Managing logistics performance on export and international market competitiveness: An evaluation using firm business data

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Abstract

This research paper aims to enhance export intensity and international market competitiveness through logistics performance at the firm level. The effects of customs efficiency and infrastructure on exports, logistics performance, the role of logistics adoption components in enhancing competitiveness, and the impact of competitiveness on corporate exports were also analyzed. The study was based on data collected from export-oriented enterprise managers; the survey was disseminated to managers responsible for exports. A total of 224 replies were gathered, serving as the foundation for the application of the structural equation modeling (SEM) technique for this research. Physical infrastructure was identified as a crucial element in enhancing exports, while the effect of logistics quality on competitiveness levels was significant. The findings further suggest that enhancing the competitiveness of firms has favorable outcomes in boosting their exports. Research examining trade logistics based on survey data is scarce; this gap was addressed through this research. This study presents the first use of the SEM technique in evaluating the impact of logistical efficiency on the export capabilities and competitiveness of individual firms.

1. Introduction

Economic and corporate growth may benefit greatly from logistics, it organizes, carries out, and regulates the effectiveness of the movement of products [1]. Customs procedures, international market specifics, quality standards and documentation, delivery tracking and storage, estimation, and the technical support required make international logistics activities more important [2]. In particular, Beysenbaev and Dus [3] highlight the importance of logistics in emerging nations. Research demonstrates the increasing significance of logistics-related subjects.

Gammelgaard, et al. [4]; Wang, et al. [5] and Donthu, et al. [6] Previous Studies Researchers advocated that within the context of Industry 4.0, where it is stressed that "success will belong to the companies that are able to get out of the box to shape customer expectations and then build the supply chain capabilities required to deliver distinctive value," and stands out as a key trend. Accordingly, SCM is the function most suited and provide value in an Industry 4.0 environment [7]. This logistics system unavoidably affects the success of each company's logistics operations on a personal level, raising the question of which logistics segment contributes the most and to what degree.

According to Marti and Puertas [8], effective logistics are more important than the distance between trading nations, particularly in EU countries. In countries with reduced trade costs, logistics takes center stage in international commerce. It is becoming more widely accepted that international logistics and transportation are crucial to the effectiveness of global supply chains (GSC), necessitating more research and comprehension of the roles played by the various components of trade logistics. For competitiveness and the advancement of economic and industrial growth, successful participation in regional and GSC is crucial [8]. In light of a nation's economic objectives, the idea of macro logistics offers a holistic approach to resolving logistical issues. Macro logistics costs, or logistics costs at the economic level, have a big impact on an economy's competitiveness and, therefore, the amount and value of international commerce [9].

The first presumption is that lower logistical costs may have a beneficial impact on international trade. Each country has a different logistics cost share in terms of overall expenses and GDP structure. In contrast, logistics costs can reach up to 25% in underdeveloped and developing nations [10]. Additionally, logistical expenses account for a significant portion of the final product's value at the individual level, particularly for SMEs and developing nations. For instance, logistics expenses account for 19–39% of the total value of commodities in Latin American nations, but they only make up around 7% in OECD nations. Due mostly to high inventory and storage expenses, the percentage may exceed 40 % for small businesses [11]. Given that businesses often rely on outside variables inside the logistics system, their capacity to manage logistics has an impact on both this position and the amount of logistical expenses. One source of competitive advantage in the logistics-intensive industry is a nation's capacity to provide top-notch logistics and transportation infrastructure [12]. Additionally, logistics must use existing infrastructure and resources to meet new customer demands and ensure timely delivery in light of e-commerce in a global environment in recent years [13].

There are two main ways to view logistics' potential contribution in this context. its effects on competitiveness and the rise in the amount and intensity of international commerce, particularly exports. Most research takes into consideration the economy as a whole, using secondary data. The research is scarce on the competitiveness at the individual business level. Additionally, research on how logistics performance affects export volume Bugarčić et al. [15] and Mendes Dos Reis et al. [16] highlights the significance of logistics in promoting exports, but it does not sufficiently support the significance of logistics' individual components as a factor in export promotion. According to earlier studies in the field of competitiveness [14], logistics performance plays a direct or indirect role in the economy's incentive for global competitiveness [15]. Thus, logistics' function as a national production element that lowers transportation costs and boosts global competitiveness is highlighted [16].

