + \varepsilon_{5t} \dots \dots \dots (5) \end{aligned}$$

Where $(i_3), (i_4), (i_5)$ represent the Intercept of the model (3), (4), (5), respectively.. $(\lambda_1), (\lambda_2), (\lambda_3),$ and (λ_4) indicate the impact of logistical

investments in roads, railways, the Internet, and maritime transport on the efficiency of the use of logistics services (the first mediation variable) respectively. $(\gamma_1), (\gamma_2), (\gamma_3), (\gamma_4)$ indicate the impact of logistical investments in roads, railways, the Internet, and maritime transport on competitiveness (the second mediation variable) respectively. $(\delta_1), (\delta_2), (\delta_3), (\delta_4)$, represent the impact of logistical investments in roads, railways, internet, and maritime transport on trade openness (the third mediation variable) respectively. $(\epsilon_3), (\epsilon_4), (\epsilon_5)$ indicate the unexplained variance in models (3), (4), (5), respectively.

4. Results and Discussion:

Table No. (1) Shows the descriptive statistics of the study variables in the countries of the OECD, as it turns out that the average ratio of logistic investment to GDP is about 3.9% annually. This is contributed to achieving relatively and high annual average of the degree of logistical efficiency of 3.63 is out of a total of 5 degrees, and an annual average of great competitiveness of 4.95 is out of a total of 7 degrees, which was demonstrated in achieving an average trade openness of 1.05% annually. Therefore, the OECD countries achieved an average economic growth rate of 1.7% annually from 2007 to 2018.

Table No. (1)
Summary of descriptive statistics for study variables in OECD countries

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>growth</i>	372	1.679763	3.451729	-14.83861	25.16253
<i>loginvestp</i>	372	3.942261	1.415307	.0393784	16.76076
<i>LPIs</i>	372	3.634153	.355591	2.78	4.23
<i>comps</i>	372	4.948306	.4686732	3.86	5.85
<i>OPENS</i>	372	1.052325	.6342403	.2526634	3.845817

Source: Calculated by researcher

As for the Arab countries (six countries only), Table No. (2) Shows the descriptive statistic summary of the study variables that the average ratio

of logistic investment to GDP is 3.32%. That reflected in the average logistics efficiency, which is about 3.01 degrees and was reflected in the average competitiveness and trade openness with an average of 4.14 degrees and 1.08% respectively. In contrast to the OECD countries, the Arab countries achieve a relatively high average economic growth rate of 3.48% indicating logistical investment works in developing countries than in developed countries, and it is consistent with the findings of a study (Chu, 2012 ; Datta & Agarwal, 2004).

Table No. (2)
Summary of descriptive statistics for study variables in the selected Arab countries

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>growth</i>	60	3.477247	3.00824	-7.076056	9.628407
<i>loginvestp</i>	60	3.322836	1.480164	.9133829	6.216783
<i>LPIs</i>	60	3.014838	.369744	2.370836	3.941767
<i>comps</i>	60	4.412417	.3752553	3.6	5.33
<i>OPENs</i>	60	1.079009	.3458516	.4065094	1.76145

Source: Calculated by researcher

The study depends on the analysis of Serial Mediation based on Figure No. (1) that is extracted from the logistics literature. It shows that logistics investments affect economic growth through a group of mediators. Each of them leads to the other (Hayes, 2017). Before conducting the mediation, the following assumptions must be considered in all regressions, which are linearity, homoscedasticity, normality of estimation error, and independence of observations (Hayes, 2017). All the regressions met these requirements well allowing to perform a mediation analysis between logistics investments (both gross and classified) and economic growth. The bootstrapping test is performed based on the biased-corrected confidence interval based on 10,000 boot samples.

We also used the Granger causality test to obtain a solid basis for performing the mediation tests. The results of the test showed that there is a one-way and two-way relationship between the study variables. Accordingly, we can perform mediation tests based on these results.

4.1 The results of mediation analysis in the OECD countries:

Results of the sequential mediation analysis is shown in Table No. (1) and Figure No. (1) in the annex indicating the mediation conditions are met as the total effect between logistic investment and economic growth is statistically significant. The logistic investment coefficient is 0.6758 with a level of significance (0.000000), which is the first condition. As for the second condition, direct mediation between logistic investment and economic growth is significant, which has been achieved since the logistic investment coefficient is 0.5830 with a level of significance (0.000000). The low value of the logistic investment coefficient in the presence of mediation variables. The total indirect effect is not significant, while there are three sub-paths of significance mediation as follows:

- 1. The third path:** Logistic investment causes trade openness causing economic growth.
- 2. The fourth path:** Logistics investment causes logistics efficiency, which causes competitiveness leading to economic growth.
- 3. The seventh path:** Logistics investment causes logistical efficiency, which in turn causes competitiveness leading to trade openness and economic growth.

The last track is the assumption that confirms the existence of an indirect effect between logistical investment and economic growth through the three mediators in this study. Accordingly, it can be concluded that the case of OECD countries applies to the first type of mediation classification, which is Complementary Mediation concerning the seventh track according to the classification (Zhao et al., 2010).

