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The role of logistics in economic growth and global competitiveness*

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Abstract

There is a rising demand to find new patterns for economic growth and development, and improving competitiveness, where the role of logistics should be considered in more detail. The main purpose of the article is to examine and compare the effects of countries' logistics performance in EU, BRICS, and ASEAN, and to test the role of individual logistics components. The research method is based on panel data using fixed effects regressions for the period 2007-2018. The results confirm the positive impact of logistics on economic growth and competitiveness in the total sample and EU countries, while logistics contributes to rising competitiveness in BRICS countries. Individual contributions of LPI components were also identified, presenting the importance of sub-indices for economic growth and national competitiveness. The research implications emphasize the role of logistics as a factor of economic growth and development and highlight its potential in rising national competitiveness. The main contribution is new evidence on the effects of logistics at the level of selected groups of countries, which highlights the importance of this sector and provides recommendations for economic policymakers.

Keywords: *logistics performance index (LPI), economic growth, global competitiveness, panel data*

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1. Introduction

The importance of logistics can be highlighted in different dimensions of economic development. From the aspect of the national economy, the system of international logistics as a non-tariff trade facilitator affects the intensity of international trade in goods (Puertas et al., 2014; Gani, 2017; Bugarčić et al., 2020; Zaninović et al., 2020), energy (Górecka et al., 2022), creating and improving the investment environment in order to attract FDI (Luttermann et al., 2020; Bugarčić et al., 2023), eliminating the negative consequences of the crisis and as support in implementing the goals of sustainable development and structural reforms (Taqi et al., 2020; Mićić and Bugarčić, 2022). Logistics benefits in reducing costs, time of transport, safety, as well as the quality of logistics services have always been an important factor in stimulating competitiveness (Persson, 1991). Management of the logistics system, from the procurement of materials, through the distribution of semi-finished products and the delivery of final goods to customers, could be the key determinant of competitive advantage. Reducing transportation costs can accelerate industrial aggregation (Krugman, 1991), which potentially leads to better competitive advantages for the region or country that makes more progress in this field. The main motive for national logistics improvement is to stimulate competitiveness and achieve additional and continuous economic growth. Viewed as an integrated system, logistics encompasses a "complete system of information, packaging, storage, and transport that meets the requirements in terms of time, quality, quantity and cost" (Puertas et al., 2014).

According to OECD studies, logistics costs are up to 15% of the total turnover and its reduction can have a positive effect on the countries' international competitiveness (Engman, 2005). The share of logistics costs in the final cost of production is approximately 11%, which presents the global average. Observing the world's largest economies, logistics costs are 14% in China, 11% in the EU, and 10% in the US and Canada (Yergaliyev and Raimbekov, 2016). The efficient development of transport and logistics systems at the national level encourages the accelerated development of related industries and sectors of the economy. Flexibility, timeliness, completeness, integrity, and security can be highlighted as important factors of logistics, especially in crisis and circumstances of economic recession (Chornopyska and Bolibrukh, 2020). The stability of the logistics sector and its improvement would enable uninterrupted and accelerated business activities within the economy and more efficient connections with foreign markets. Improving the logistics system, as a connecting factor of different industries, suppliers and consumers, can provide an equal chance for the development of all individual industries and participants in supply chains.

The logistics performance index (LPI) defined by the World Bank can be used as a key determinant in accessing the level of international trade logistics development.

LPI was developed with the aim of assessing and monitoring the quality of logistics of individual countries with the possibility of identifying space and opportunities to improve their international position. The index was developed based on a global survey of logistics professionals who assess the individual characteristics of the logistics sector in the country in which they operate, as well as in the countries with which they cooperate (World Bank, 2020). The degree of national competitiveness can be measured by the Global Competitiveness Index (GCI), which in aggregate terms contains estimates of the relevant pillars of competitiveness. The results of the GCI 4.0 report from 2019 reveal that countries are still lagging in terms of improving national competitiveness, which is why new patterns need to be found to encourage it (WEF, 2019). For this reason, the article examines the degree and strength of logistics performance impact, as a potential factor in improving global competitiveness of national economies.