The Logistics Performance Index (LPI) has established logistics performance indicators that we use to build logistics variables and conduct the study. The World Bank developed this index, which is the most thorough measurement at the national level. It assesses the infrastructure, which includes "hard" logistics components like ports, railroads, etc., as well as "soft" logistics components like border procedures and customs efficiency, logistics services quality, shipment timeliness, and tracking and tracing capabilities [17].

This gives rise to the topic of study and the need for a more thorough analysis of the role logistics play in promoting global commerce and enhancing businesses' competitiveness, as a direct precondition for more fruitful involvement in global marketplaces. In addition to pointing out useful ramifications for businesses, this method may provide economic policymakers with more proof of the value and its constituent parts, as well as associated operations in carrying out commercial operations. The article is organized as follows: The literature review is offered after the introduction. The SEM approach is used to experimentally examine hypotheses that are produced from the literature study. The discussion of the methodology, including the sample, measurements, analysis, and findings, takes up the third section. Conclusions and implications follow the presentation of the discussion at the end.

2. Review of the Literature

As a continuation of early research in this field, the macro logistics theoretical framework which views logistics performance as a significant component [16, 18]. This idea highlights how logistics contribute to the growth of global commerce and increasing the level of competition. The Logistics Performance Index serves as the theoretical foundation for the classification of logistics into infrastructure, logistical services, and customs efficiency. Since 2007, it has been evaluating and assessing the overall and specific logistics performance of nations [19]. Based on the factors that now influence this idea in the literature, the fourth variable, Logistics 4.0, was developed.

2.1. Development of Hypotheses

2.1.1. Customs Efficiency and Exports

In this context, the quantity of papers needed, and the time needed to complete the export are crucial factors [20]. According to some research, customs efficiency plays a significant, if not critical, role in international logistics and transportation, particularly in poor nations. Any enhancements made to these processes have an impact on the logistics system's overall efficiency [21, 22]. However, exports from underdeveloped nations need six times as many signatures and almost twice as much paperwork [19]. This is especially important when it comes to the export of industrial products. Furthermore, according to Cadot, et al. [23] the effectiveness of laws and procedural elements pertaining to sanitary and phytosanitary controls as well as physical border checks might affect the volume of international commerce.

According to Elliott and Bonsignori [24] customs efficiency may sometimes result in a 5% increase in trade flows. Among the elements that affect the level of trade facilitation, Grainger and Morini [2] stress the significance of streamlining and standardizing rules and processes. Because the COVID epidemic directly affected the volume of international commerce flows, the significance of efficient customs and associated border processes has gained significant attention [25, 26]. This is why studying this group of trade reliefs is becoming more and more important [27]. Increasing the effectiveness of customs processes is another area where contemporary technology may be used to enhance these operations [28]. As a result, it is reasonable to assume that the standard of customs and associated administrative processes can support export incentives. This assumption serves as the foundation for the next one:

H_1: The volume of exports (EX) is positively impacted by the effectiveness of customs processes (CP).

2.1.2. Infrastructure's Impact on Exports

According to Wessel, et al. [29] and Rahman, et al. [30] there is a two-way causal link between exports and infrastructure that is both short-term and long-term. One of the major outcomes of this relationship is that infrastructure has a favorable influence on the international trade balance [31-33]. In terms of the influence on export competitiveness, trade infrastructure has no beneficial impacts on the example of lower-income nations [34]; nonetheless, its significance may be achieved indirectly via the industry's structure [35]. Improving different types of infrastructure helps to increase the amount of exports and enhances their complexity, making them one of the essential components of economic development [36]. The following hypothesis was developed in order to investigate how trade infrastructure affects businesses' exports:

H_2: The amount of exports (EX) is positively impacted by the quality of trade infrastructure (INF).

2.1.3. The Connection between Competitiveness and Logistical Services

Gaining a competitive edge may be largely dependent on the effectiveness of logistical operations and services. Djankov, et al. [37] shown that commerce decreases by more than 2% for each extra day of product delay. Additionally, a product's international delivery and transportation might be delayed by one day, which is equal to an extra 50 kilometers between trading nations. As a crucial component of competitiveness, delivery time is particularly crucial for products that are susceptible to delays, such perishable commodities and those with short lifespans and delivery windows. The significance of these activities at the corporate level was increased when logistics requires particular attention in order to gain competitive advantage in the global context. According to Kovács and Kot [38] more customer expectations and more drastic market shifts need a greater level of logistical service efficiency. This could effectively eliminate the issues and expenses associated with long distances transportation of goods [39, 40]. The following assumption may be made since infrastructure components were crucial in logistics environment, crucial for company growth in a particular market [41].