Table No. (3)
Total Effects Model

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>T-statistic</i>	<i>p-value</i>
<i>Lroad</i>	-0.807	0.480	-1.681	0.094*
<i>Lintuse</i>	1.879	0.459	4.097	0.000***
<i>Lrail</i>	0.029	0.076	0.383	0.702
<i>LLSCI</i>	-0.073	0.144	-0.508	0.612

$R^2 = 0.063$, F-statistic = 4.755, p-value= 0.001

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (3) shows the results of the total effects of the main logistical investment fields on economic growth in the OECD countries from 2007 to 2018. It appears that both the quality of roads and the number of Internet users had a significant impact on economic growth. The number of internet users positively is correlated with economic growth, which has the same conclusion reached (Hayaloglu, 2015; Hsieh & Goel, 2019; Sezer & Abasiz, 2017). Road quality is correlated with economic growth negatively, which has the same finding (Park, Seo, & Ha, 2019). While railways have a non-significant effect on economic growth that has the same conclusion reached (Hayaloglu, 2015; Sezer & Abasiz, 2017). The effect of regular Liner shipping connectivity was also negative and insignificant, which contradicts was reached (Fratila, Gavril, Nita, & Hrebenciuc, 2021). The impact of the Internet was in the first place in the areas of logistical investment followed by the quality of roads.

Table No. (4)
Direct effects model

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>T-statistic</i>	<i>p-value</i>
<i>Lroad</i>	<i>-1.151</i>	<i>0.513</i>	<i>-2.242</i>	<i>0.026**</i>
<i>Lintuse</i>	<i>1.523</i>	<i>0.602</i>	<i>2.528</i>	<i>0.012**</i>
<i>Lrail</i>	<i>0.209</i>	<i>0.097</i>	<i>2.167</i>	<i>0.031**</i>
<i>LLSCI</i>	<i>0.229</i>	<i>0.161</i>	<i>1.421</i>	<i>0.156</i>
<i>comps</i>	<i>0.986</i>	<i>0.325</i>	<i>3.034</i>	<i>0.003***</i>
<i>OPENNESS</i>	<i>0.890</i>	<i>0.241</i>	<i>3.699</i>	<i>0.000***</i>
<i>LPIs</i>	<i>-1.553</i>	<i>0.478</i>	<i>-3.246</i>	<i>0.001***</i>

$R^2 = 0.131$, F-statistic = 6.049, p-value= 0.000

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (4) shows the direct impact of the different areas of logistic investment on economic growth, and it represents the effect of logistic investment on economic growth in the absence of any mediators. It shows that there is a positive significant relationship between each of the internet users, railways, and economic growth, while the relationship between regular Liner shipping connectivity and economic growth is positive and is not significant. Finally, there is a negative significant relationship between road quality and economic growth. From this, mediators partially mediate the impact of logistical investment in railways, the internet, and road transport on economic growth. In contrast to investment in maritime transport in which mediators completely mediate its impact on economic growth.

Table No. (5)
Indirect Effects Model

<i>Mediator's effect on Economic Growth</i>				
<i>Lrail</i>				<i>Indirect effect</i>
	<i>comps</i>	<i>0.120419233***</i>	<i>0.986477623**</i>	<i>0.118790878**</i>
	<i>OPENNESS</i>	<i>-0.211022884***</i>	<i>0.889875349***</i>	<i>-0.187784062***</i>
	<i>LPIs</i>	<i>0.071621862***</i>	<i>-1.552832268**</i>	<i>-0.111216738**</i>
<i>Lroad</i>				
	<i>comps</i>	<i>0.803285773***</i>	<i>0.986477623**</i>	<i>0.792423439**</i>
	<i>OPENNESS</i>	<i>-0.079621363</i>	<i>0.889875349***</i>	<i>-0.070853088</i>
	<i>LPIs</i>	<i>0.243301175**</i>	<i>-1.552832268**</i>	<i>-0.377805916**</i>
<i>Lintuse</i>				
	<i>comps</i>	<i>1.303407369***</i>	<i>0.986477623**</i>	<i>1.285782202**</i>
	<i>OPENNESS</i>	<i>0.500398225***</i>	<i>0.889875349***</i>	<i>0.445292045**</i>
	<i>LPIs</i>	<i>0.885685236***</i>	<i>-1.552832268**</i>	<i>-1.375320614**</i>
<i>LLSCI</i>				
	<i>comps</i>	<i>-0.078883694**</i>	<i>0.986477623**</i>	<i>-0.077816999*</i>
	<i>OPENNESS</i>	<i>-0.028249938</i>	<i>0.889875349***</i>	<i>-0.025138923</i>
	<i>LPIs</i>	<i>0.128272716***</i>	<i>-1.552832268**</i>	<i>-0.199186013**</i>

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (5) shows that the indirect effects of many logistical investment fields on economic growth using mediation analysis in the OECD countries from 2007-2018. The fifth column shows the indirect effects of the different areas of logistic investment on economic growth, which is the output of the product of the third column (the effect of the three areas of logistic investment on mediators) in the fourth column (the effect of mediators on economic growth).