Our motivation is to investigate the effects of logistics performance on economic growth and the global competitiveness of national economies and make comparisons based on sample selection. We examine the impact on the total sample and compare the effects of logistics in different regions, which represents the main novelty compared to previous literature. Additionally, results provide some evidence regarding the contribution of individual LPI sub-indices. We use OLS and fixed effects regressions based on panel data for selected countries in the period 2007-2018. In line with that, the following hypotheses are tested:

H1: A better logistics system may have a positive impact on economic growth.

H2: National competitiveness depends on the development of the logistics system.

The paper consists of the following parts: after the introduction (1), a review of the literature will be presented (2), where the results of relevant research on the connection between logistics and economic growth (2.1), as well as logistics and competitiveness (2.2), will be presented separately. After that, the research methodology and used data will be explained in detail (3). Empirical findings (4), discussion (5), and concluding remarks (6) with recommendations for policymakers and future research.

2. Literature review

The literature review is structured and divided into two parts. The first part analyses previous research in the context of logistics and economic growth, and the second part analyses logistics and competitiveness.

2.1. Logistics and economic growth

Logistics, as part of the value chain includes planning, implementation, and control of the efficiency of the flow of goods, services, and information from the place of origin to the place of consumption (De Souza et al., 2007). The related activities include transportation, storage, and packaging. Improving logistics can have positive consequences for economic growth and development in several ways, through increased demand for goods and services due to greater investment in logistics infrastructure and better logistics services (Roller and Weverman, 2001). Furthermore, better logistics infrastructure increases transport efficiency and reduces additional costs that would arise due to inadequate development of the logistics sector (Gunasekera, Anderson, and Lakshmanan, 2008). Logistics systems may be one of the most important driving forces for economic growth, regional development, investment inflow, employment, and per capita income (Cheng et al., 2010; Sezer and Abasiz, 2017). Research (Chu, 2012) shows that the contribution of investment in logistics development is especially important for less developed areas and provinces. Wang, et al. (2021) performed Granger causality tests between the logistics infrastructure and economic development indicators under the VAR and VECM frameworks. The empirical results suggest that there is a long-run relationship between the logistics infrastructure and the economic development in China. The main finding is that logistics infrastructure causes economic development and has a key role in promoting economic growth. Analogously, Lean et al. (2014) have proved that economic growth causes logistics output, implying that economic development causes more demand for logistics services and hence leads to logistics development. Better logistics infrastructure could cause economic growth, through a reduction of transportation time and increased traffic volume. Improvement in land and railway transport infrastructure initiates economic growth with a feedback effect. In this way, economic and logistics development are interrelated, where the advancement of one, leads to the progress of the other, and vice versa, so the relationship between logistics and economic development is interactive. Further economic development requires continuous improvement of the logistics industry and its progress (Zhu et al., 2008).

The development of logistics at the national level implies the improvement of four key components, namely, infrastructure, institutional environment, service providers, and shippers (Banomyong et al., 2008). To these dimensions of logistics can be added the integration of peripheral areas and the emphasis on the importance

of standardization and improvement of technology to intensify trade and strengthen the industry. Coto-Millán Fernández et al. (2016) found, using the LPI, that a 1% improvement in logistics performance contributes to a 0.59% improvement in technical efficiency. In this way, the development of logistics gives a positive impetus to the development of technology that further gives impetus to economic growth and the improvement of industrial production. Kovács and Kot (2016) point out that faster changes in the market and higher consumer demands require a greater degree of efficiency in logistics services. The authors note that modern production processes, supply chains, and transport activities are key elements that require improvement to act on economic growth and by the requirements of the new industrial revolution and Industry 4.0.