H_3: The quality of logistics services (LSS) determines the degree of competitiveness (CMP).

2.1.4. The Connection between Competitiveness and Logistic Adoption

Continuity in accomplishing logistics objectives necessitates dynamic modifications to satisfy the standards for timeliness and quality of service. Winkelhaus and Grosse [42] claim that logistics is enhanced by boosting process efficiency, decreasing reaction time, personalizing services, and enhancing transparency. The degree of competitive advantages that businesses have in global marketplaces may be greatly impacted by this strategy, which is founded on innovation and digitalization [43].

Evidence supports the premise that Logistics 4.0 (LA) will have a favorable influence. New digital technologies significantly affect how operations are organized inside the supply chain [44, 45], where in logistics, the use of contemporary technology needs to be the foundation of operations [46] in order to facilitate the enhancement of competitive advantages [47]. Considering that Industry 4.0 factors and cutting-edge technology might have a beneficial impact, Ślusarczyk, et al. [48] and Lagorio, et al. [49] advocate that Logistics 4.0's foundation, digital transformation, makes it possible to increase supply chains' flexibility and automation, as noted by Núñez-Merino, et al. [50]. Bag, et al. [51] have shown that Logistics 4.0 capabilities have a major impact on business performance [51, 52]. This led to the formulation of the following assumption:

H_4: Logistics adoption (LA) determines the level of competitiveness (CMP).

2.1.5. The Connection between Export and Business Competitiveness

The fundamental tenets of competitiveness highlight the importance of the business in delivering competitive advantage and exports for nations [53]. Because of this, a company's degree of competitiveness is critical to its ability to compete internationally and export [54]. Logistics factors can be identified among the many factors that affect a company's competitiveness [11, 55]. The following hypothesis was developed in light of these facts and to improve the previously mentioned presumptions that look at how logistical components affect export and competitiveness:

H5: The amount of exports (EX) is positively impacted by the competitiveness (CMP) of businesses.

3. Research Methodology

A sample of 224 export-oriented businesses operating in India was the subject of an empirical study. The Indian Chamber of Commerce and Industry's list of all export-focused businesses operating in India served as the sample frame. Five hundred fifteen export-house managers participated in completing the questionnaire. Two hundred twenty-four completed surveys were received after sending reminders, yielding a 61.9% response rate. In order to create a sample that broadly represents the population's structure in terms of its primary characteristics, the major characteristics of the export-oriented enterprises were analyzed. Our sample is representative of the population structure of export enterprises based on two specified criteria (ownership structure and parent country), which was furnished through the Business Standard ranking list, 2024. Regarding company age, there is no data available for the whole population. Therefore, the company age was asked through a questionnaire. Table 1 displays the sample's comprehensive structure.

Table 1.
Showing Demographic structure of responding firms.

Demographic variables	Frequency (n)	Percent (%)
Firm Age		
0-15 years	110	49.10
15- 20 years	64	28.33
More than 20 years	50	22.30
Total	224	100.0
Experience		
0-15 years	88	39.28
15- 20 years	92	41
More than 20 years	43	19.2
Total	224	100.0
No of employees (Size)		
1-150	100	44.56
150-500	76	34.01
More than 500	48	21.72
Total	224	100

3.1. Measures

Primary data were gathered using a survey approach. The managers of Indian export-oriented businesses were the respondents from whom the data were gathered. They provided their opinions on the main points (statements) of the study model's variables (CP, INF, LSS, LA, EX, and CMP) by completing the questionnaire. A multi-item method was used to evaluate the constructs; that is, each construct was assessed using a number of questions that were extracted and modified from an analysis of the relevant literature. A five-point scale was used by respondents to indicate their opinions (1 being I strongly disagree and 5 being I fully agree).

4. Findings

4.1. Reliability, Validity and Model Fit Testing

Reliability was evaluated by examining the Cronbach's alpha value, this indicator has a value between 0 and 1, and if the CA values are more than the cutoff of 0.7 [56]. All of the variables in our model show a sufficient degree of dependability, with the variable ECP having the highest CA value (Table 2). All the constructs were found to be reliable and valid.

Table 2.
Measurement Model Estimation.