As for the indirect effect of investment in railways, Table No. (5) shows an increase of 1% in the length of the railways that will contribute to

achieving a significant increase in economic growth by 0.12% through an increase in competitiveness by 0.12%. In addition, an increase of 1% in the length of the railways will lead to a significant reduction in economic growth by 0.19% through the reduction of trade openness by 0.21%. The increase in railway length contributes to a significant reduction in economic growth by 0.11%, despite the increase in the level of logistics performance by 0.07%. The mediation of competitiveness in achieving economic growth through investment in railways is a complementary mediation, while the mediation of trade openness and the mediation of the level of logistical performance in achieving economic growth is a competitive mediation according to classification (Zhao et al., 2010).

As for the indirect effect of investment in road transport expressed in road quality, it is evident from Table (5) that an increase of 1% in road quality will lead to a significant increase in the economic growth of 0.79% through an increase in competitiveness by 0.8%. Also, an increase of 1% in the quality of roads will lead to an insignificant reduction in economic growth by 0.07%, through a reduction of trade openness by 0.08%. However, the relationship between road quality and economic growth through trade openness is not significant. An increase of 1% in the quality of roads will lead to a significant reduction in economic growth by 0.38% through the logistic performance. This is even though the quality of the roads contributes to an increase in the logistic performance by 0.24%. The mediation of logistical performance in achieving economic growth through the quality of roads is a complementary mediation. The mediation of competitiveness in achieving economic growth is considered a competitive mediation. The mediation of Trade openness in achieving economic growth is absent (direct effect only), according to classification (Zhao et al., 2010).

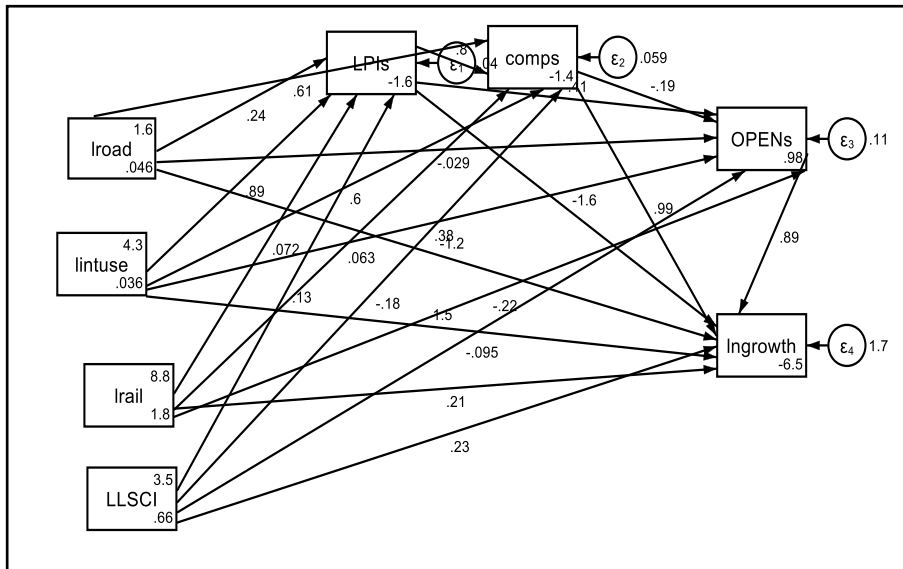
As for the indirect impact of internet users expressing investment in the telecommunications sector shown in Table No. (5). It shows that an increase in the number of internet users (as a percentage of the

population) by 1% leads to a significant increase in economic growth by 1.29%, through an increase in competitiveness by 1.3%. In addition, an increase of 1% in the number of Internet users leads to a rise in economic growth by 0.45% through a significant increase in trade openness by 0.50%. An increase of 1% in the number of Internet users leads to a significant decrease in economic growth by 1.38% through the level of logistic performance. Although the level of logistic performance increases by 0.89% because of an increase of 1% in the number of Internet users. The mediation of competitiveness and the mediation of Trade openness in achieving economic growth through the number of Internet users is a complementary mediation, while the mediation of the level of logistical performance in achieving economic growth is a competitive mediation according to classification (Zhao et al., 2010).

As for the indirect effect of investment in maritime transport, expressed in regular Liner shipping connectivity shown in Table (5), the increase in the regular shipping lines by 1% leads to a significant decrease in economic growth by 0.08%, through a decrease in competitiveness by 0.08%. An increase of 1% in the connection with regular shipping lines leads to a significant decrease in economic growth by 0.03% through a decrease in trade openness by 0.03%. An increase of 1% in the connection with shipping liner lines leads to a significant decrease in economic growth by 0.20% through the level of logistic performance, despite the increase in connectivity with shipping liner lines leading to an increase in the level of logistic performance by 0.13%. The mediation of competitiveness and the level of logistical performance in achieving economic growth through linking to regular shipping lines is a competitive mediation, while the mediation of trade openness in achieving economic growth is No mediation (direct effect only), according to classification (Zhao et al., 2010). Figure No. (2) shows the total, direct and indirect effect of the four main areas of logistical investment on economic growth in OECD countries.