A large number of researchers pay attention to logistics as a factor of trade facilitation, which consequently, through the connection of international trade, can lead to industrial and economic development. Lai et al. (2019) proved on the example of ASEAN countries that trade liberalization and transport development are interconnected and mutually reinforce the positive effects on international trade. Trade facilitation effects have remarkable effects in developed countries, but they are particularly important for developing countries, where logistics play an important role in trade promotion and economic development (Çelebi, 2019). In addition to the direct impact, the effects of logistics on economic growth can have an indirect impact, as a mediator of the relationship between competitiveness and economic growth. At the same time, logistics acts as a reinforcing factor of the impact of GCI on GDP growth, thus contributing to a more significant positive impact of national competitiveness on economic growth and development (Civelek et al., 2015; D'Aleo and Sergi, 2017b). In other words, better logistical support, improved competitiveness and other related parameters of economic development will give better results for the country, than would be the case if the network of logistics infrastructure and services would not be at a satisfactory level. The impact of logistics performance on economic growth and development can be particularly significant for developing countries (Saidi et al., 2020; Nguyen et al., 2021) and African region (Chakamera and Pisa, 2021), where this sector can serve to initiate and accelerate the development of these countries.

2.2. Logistics and competitiveness

The future of national economies will develop around the ability to find new ways to stimulate economic growth and maintain greater competitiveness. According to D'Aleo and Sergi (2017b), global competitiveness is a correct variable to assess economic growth and it has a crucial role in economic recovery and development. Using Baron and Kenny's model, the authors came to the conclusion that logistics performances have a mediator effect on the relationship between GCI and GDP, so logistics and global competitiveness, considered together, are good predictors

of economic growth. An improvement of the logistics sector, framed in a general perspective of competitiveness and growth, could become a winning factor for national economies. The elevation of the logistics industry could force logistics as a national production factor, thereby contributing to reducing national freight costs and improving global competitiveness (Havenga, 2018). Considering the fact that the volume and nature of international trade mostly depend on changes in transport costs (Behar and Venables, 2011), logistics as a trade facilitation factor can contribute to a better competitive advantage for the economy in the sense of cost reduction and better national conditions.

One of the key competitive advantages provided by logistics is that its improvement reduces transport costs and obstacles in the form of distance, which can successfully neutralize various costs related to international trade of goods (Halaszovich and Kinra. 2020; Bugarčić et al., 2020). In this way, the improvement of logistics infrastructure and especially logistics services within an economy can consequently contribute to the improvement of the global competitiveness of the economy, especially in the field of industrial products. Logistics contribute to economic growth and development, as well as improving competitiveness by being an important factor in attracting foreign and domestic investments (Hong, 2007), which is widely regarded as an important engine of economic growth. The timeliness of delivery is a crucial factor in international trade, and this segment of logistics stands out as a key factor of competitiveness (Zaman and Shamsuddin, 2017). There is a great chance that companies, and thus the economy in which they operate, will achieve a greater competitive advantage if they perform their activities accurately, efficiently, and on time, with a certain level of security. Additionally, the human factor can play an important role in determining the level of competitiveness of the logistics sector and thus the entire economy (D'Aleo and Sergi, 2017a).

Beysenbaev and Dus (2020) emphasize the great role of logistics in the development of the country at the international level. By improving the elements of logistics, the country achieves a better position in international markets, either through the benefits of direct international trade or as an intermediary and logistics hub in international trade flows. Logistics performances play a very important role in increasing the country's competitive position at the international level, primarily through the improvement of certain logistics subcomponents: international transportation, tracking and tracing, and timeliness. This conclusion is found (Çemberci et al., 2015) by examining the moderating impact of the GCI on LPI. Evaluating logistics cluster competitiveness among Asian countries based on Porter's diamond model, Chung (2016) found that there is a big difference in logistics cluster competitiveness between the observed countries so, economic policymakers should pay more attention to this issue, especially in less developed countries. Zaninović et al. (2020) observed the effects of LPI on bilateral trade

flows in the example of European Union countries, where they concluded that new EU members must improve their logistics systems in order to move closer to developed members through better transport corridors, reduced freight times and improved shipment price competitiveness. The link between logistics performance and the level of competitiveness must also be taken into account by the specific group of countries (Sergi et al., 2021).