Measures	CR	Cronbach Alpha	Min t values	AVE	Min Loadings
CP	0.90	0.80	4.67	0.702	0.35
INF	0.90	0.82	5.32	0.708	0.32
LSS	0.90	0.83	7.43	0.709	0.38
LA	0.90	0.81	4.62	0.721	0.54
EX	0.90	0.84	5.39	0.754	0.47
CMP	0.90	0.85	7.00	0.732	0.64

A test of the model fit was conducted after the reliability check. The findings show that the model matches the data rather well. The ratios' χ2/df value is less than the suggested cut-off of 3. All of the fit index values are in line with Nguyen and Khoa [55] and Hair et al. [58] guidelines. Specifically, the RMSEA value is less than 0.08, and the GFI, CFI, and NFI index values are more than the 0.9 threshold (Table 5). Because all of the variables' AVEs are higher than 0.5, the model satisfies the convergent validity requirement. These values are consistent with Fornell and Larcker's proposal [57]. Furthermore, the CR values are greater than the 0.6 criteria for every variable (Table 2). Convergent validity was supported through acceptable t values and path values more than 0.40 for most of the constructs [58]. Lastly, a common method variance test was performed on the data. EFA was performed on all research constructs to ensure common method bias (refer to Table 4), Barlett's test for adequacy value was in an acceptable range (refer toTable 3). This issue may arise in survey research because respondents may rate diverse claims similarly owing to lengthy questionnaires and the use of the same technique to test different variables, which might show a misleading correlation between variables.

Table 3.
KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Sampling Adequacy.		0.712
Bartlett's Test of Sphericity	Approx. Chi-Square	1674.656
	Df	435
	Sig.	0.000

Table 4.
Total Variance Explained.

Construct	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sum of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.784	12.613	12.613	3.784	12.613	12.613	2.937	9.791	9.791
2	3.328	11.093	23.706	3.328	11.093	23.706	2.813	9.376	19.167
3	1.770	5.898	29.605	1.770	5.898	29.605	1.801	6.002	25.169
4	1.627	5.423	35.027	1.627	5.423	35.027	1.719	5.729	30.898
5	1.322	4.407	39.434	1.322	4.407	39.434	1.610	5.366	36.264
6	1.299	4.329	43.764	1.299	4.329	43.764	1.598	5.327	41.591
7	1.270	4.233	47.997	1.270	4.233	47.997	1.515	5.049	46.640
8	1.197	3.989	51.986	1.197	3.989	51.986	1.357	4.524	51.164
9	1.119	3.730	55.716	1.119	3.730	55.716	1.275	4.249	55.413
10	1.045	3.483	59.199	1.045	3.483	59.199	1.136	3.786	59.199
Extraction Method: Principal Component Analysis.									

We used Harman's single-factor test for this investigation. Unrotated factor analysis was used to arrange all of the assertions around a single factor. In this instance, a single component accounted for 12.61% of the variation, below the 51% threshold. This finding suggests that the research did not encounter common method variance.

Table 5.
Showing Fit Indices.