Figure No. (2)

Total, direct, and indirect effect of the four main areas of logistical investment on economic growth in OECD countries



Source: Calculated by researcher

4.2 The results of mediation analysis in the Arab countries:

Although (Baron & Kenny, 1986) focused on the starting point in the mediation test that there is a total effect, where the independent variable significantly affects the dependent variable. Recent studies have shown that even if we do not find a significant correlation between the independent variable X and the dependent variable Y. The rest of the steps of the mediation test can be performed if it has a good theoretical background on this relationship (Shrout & Bolger, 2002). Although there is no statistically significant relationship between the total logistic investment and economic growth, as the logistic investment coefficient

(0.2790) is at a significant level ($p = 0.2955$), we have completed the mediation analysis procedures.

Results of the sequential mediation analysis shown in Table No. (2) and figure NO. (2) in the annex indicated that there are no total indirect effects between the total logistic investment and economic growth in the Arab countries, as the total indirect effect is (-0.0626), where the confidence interval is CI (0.2861 to - 0.1036). It indicates that the total indirect effect is not significant, because zero mediates the confidence interval. In addition, there are no effects for any of the seven sub-indirect effects. Also, there is no direct and significant effect between logistic investment and economic growth, as the logistic investment coefficient (0.3417) is at a significant level (0.2217). This result contradicts what was reached (Abdel Hamid, 2020; Rizkallah, 2014). Accordingly, this study concluded that the case of the Arab countries applies to the fifth type of mediation classification, which is no Effect and non-Mediation issued by (Zhao et al., 2010).

Despite the convergence of the ratio of logistical investments to GDP in the Arab countries in the OECD countries, the impact of those investments in the OECD countries was more effective given the large and stable size of the logistical infrastructure for many years. In contrast to the Arab countries, which have recently begun to pay attention to directing their investments to the various logistical fields. There is a time delay between the impact and the result in the Arab countries due to the weakness of the Arab logistical infrastructure. In other words, the relationship between logistic investment and economic growth is achieved in the long term and not in the short term, even with the presence of mediation variables.

Table No. (6)
Total Effects Model

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>T-statistic</i>	<i>p-value</i>
<i>Lroad</i>	-0.758	1.393	-0.544	0.591
<i>Lintuse</i>	-1.245	0.469	-2.653	0.014**
<i>Lrail</i>	-0.262	0.206	-1.271	0.215
<i>LLSCI</i>	0.079	0.294	0.268	0.791

$R^2 = 0.317$, F-statistic = 2.899, p-value= 0.042

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (6) showed the results of the total effects of the main logistical investment fields on economic growth in a selected Arab countries from 2007 to 2016. It showed a negative and insignificant relationship between the length of railways, road quality, and economic growth in the Arab countries. This is consistent with the findings of a study (Park et al., 2019) regarding road quality in developing countries. As for the relationship between regular liner shipping connectivity and economic growth, it was positive and not significant, while the relationship between the number of Internet users and economic growth was significant but negative, in contrast to what was found in the study of (Bahrini & Qaffas, 2019; Hodrab, Maitah, & Smutka, 2016).

Table No. (7)
Direct effects model

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>T-statistic</i>	<i>p-value</i>
<i>Lroad</i>	1.043	1.940	0.538	0.596
<i>Lintuse</i>	-1.801	0.583	-3.089	0.005**
<i>Lrail</i>	-0.640	0.389	-1.646	0.114
<i>LLSCI</i>	-1.190	0.835	-1.425	0.168
<i>comps</i>	-2.574	1.344	-1.916	0.068*
<i>OPENS</i>	-2.407	1.785	-1.348	0.191
<i>LPIs</i>	0.394	0.713	0.552	0.586

$R^2 = 0.419$, F-statistic = 2.267, p-value= 0.067

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (7) showed the direct impact of the main areas of logistical investment on economic growth in the Arab countries indicates a positive and insignificant relationship between the quality of roads and economic growth. As for the relationship between railway length, regular liner shipping connectivity, and economic growth, it was negative and not significant. There is a negative and significant relationship between the number of internet users and growth.

The volume of investments directed to rail, road and maritime transport was not sufficient for affecting economic growth, or in other words, these investments are expected to have an impact in the long term. As for Internet users, although it is significant, it has a negative impact. This is due to the use of the Internet in Arab countries directed to entertainment more than the productive and service process leading to economic growth as in (similar web, 2021).