Tongzon (2007) suggested several areas that need to be improved in order to raise the competitiveness of logistics hubs: establishing a free trade and investment environment; increasing the number of qualified human resources and logistics specialists; increasing the degree of transparency of government industrial policies; more efficient administration and promoting mutual cooperation between government and the private sector. Certain research shows that demand for products in some areas is determined by the level of quality of logistics and demand for logistics services (Du and Yan, 2008). Therefore, the way to stimulate demand for certain products should be stimulated by improving the quality of logistics services. Efficient transport and logistics systems provide a chance for the economy to attract companies from certain industries and thus improve the country's position in the international trade and production network (Yergaliyev and Raimbekov, 2016). In order to stimulate international trade, improving logistics performance has a greater impact on exports than on imports of goods (Puertas et al., 2014). This evidence is particularly suitable for export-oriented industries that may seek a chance to increase the placement of their products in foreign markets by looking at space for improvement of logistics performance, especially logistics service competence and tracking of consignments. Andrade et al. (2014) indicate the great importance of reverse logistics as a potential for companies to improve their competitiveness, which can have positive effects on the whole economy. Reverse logistics can stimulate positive effects in the form of sustainable economic development and maximum utilization of used production resources. Another way to improve logistics performance could be through certain dimensions of global competitiveness (Ekici et al., 2019), which indicates the existence of a strong connection between these segments of the economy.

3. Methodology and data

Our main goal is to examine the impact of logistics performance on economic growth and global competitiveness in selected groups of countries. The analysis includes EU28, BRICS and ASEAN countries. We also strive to identify potential differences in these regions. Biannual panel data is used for the available period from 2007 to 2018. Among selected countries, Malta, Lao PDR and Myanmar were excluded due to missing data. We raised our models based on Chu (2012) which includes logistics performance as a proxy variable:

Model 1:

$$Growth_{it} = \beta_0 + \beta_1 LPI_{it} + GDPGrowth_{it} + CIP_{it} + lnPOP_{it} + Unemp_{it} + \\ + GOVexp_{it} + \mu_i + v_{it}$$

Model 2:

$$Competitiveness_{it} = \beta_0 + \beta_1 LPI_{it} + GDPGrowth_{it} + CIP_{it} + lnPOP_{it} + \\ + Unemp_{it} + GOVexp_{it} + \mu_i + v_{it}$$

where i indexes countries; t time, i.e. years; μ_i captures the countries fixed effects; v_{it} is the transitory error term. For the measure of economic growth, we select lnGDP per capita (World Bank, 2021), while data for GCI are taken from World Economic Forum (WEF, 2018) and used as a measure of competitiveness. The reason for choosing GDP per capita as a measure of economic growth is that it reflects and catches the changes in an economy, as opposed to the overall level that can lead to bias in assessing real effects. Previous research which includes per capita level in empirical research proved its relevance (Barro and Lee, 1993; Ozturk and Acaravci, 2010). Also, the difference compared to the initial model of Chu (2012) is the use of LPI as a measure of logistics whose data is available for shorter period. The composite index LPI is used to express the overall country-level logistics performance. As LPI, which represents the main variable of interest in our model, reflects the state of logistics for two years (the given year and the year before), we did not include the lags in our model. To avoid potential biases, we use control variables based on Chu (2012). Thus, we include IMF data for real GDP growth, lnPOP (Population), Unemp (Unemployment rate), GOVexp representing government expenditure in % of GDP and CIP index (Competitive Industrial Performance Index – (UNIDO, 2019). LPI contains the following six components (World Bank, 2020):

- Customs – efficiency of customs and cross-border procedures;
- Infrastructure – quality of physical infrastructure;
- International shipments – ease of arranging shipments with competitive prices;
- Logistics competence – logistics service quality;
- Tracking and tracing – ability to track and trace consignments;
- Timeliness – delivery at the agreed or expected time.