	GFI	X2	DF	X2/DF	AGFI	CFI	IFI	AIC
M1	0.90	136.07	56	1.20	0.90	0.91	0.92	988.14

4.2. Results of Structural Equation Modelling

The study model's variables were tested for causal links using structural equation modelling, or SEM. Three of the five causal effects that were examined turned out to be statistically significant. Figure 1 show the findings of the SEM investigation.
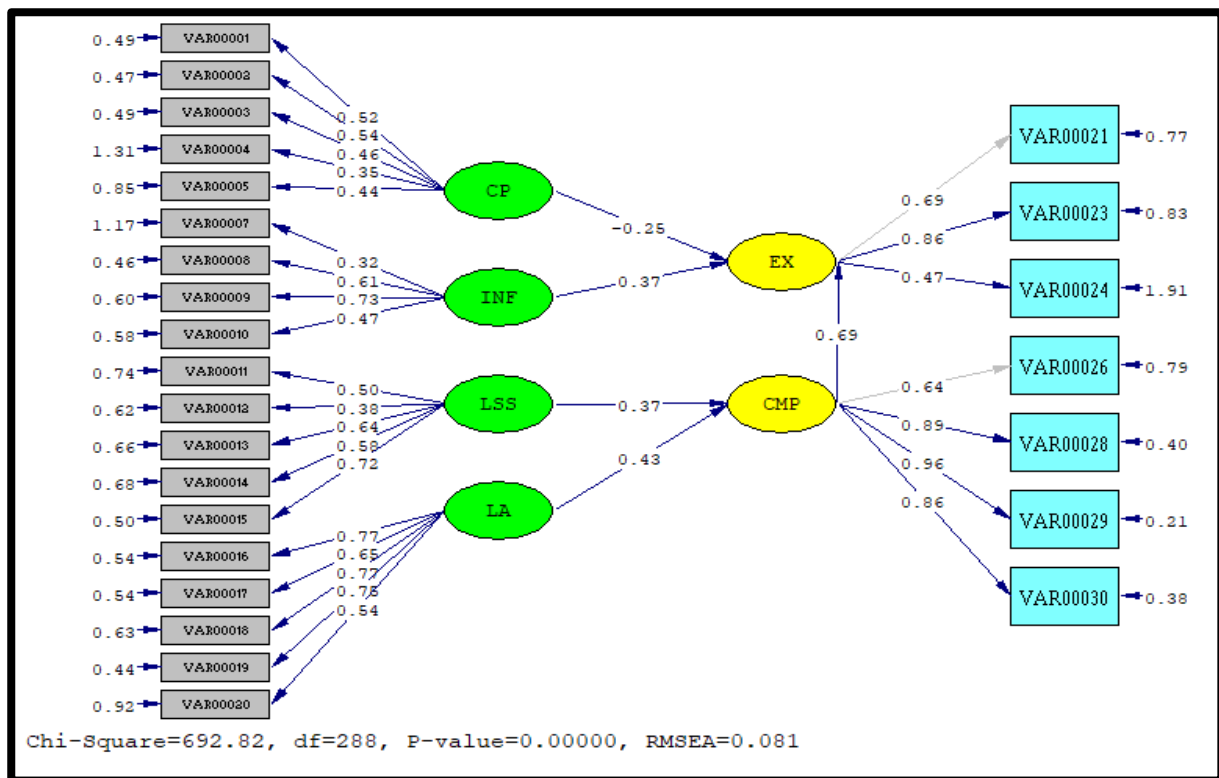
Figure 1.
Structural Model.

5. Discussion and Conclusions

The findings point to significant ramifications that may be examined and contrasted with earlier studies on these connections. The study's findings support four of the five hypotheses that were put forward. (H1) states that more effective customs officer processes, well-defined administrative rules, and export and import paperwork might all lead to a rise in export volume. Our findings did not support the stated hypothesis, despite prior studies confirming the significance of these parameters in enabling trade [17, 25, 26]. This suggests that significant efforts must be made to enhance these procedures since the existing state of affairs in this field is insufficiently capable of having an effect and serving as a foundation for export promotion. On the other hand, a more extensive use of contemporary technology may play a part in a more effective customs clearance and associated export processes, which provides the possibility of further facilitating and improving commerce.

The significance of physical trade infrastructure (H2) was supported, such as the caliber of transport channels and riverine ports, as well as the effectiveness and caliber of infrastructure for air cargo operations and storage facilities, which is validated by their beneficial effects on promoting exporting by businesses. Prior studies such as Wessel [31], Töngür et al. [60] Karymshakov and Sulaimanova [32], and Rahman et al. [61] are in agreement with these findings. When viewed from a macroeconomic perspective and by Indian economic policymakers, these findings support the current approaches, and the data offered supports these export-promoting strategies. (H3) was also supported, inferring a strong relation between logistical support and competitiveness.

The hypothesis (H4) stated that the use of contemporary technology and the factors that influence this idea may significantly impact a company's ability to compete. Elements of Logistics 4.0 that were extracted from the early studies of this idea with Hofmann et al. [45], Winkelhaus and Grosse [42]. the study provides empirical evidence of their role in establishing businesses' competitive advantage. This also highlights the need for more business digitization in developing nations, which has great potential for their economic growth in the future. It is particularly important for applications in logistics systems, as demonstrated in other instances by Núñez-Merino et al. [51] and Gligor et al. [31]. The final hypothesis (H5) is validated, supporting the goal of increasing businesses' competitiveness to start more international market participation and promote overall exports, which is particularly important for developing nations, as suggested by earlier studies [55].