Table No. (8)
Indirect Effects Model

	<i>Mediator's effect on Economic Growth</i>			
<i>Lrail</i>				<i>Indirect effect</i>
	<i>comps</i>	<i>0.050</i>	<i>-2.574*</i>	<i>-0.129591848</i>
	<i>OPENs</i>	<i>-0.202***</i>	<i>-2.407</i>	<i>0.486746245</i>
	<i>LPIs</i>	<i>0.053</i>	<i>0.394</i>	<i>0.020782407</i>
<i>Lroad</i>				
	<i>comps</i>	<i>1.248***</i>	<i>-2.574*</i>	<i>-3.211846297*</i>
	<i>OPENs</i>	<i>-0.514**</i>	<i>-2.407</i>	<i>1.236200442</i>
	<i>LPIs</i>	<i>0.444</i>	<i>0.394</i>	<i>0.174812419</i>
<i>Lintuse</i>				
	<i>comps</i>	<i>-0.063</i>	<i>-2.574*</i>	<i>0.162684229</i>
	<i>OPENs</i>	<i>-0.111*</i>	<i>-2.407</i>	<i>0.266802478</i>
	<i>LPIs</i>	<i>0.322**</i>	<i>0.394</i>	<i>0.126916789</i>
<i>LLSCI</i>				
	<i>comps</i>	<i>-0.113280051**</i>	<i>-2.574*</i>	<i>0.291625958</i>
	<i>OPENs</i>	<i>-0.382856381***</i>	<i>-2.407</i>	<i>0.921453322</i>
	<i>LPIs</i>	<i>0.141021002</i>	<i>0.394</i>	<i>0.055505907</i>

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Source: Calculated by researcher

Table No. (8) shows the indirect effects of the various logistical investment fields on economic growth in some selected Arab countries from 2007-2016. The fifth column shows the indirect effects of the various areas of logistic investment on economic growth.

Table No. (8) shows the indirect impact of investments in railways, as an increase of 1% in the length of railways contributes to a decrease in economic growth by 0.13% through competitiveness. While an increase of 1% in the length of the railways contributes to the rise in economic growth through both trade openness and the level of logistic performance by 0.49% and 0.02% respectively. The indirect relationship between railway length and economic growth through the three mediators is not significant. Hence, the mediation of competitiveness, trade openness, and level of logistic performance are considered no mediation with no effect according to classification (Zhao et al., 2010).

As for the indirect effect of investment in road transport expressed in road quality in Table No. (8), an increase of 1% in road quality will lead to a significant decrease in economic growth by 3.21% through competitiveness. The impact of road quality on competitiveness is positive and significant. The high quality of roads affects competitiveness in the short term, but the transmission of this indirect effect of road quality to economic growth occurs in the long term. While an increase of 1% in the quality of roads will lead to an insignificant increase in economic growth through both trade openness and the level of logistic performance by 1.24%, 0.17%, respectively. The mediation of trade openness and the level of logistical performance through road quality is considered no mediation with no effect. As for the mediation of competitiveness, it is only indirect mediation according to the classification of (Zhao et al., 2010).

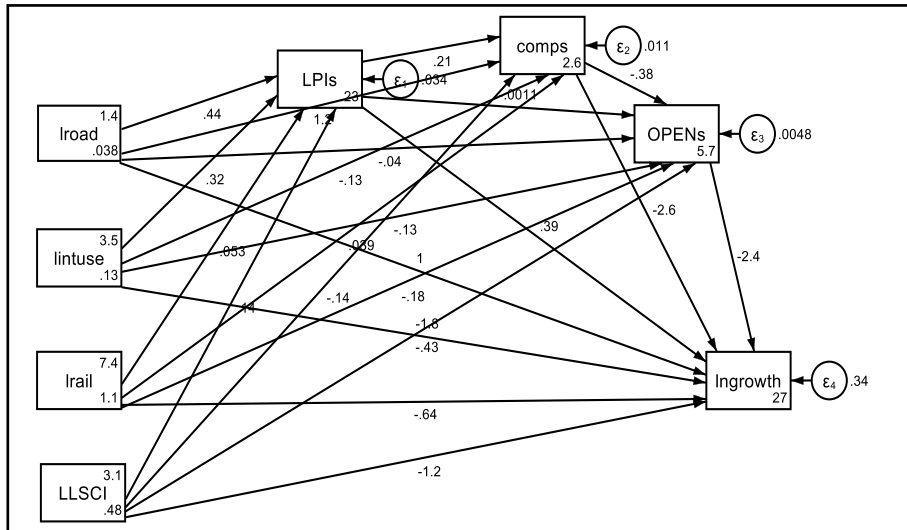
As for the indirect impact of Internet users expressing investment in the telecommunications sector, it is clear from Table (8) that an increase in the number of Internet users (as a percentage of the population) by 1% leads to an insignificant rise in economic growth through both competitiveness and openness, and logistic performance levels by 0.16%,

0.27%, and 0.13%, respectively. The mediation of competitiveness, the mediation of trade openness, and the level of logistic performance in achieving economic growth through the number of Internet users is No mediation (direct effect only), according to classification (Zhao et al., 2010).