We conduct analysis using OLS and fixed effects and compare results. As a further step, we look at results on region level, based on included dummies. At the end, we strive to identify and compare the impact of individual logistics performance on economic growth and competitiveness, where the following models were formulated:

Model 3:

$$GROWTH_{it} = \beta_0 + \beta_1 LPIcomponents_{it} + GDPGrowth_{it} + CIP_{it} + lnPOP_{it} + \\ + Unemp_{it} + GOVexp_{it} + \mu_i + v_{it}$$

Model 4:

$$Competitiveness_{it} = \beta_0 + \beta_1 LPIcomponents_{it} + GDPGrowth_{it} + CIP_{it} + \\ + lnPOP_{it} + Unemp_{it} + GOVexp_{it} + \mu_i + v_{it}$$

In order to have robust results based on selected methodology, we applied kurtosis and skewness test, as well as Jarque Berra test and results differ through selected variable. The final judgment on the normality of the distribution for all observed variables was made based on the Shapiro–Wilk test. The results of this test confirm the normality of the distribution. VIF test is conducted for all regressions to test multicollinearity. In all cases it is less than 5 which indicates no multicollinearity problems. Additionally, equations 3 and 4 include separate regressions for each LPI component to avoid multicollinearity problems since those sub-indices are part of the same overall index. To control for heteroskedasticity we apply robust function in regressions and use fixed effects in selected model to avoid endogeneity issue. At the same time, the results of the Hausman test suggest that it is appropriate to prefer a fixed-effects model over a random-effects model. Also, Based on Pedroni panel cointegration test results ($p < 0.05$) it could be concluded that there is the existence of a robust long-run relationship between GDPpc and explanatory variables as well as for GCI and explanatory variables.

4. Empirical results

In order to avoid spurious regression and to check the stationarity of the panels, Levin-Lin-Chu unit-root tests were conducted (Levin et al., 2002). The null hypothesis of the unit-root test is *Panels contain unit roots*, the alternative is *Panels are stationary*. The test results presented in Table 1 indicate that all panels are stationary.

Table 1: Levin-Lin-Chu panel unit root test

Variable	adjusted t	p-value
LPI_Score	-58.8497	0.0000
Customs	-35.5716	0.0000
Infrastructure	-1.00E+02	0.0000
International_shipments	-33.8491	0.0000
Logistics_competence	-20.0807	0.0000
Tracking_tracing	-28.9681	0.0000
Timeliness	-52.9808	0.0000
lnGDPpc	-28.3286	0.0000
GCI	-14.0927	0.0000

Note: Number of panels: 39; Number of periods: 6; Time trend: not included; Panel means: included; ADF regressions: 1 lag

Source: Authors' calculation

Table 2 presents descriptive statistics for the LPI overall score, its sub-indices, and dependent variables. Among the observed variables, the lowest average value among the LPI components is recorded in the efficiency of customs procedures, which indicates room for improvement in this area. Also, the customs component has the lowest minimum and maximum value of the index and, in addition to infrastructure, has the highest level of standard deviation among the observed countries. According to the analyzed groups of countries, the EU-28 has the highest quality of logistics performance.

Table 2: Descriptive statistics

Total sample					EU-28	BRICS	ASEAN
Variables	Mean	Std. Dev.	Min	Max	Mean		
Independent							
LPI_Score	3.42	0.4510	2.37	4.23	3.50	3.17	3.20
Customs	3.20	0.5201	1.94	4.18	3.27	2.79	2.97
Infrastructure	3.33	0.5849	2.12	4.44	3.43	3.10	3.02
International shipments	3.33	0.3741	2.19	4.24	3.40	3.11	3.21
Logistics competence	3.39	0.4906	2.29	4.31	3.48	3.20	3.13
Tracking tracing	3.47	0.4804	2.17	4.38	3.55	3.24	3.25
Timeliness	3.82	0.4184	2.75	4.80	3.91	3.58	3.60
Dependent							
GDPpc	26,249	22,904	632	118,824	28,769	7,257	11,170
GCI	4.66	0.5115	3.48	5.70	4.68	4.41	4.55

Source: Authors' calculation

Table 3 presents the correlation matrix for LPIs and dependent variables. There is a positive correlation between all observed logistics performance and GDPpc, also in relation to GCI.