As for the indirect impact of investment in maritime transport, expressed in Regular Liner shipping connectivity, it appears from Table (8) an increase of 1% in the Regular Liner shipping connectivity, which leads to an insignificant increase in economic growth through both competitiveness, trade openness, and the level of Logistic performance by 0.29%, 0.92%, 0.06%, respectively. The mediation of competitiveness, trade openness, and logistics performance through Regular Liner shipping connectivity are considered non-mediation with no effect according to classification (Zhao et al., 2010). Figure No. (3) shows the total, direct and indirect effect of the four main areas of logistical investment on economic growth in ARAB countries.

Figure No. (3)

Total, direct, and indirect effect of the four main areas of logistical investment on economic growth in ARAB countries



Source: Calculated by researcher

The study concluded that the investments directed from the Arab countries to the various fields of investment were not sufficient to affect economic growth directly or indirectly, except for the indirect effect of road quality through competitiveness and a direct impact through the number of Internet users.

Mediation analysis was based on PROCESS version 3.5.5, although the program cannot estimate any model that allows the independent variable to modify any path in the mediation model. However, this current study tested the assumption that there is no interaction between the independent variable and each variable specified as a mediator. The results concluded that most mediation paths did not suffer from this interaction, except in the path of competitiveness and openness in the Arab countries, and competitiveness in the OECD countries. Where (Baron & Kenny, 1986) indicates that the mediator is considered a Moderated Mediation. (Kraemer, Wilson, Fairburn, & Agras, 2002) considers this interaction a form of mediation.

The greatest impact of the three investment areas (roads, railways, and the Internet) in achieving economic growth is through enhancing competitiveness. As for the investment in maritime transport, it did not affect economic growth. This is because the infrastructure in maritime transport investment has reached its highest levels in the OECD countries. Therefore, any increase may not contribute significantly to achieving economic growth. This contrasts with the Arab countries where investment in maritime transport was not sufficient to affect economic growth. The impact of logistical performance on economic growth may be negative, in short term, but in the medium and long term are positive. Thus, there is a time between the effect and the result, as the four logistical investment fields contribute positively to affecting the mediation variables (competitiveness, trade openness, and the level of logistical performance), where the influence of the mediation variables to economic growth takes place in the short term through enhancing competitiveness. There is an exception to this concerning trade openness about the impact of road quality and Regular Liner shipping connectivity.

5. Conclusion

Logistics is one of the most significant determinants of economic growth. Investment in the logistics sector will improve the efficiency of logistics services, facilitate the flow of the country's foreign trade, and increase its competitiveness. Although there are studies that deal with the relationship between logistics and economic growth, some studies that deal with investment in the entire logistics sector instead of proxies that only reflect some aspects of the logistics sector. Furthermore, studying the direct and indirect impact of logistics investment and its impact on economic growth may be absent in the literature of logistics services. Also, most of these studies focused on one country or a specific region or all countries of the world. Some studies compared two groups of countries and reflected different levels of logistical performance to identify the mechanism through the impact of logistical investment that is transmitted to achieve economic growth.

Therefore, this study attempted to bridge this gap by using logistic investment in the entire sector and to measure the direct and indirect impact through mediation analysis using three mediators, namely, the level of logistic performance, competitiveness, and trade openness. The study focused on two groups of countries, first: the Arab countries (6 countries), second: the countries of the OECD (31 countries). The study period extends for the first group from 2007 to 2016, and for the second group from 2007 to 2018. The current study adopts a Product of Coefficients approach with the bootstrapping method used to test the direct and indirect impact of the relationship between total logistic investment and economic growth. Four independent variables were used to reflect different logistic investments to identify the strength and the impact of each on economic growth through the same three mediators.

This current study did not find a relationship between logistic investment and economic growth, either directly or indirectly, in the Arab countries. Unlike in the OECD countries, there is a direct and indirect impact between logistical investment and economic growth through logistical

efficiency, competitiveness, and openness of trade as mediators in this relationship. The study also confirmed that investment in the quality of roads had the largest role in achieving economic growth in Arab countries. While investment in the quality of roads, railways and the Internet had the largest role in achieving economic growth in the countries of the OECD. Consequently, Arab countries must direct more investments into the logistics sector, especially roads, railways, and the Internet, to increase logistical efficiency, competitiveness, and openness, which leads to economic growth. As for the volume of investments in maritime transport was not sufficient in the two groups of countries to have a significant impact on economic growth. It also means directing more investments towards Regular Liner shipping connectivity that would increase competitiveness and achieve economic growth. The lack of data on the logistics sector prevented the study from enriching in more countries, especially Arab countries, and for long periods. There is a need to conduct more studies on the impact of logistical investment on economic growth through other mediators such as productivity and technological capacity. As well as the use of other indicators, that reflect the level of logistical performance, such as the Trading across Borders index, with reliance on multi-dimensional logistical investments.