Table 3: Correlation matrix

Variables	1	2	3	4	5	6	7	8	9
LPI_Score (1)	1.0000								
Customs (2)	0.9598	1.0000							
Infrastructure (3)	0.9683	0.9343	1.0000						
International shipments (4)	0.9195	0.8578	0.8449	1.0000					
Logistics competence (5)	0.9740	0.9207	0.9484	0.8795	1.0000				
Tracking tracing (6)	0.9571	0.8887	0.9187	0.8519	0.9320	1.0000			
Timeliness (7)	0.9214	0.8547	0.8584	0.8279	0.8679	0.8653	1.0000		
GDPpc (8)	0.7155	0.7321	0.7229	0.5912	0.6909	0.6576	0.6718	1.0000	
GCI (9)	0.8487	0.8477	0.8461	0.7564	0.8505	0.7843	0.7383	0.7141	1.0000

Source: Authors' calculation

Table 4 presents regression results for the total sample and for observed country groups. The results show a positive statistically significant impact of overall logistics performance on economic growth in the total sample, and for EU28 as well, which proves the H1 hypothesis. The LPI coefficient is not significant for BRICS and ASEAN mainly due to the small number of observations in those sub-samples, where we are aware of that issue regardless of the maximum possible number of countries and years included. However, despite the limited number of observations, the richness of the data structure enables the examination of trends and patterns over country groups. Also, panel regression can capture individual dynamics and control for unit-specific characteristics through fixed effects models and even with a small number of units, understanding the effects in individual country groups over time. Still, we made our interpretations and conclusions mainly based on the total sample. Regarding results, there is no big difference depending on the estimation method on the total sample and we choose to present fixed effects results for country groups. Regarding the influence of control variables, the CIP index has a strong impact, especially for ASEAN, which justifies the role of these countries as industrial production hubs. Population has a slightly negative impact

on GDPpc, which is reasonable. Also, the unemployment rate negatively affects GDPpc except for the EU. Government expenditure shows the role of public investments in gaining economic growth.

Table 4: Logistics and economic growth: a panel data approach

	Estimation model Total sample		Country groups		
Variables	1	2	EU28	BRICS	ASEAN
LPI_score	0.714***	0.681***	1.278***	0.065	0.101
	(0.118)	(0.131)	(0.100)	(0.172)	(0.178)
GDPgrowth	-0.012	-0.013	-0.023	-0.017	0.003
	(0.013)	(0.015)	(0.015)	(0.024)	(0.023)
CIP	2.002***	2.150***	1.545***	-1.769	14.656***
	(0.546)	(0.601)	(0.533)	(4.156)	(1.577)
lnPopulation	-0.230***	-0.232***	-0.269***	-0.286	-0.055
	(0.032)	(0.032)	(0.032)	(0.243)	(0.071)
Unemployment	-0.013**	-0.011*	0.013**	-0.046***	0.105***
	(0.006)	(0.006)	(0.006)	(0.010)	(0.027)
GOVexp	0.030***	0.030***	0.004***	0.015	0.013
	(0.005)	(0.005)	(0.006)	(0.018)	(0.015)
Estimation method	OLS	Fixed effects	Fixed effects	Fixed effects	Fixed effects
R-squared	0.8352	0.8407	0.8062	0.9681	0.98
Observations	193	193	150	19	24

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculation

Table 5 shows the effects on national competitiveness, measured through GCI, also using OLS (1) and fixed effect estimation (2) methods. The results show a significant positive impact of overall logistics performance on global competitiveness in all cases, except for ASEAN. As previously mentioned, the small number of observations for this country group is one of the limitations, but we can confirm the initial assumption that countries' national competitiveness depends on the level of logistics system development, proved by the total sample, EU28, and BRICS. Thus, H2 is confirmed. Results also show that industrial performance is key to building national competitiveness. Population has a negative sign in the total sample and EU, while unemployment is a significant and important factor for competitiveness in all cases. Government expenditure only shows the influence of BRICS, and it is negative, which raises the question of its structure for future research in this area.