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Appendix

Table No. (1)

Mediation analysis between logistics investment and economic growth in OECD countries

<i>Model</i>		<i>Coeff.</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>R-sq</i>
LPIs						0.0264
	<i>constant</i>	3.7952	0.0540	70.3147	0.0000	
	<i>loginvestp</i>	-0.0408	0.0129	-3.1694	0.0017	
comps						0.5982
	<i>constant</i>	1.2916	0.1734	7.4473	0.0000	
	<i>loginvestp</i>	-0.0074	0.0111	-0.6661	0.5058	
	LPIs	1.0142	0.0441	23.0088	0.0000	
OPENs						
	<i>constant</i>	1.3245	0.3671	3.6085	0.0004	
	<i>loginvestp</i>	0.1496	0.0219	6.8420	0.0000	
	LPIs	0.1658	0.1357	1.2217	0.2226	
	<i>comps</i>	-0.2960	0.1027	-2.8813	0.0042	
growth						0.1226
	<i>constant</i>	-5.8841	2.0655	-2.8487	0.0046	
	<i>loginvestp</i>	0.5830	0.1284	4.5404	0.0000	
	LPIs	-1.6275	0.7521	-2.1639	0.0311	
	<i>comps</i>	2.0861	0.5745	3.6314	0.0003	
	OPENs	0.8148	0.2883	2.8264	0.0050	
growth						0.0768
	<i>constant</i>	-0.9843	0.5102	-1.9293	0.0545	
	Loginvestp	0.6758	0.1218	5.5471	0.0000	
Indirect effects						
	<i>Effects</i>	<i>BootSE</i>	<i>BootLLCI</i>	<i>BootULCI</i>		
TOTAL	0.0928	0.0562	-0.0193	0.2032		
Ind1	0.0665	0.0528	-0.0159	0.1903		
Ind2	-0.0154	0.0315	-0.0915	0.0387		
Ind3	0.1219	0.0451	0.0418	0.2188		
Ind4	-0.0864	0.0441	-0.1918	-0.0226		
Ind5	-0.0055	0.0064	-0.0216	0.0038		
Ind6	0.0018	0.0036	-0.0045	0.0104		
Ind7	0.0100	0.0065	0.0018	0.0267		

Source: Calculated by researcher

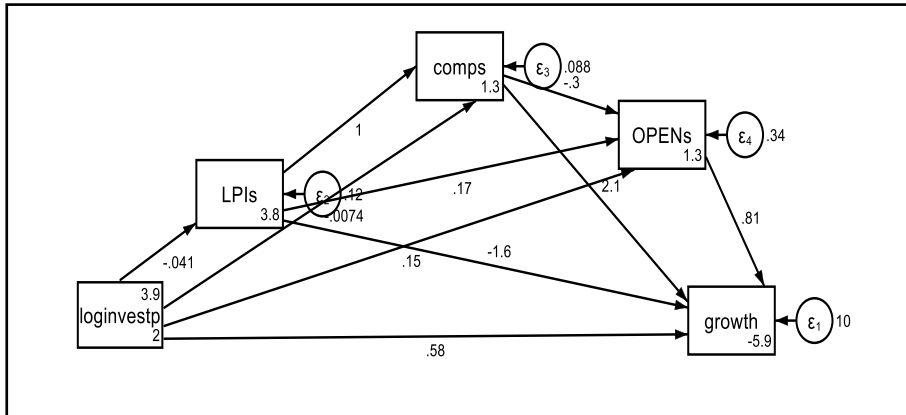
Table No. (2)
**Mediation analysis between logistics investment and
economic growth in the Arab countries**

<i>Model</i>		<i>Coeff.</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>R-sq</i>
LPIs						0.0562
	<i>constant</i>	2.8181	.1158	24.3455	0.0000	
	<i>loginvestp</i>	0.0592	0.0319	1.8580	0.0682	
comps						0.4254
	<i>constant</i>	2.4337	0.3097	7.8577	0.0000	
	<i>loginvestp</i>	0.0297	0.0262	1.1326	0.2621	
	<i>LPIs</i>	0.6236	0.1049	5.9456	0.0000	
OPENs						0.6038
	<i>constant</i>	-2.0475	0.3452	-5.9321	0.0000	
	<i>loginvestp</i>	0.0058	0.0205	0.2831	0.7782	
	<i>LPIs</i>	0.1923	0.1031	1.8655	0.0674	
	<i>comps</i>	0.5728	0.1023	5.6010	0.0000	
growth						0.0623
	<i>constant</i>	4.3501	5.9468	0.7315	0.4676	
	<i>loginvestp</i>	0.3417	0.2764	1.2361	0.2217	
	<i>LPIs</i>	-2.1673	1.4344	-1.5109	0.1365	
	<i>comps</i>	1.0421	1.7248	0.6042	0.5482	
	<i>OPENs</i>	-0.0668	1.8043	-0.0370	0.9706	
growth						0.0189
	<i>constant</i>	2.5500	0.9602	2.6557	0.0102	
	<i>Loginvestp</i>	0.2790	0.2643	1.0556	0.2955	
Indirect effects						
	<i>Effects</i>	<i>BootSE</i>	<i>BootLLCI</i>	<i>BootULCI</i>		
TOTAL	-0.0626	0.0970	-0.2861	0.1036		
Ind1	-0.1283	0.1264	-0.4390	0.0340		
Ind2	0.0309	0.0723	-0.1257	0.1860		
Ind3	-0.0004	0.0420	-0.0926	0.0848		
Ind4	0.0385	0.0872	-0.1135	0.2404		
Ind5	-0.0008	0.0337	-0.0544	0.0873		
Ind6	-0.0011	0.0482	-0.0919	0.1123		
Ind7	-0.0014	0.0535	-0.0932	0.1314		