Table 5: Logistics and global competitiveness: a panel data approach

	Estimation model		Country groups		
Variables	1	2	EU28	BRICS	ASEAN
LPI_score	0.821***	0.823***	0.926***	0.401***	0.234
	(0.058)	(0.062)	(0.083)	(0.103)	(0.202)
GDPgrowth	-0.005	-0.005	-0.004	0.013	0.033
	(0.007)	(0.008)	(0.010)	(0.020)	(0.022)
CIP	0.652***	0.650***	0.857***	-0.596	12.588***
	(0.239)	(0.242)	(0.284)	(4.217)	(1.548)
lnPopulation	-0.028***	-0.027***	-0.077***	-0.196	0.078
	(0.013)	(0.013)	(0.020)	(0.258)	(0.080)
Unemployment	-0.025***	-0.025***	-0.020***	-0.037***	0.112***
	(0.003)	(0.003)	(0.004)	(0.008)	(0.030)
GOVexp	-0.003	-0.003	0.001	-0.031***	0.003
	(0.003)	(0.003)	(0.004)	(0.013)	(0.021)
Estimation method	OLS	Fixed effects	Fixed effects	Fixed effects	Fixed effects
R-squared	0.7786	0.7805	0.8128	0.8741	0.9337
Observations	193	193	150	19	24

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculation

Results presented in Table 6 seek to point out the importance of individual elements of the logistics system for economic growth and global competitiveness. The applied fixed effects methods include the same control variables as for overall LPI regressions. We present only the coefficients for LPI sub-indices because the other variables behave in the same way as in previously presented results. All coefficients are statistically significant for LPI sub-indices where infrastructure and logistics competencies have the strongest impact on economic growth. On the other side, LPI sub-indices seem to have a slightly stronger impact on competitiveness, especially the efficiency of customs procedures and logistics competencies as well. Improvement of the quality of logistics services and providers' competencies could make a positive contribution to economic development and should be considered as policy recommendations along with customs, infrastructure, and other components.

Table 6: Impact of LPI sub-indices

Variables	lnGDP_pc	GCI
Customs	0.479***	0.702***
	(0.109)	(0.055)
Infrastructure	0.638***	0.678***
	(0.099)	(0.048)
International_shipments	0.408***	0.610***
	(0.132)	(0.067)
Logistics_Competence	0.642***	0.797***
	(0.111)	(0.050)
Tracking_Tracing	0.532***	0.594***
	(0.108)	(0.058)
Timeliness	0.547***	0.545***
	(0.121)	(0.065)

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculation

5. Discussion

The presented results are in accordance with the initial assumptions and provide a supplement to previous research. The previously emphasized indirect role of logistics in economic development (Roller and Weverman, 2001; Gunasekera et al., 2008), as well as its role as a mediator in the relationship between national competitiveness and economic growth (Civelek et al., 2015; D'Aleo and Sergi, 2017b), is now empirically confirmed through the direct impact of LPI on GDP per capita. This evidence is in accordance with Cheng et al. (2010), Kovács and Kot (2016), and Sezer and Abasiz, (2017), who note the role of logistics as one of the leading forces in achieving economic growth and development. The impact of logistics performance on economic growth has been proven in the total sample but is especially important in the EU. It proves the role of logistics as one of the factors for achieving the level of economic development in those countries.

Other country groups, especially the ASEAN countries, which include some of the world's largest exporters and production hubs obviously rely on logistics, but we did not prove the direct impact on economic growth. Logistics importance for ASEAN could be indirect through its proven impact on the intensification of international trade in this region (Wong et al., 2019). Bookbinder and Tan (2003) analyzed the differences in logistics systems in Asian and European economies, emphasizing the importance of continuous improvement of national logistics in both regions and we can make the same conclusions for the total sample. The third analyzed country

group, BRICS countries, represents large economies with a strong need to develop infrastructure and logistics services to allow easier access and a better position in international markets. However, there is no clear indication of the direct contribution of logistics to economic growth in these countries. In terms of individual components of logistics, the positive impact is recorded for all LPI sub-indices, especially for logistics competencies. Infrastructure also has a positive impact on economic growth, which justifies the efforts of developing countries to develop this area.

When it comes to stimulating the level of national competitiveness, the growing importance of logistics has been proven. The research results confirm the assumption that logistics can be treated as a national production factor that contributes to reducing transport costs and improving the country's position in the global environment (Havenga, 2018). Reducing spatial barriers (Halaszovich and Kinra, 2020; Bugarčić et al., 2020) and removing barriers to international trade enables a more competitive global environment, where the success of countries' participation in international markets predominantly depends on competitive position represented through logistics quality and transportation costs. The results suggest the conclusion, which is in line with Beysenbaev and Dus (2020), that the role of logistics and its elements is one of the main instruments for a country's position in an international environment.

In terms of the individual impact of logistics determinants on improving the country's competitive position, all categories of LPI also have a positive impact on GCI, while logistics competence and the quality of logistics services stand out as the most influential factors together with customs procedures. If logistics providers are at a high-quality level, it will enable more efficient performance for all market participants. On the other side, Zaman and Shamsuddin (2017) specifically emphasize the delivery timeliness component. In the context of observed country groups, Sergi et al. (2021) indicate that different countries have different requirements in terms of the need to improve logistics performance, with the human factor being the most important element in European countries, and Asia having a great need to improve infrastructure. This also points to other segments of the logistics system.

6. Conclusion

This paper analyzes the impact of logistics performance on key dimensions of economic development, economic growth, and national competitiveness. A step forward in relation to previous research has been made in terms of testing the impact of different components of logistics, as well as in sample selection and presenting the results for the total sample and according to selected economic groups. The results indicate the validity of logistics as a determinant of economic development. The results are in line with initial assumptions and previous evidence on the total sample and provide new insights considering EU28, ASEAN, and BRICS.

The first hypothesis that assumes a positive impact of the logistics system on economic growth was confirmed in the total sample and for EU28. From individual components, the strongest impact is recorded for infrastructure and logistics competence, which can justifiably be considered the most important component of LPI in this context (Rezaei et al., 2018). The second hypothesis confirms that logistics affects the level of countries' national competitiveness, which can now be considered an important dimension of global competitiveness. The individual impact has also been confirmed for logistics competence and customs procedures efficiency with the greatest contribution to improving the country's position in international markets.

The role of logistics as a determinant of national competitiveness and economic growth can be emphasized as a theoretical implication in these areas. It can be stated as a logistics advantage in a contemporary environment. Practical implications can be reported for economic policymakers who can use logistics as an instrument for achieving development goals, especially in regions with active participation in international trade processes. The research limitations are related to the limited period of observation, due to the availability of LPI. Also, the analysis is conducted on an aggregate level and includes three regions. Future research could focus on product/industry levels in order to identify the most relevant areas for gaining competitive advantages through logistics. Also, the model should be extended to include more variables and compare the results in a longer time series.

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Uloga logistike u gospodarskom rastu i globalnoj konkurentnosti

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Sažetak

Sve je veća potražnja za iznalaženjem novih obrazaca za gospodarski rast i razvoj, te povećanje konkurentnosti, pri čemu treba detaljnije razmotriti ulogu logistike. Glavna svrha članka je ispitati i usporediti učinke logističkih performansi zemalja EU-a, BRICS-a i ASEAN-a te testirati ulogu pojedinih logističkih komponenti. Metoda istraživanja temelji se na panel podacima uz primjenu regresije fiksnih učinaka za razdoblje od 2007. do 2018.godine. Rezultati potvrđuju da logistika ima pozitivan utjecaj na gospodarski rast i konkurentnost u ukupnom uzorku i zemljama EU-a, dok logistika doprinosi rastu konkurentnosti u zemljama BRICS-a. Identificirani su i pojedinačni doprinosi komponenti LPI-a, koji pokazuju važnost pod-indeksa za gospodarski rast i nacionalnu konkurentnost. Implikacije istraživanja naglašavaju ulogu logistike kao čimbenika gospodarskog rasta i razvoja te naglašavaju njezin potencijal u povećanju nacionalne konkurentnosti. Glavni doprinos su novi dokazi o učincima logistike na razini odabranih skupina zemalja, koji ističu važnost ovog sektora i daju preporuke kreatorima ekonomske politike.

Ključne riječi: *Indeks logističkih performansi (LPI), gospodarski rast, globalna konkurentnost, panel podaci*

JEL klasifikacija: *O110, F0, F2, L9*

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