Source: Calculated by researcher

Figure No. (1)

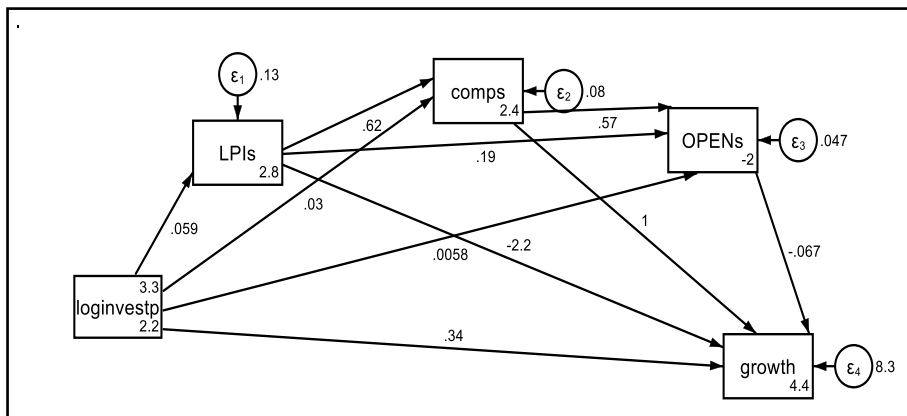
Mediation analysis between logistics investment and economic growth in OECD countries



Source: Calculated by researcher

Figure No. (2)

Mediation analysis between logistics investment and economic growth in the Arab countries



Source: Calculated by researcher

الاستثمار اللوجستي والنمو الاقتصادي في الدول العربية ودول منظمة التعاون الاقتصادي والتنمية : نهج تحليل الوساطة

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مدرس الاقتصاد - معهد طبية العالي للحاسب والعلوم الادارية

المستخلص:

تهدف هذه الدراسة إلى التحقيق في العلاقة بين الاستثمار اللوجستي والنمو الاقتصادي من خلال تحديد التأثير المباشر وغير المباشر للاستثمار في قطاع اللوجستيات بأكمله إلى جانب التأثير المصنف لبعض مجالاته على النمو الاقتصادي. تُستخدم الدراسة بيانات طولية لمجموعتين من البلدان: ست دول عربية للفترة ٢٠٠٧-٢٠١٦، و٣١ دولة من منظمة التعاون الاقتصادي والتنمية للفترة ٢٠٠٧-٢٠١٨. تتبنى هذه الدراسة نهج تحليل المسار القائم على تحليل الوساطة باستخدام طريقة نتائج المعاملات مع طريقة التمهيد لاختبار الآثار المباشرة وغير المباشرة للعلاقة بين الاستثمار اللوجستي الاجمالي والنمو الاقتصادي من خلال ثلاثة وسطاء. تساهم هذه الدراسة في الأدبيات من خلال سد فجوة تحديد التأثير غير المباشر للاستثمار اللوجستي على النمو الاقتصادي (سواء بالنسبة لقطاع الخدمات اللوجستية بأكمله أو مصنفاً لعدة مجالات)، وهي بخلاف الدراسات الأخرى التي ركزت على التأثير المباشر فقط. تثبت الدراسة الحالية أن العلاقة بين الاستثمار اللوجستي والنمو الاقتصادي، سواء بشكل مباشر أو غير مباشر، لم تكن واضحة في الدول العربية، على عكس الوضع في دول منظمة التعاون الاقتصادي والتنمية، والتي لها تأثير مباشر وغير مباشر بين الاستثمار اللوجستي والنمو الاقتصادي. من خلال الكفاءة اللوجستية والقدرة التنافسية والانفتاح التجاري كوسطاء في هذه العلاقة. كما أكدت الدراسة أيضاً على أن الاستثمار في جودة الطرق كان لها الدور الأكبر في تحقيق النمو الاقتصادي في الدول العربية، في حين أن الاستثمار في جودة الطرق والسكك الحديدية والانترنت كانت لها الدور الأكبر في تحقيق النمو الاقتصادي في دول منظمة التعاون والتنمية الاقتصادية.

الكلمات المفتاحية :

الاستثمار اللوجستي ، النمو الاقتصادي ، نهج تحليل الوساطة ، الدول العربية ، منظمة التعاون الاقتصادي والتنمية ، نهج نتائج المعاملات .