The method of conducting empirical analysis is another advancement. It was carried out using a specifically designed questionnaire that received 224 responses from businesses focused on exports and allowed for the use of structural equation modeling (SEM). This methodological consequence provides researchers in this sector the opportunity to broaden their scope of methodology in future studies. Apart from the gravity model approach and the dominance of secondary data in evaluating trade facilitation factors, the use of SEM may shift the focus from nation-oriented approaches to individual businesses. This strategy provided a clear understanding of the demands of businesses in the particular market concerning competitiveness and export development.

According to earlier claims and the findings, the research's practical implications may be identified as businesses' reliance on the macroeconomic and logistical environment. Based on additional evidence presented in the paper, this also influences

the growth of companies' exports. Because of this, both the firms themselves and those who develop economic and trade policy must work to enhance these sectors on both a global and local level.

The need to increase awareness of the significance of digitization is another practical conclusion of this concept, although one that has not been experimentally verified. According to the broader notion of Logistics 4.0 and the more specific idea of Industry 4.0, more intense use of contemporary technology, particularly in emerging nations, may have a good long-term effect. The expansion of international commerce [59] and logistics [49] has a lot of potential thanks to logistics segments that strive to create a robust system.

6. Future Implications and Limitations

The literature review's presentation of earlier studies emphasizes how crucial it is to enhance these components in order to boost exports from the nations. The effect of overall logistics performance was the basis for earlier research, which was provided using secondary data and left out information on the real requirements of businesses for specific logistics system changes to support their operations in foreign markets. Additionally, prior research suggests that logistical services may be important as a "soft" component of competitive advantages, but firm-level evidence-based confirmations were lacking. To strengthen the evidence that was provided, the effect of competitiveness on businesses' exports was also taken into account.

These logistics system components can be seen as aspects of logistical benefits for certain businesses. From the perspective of economic policy, enhancing logistics performance has a favorable impact on the business climate, making logistics a crucial component of global cooperation and economic growth. Simultaneously, the findings show that individual businesses must become more competitive in order to boost the amount of their exports; this is particularly crucial for open economies like India. In the area of logistics, the research also offers some methodological implications. This method provides a fresh perspective on the role that logistics performance plays in influencing export volume and individual company competitiveness.

By expanding the study to other nations and carrying out the research using a longitudinal research design, future studies may overcome the limitations of this paper. Additionally, comparing the impacts in developed and developing nations may reveal variations in logistics performance based on the degree of economic growth. It would also be possible to overcome response bias, which is a problem in survey-based analyses, if more surveys were conducted across a wider range of time periods. Future studies should focus on identifying industries with high logistical demands and demonstrate how logistics systems and performance vary depending on the type of economic activity.

References

[1] L. Martí, R. Puertas, and L. García, "The importance of the logistics performance index in international trade," *Applied Economics,* vol. 46, no. 24, pp. 2982-2992, 2014. https://doi.org/10.1080/00036846.2014.916394

[2] A. Grainger and C. Morini, "Disentangling cross-border interactions," *The International Journal of Logistics Management,* vol. 30, no. 4, pp. 958-973, 2019. https://doi.org/10.1108/IJLM-10-2018-0255

[3] R. Beysenbaev and Y. Dus, "Russia's national logistics system: Main directions of development," *LogForum,* vol. 16, no. 2, pp. 209-218, 2020. https://doi.org/10.17270/J.LOG.2020.395

[4] B. Gammelgaard, S. Kumar, D. Pattnaik, and R. Joshi, "Thirty years of the international journal of logistics management–a retrospective analysis," *The International Journal of Logistics Management,* vol. 31, no. 2, pp. 173-208, 2020. https://doi.org/10.1108/IJLM-03-2020-0121

[5] C. Wang, M. K. Lim, and A. Lyons, "Twenty years of the International Journal of Logistics Research and Applications: A bibliometric overview," *International Journal of Logistics Research and Applications,* vol. 22, no. 3, pp. 304-323, 2019. https://doi.org/10.1080/13675567.2018.1526262

[6] N. Donthu, S. Kumar, N. Pandey, and G. Soni, "A retrospective overview of Asia Pacific Journal of Marketing and Logistics using a bibliometric analysis," *Asia Pacific Journal of Marketing and Logistics,* vol. 33, no. 3, pp. 783-806, 2021. https://doi.org/10.1108/APJML-04-2020-0216

[7] T. J. Goldsby *et al.*, "Reflections on 40 years of the journal of business logistics: from the editors," *Journal of Business Logistics,* vol. 40, no. 1, pp. 4-29, 2019. https://doi.org/10.1111/jbl.12208

[8] P. Adelajda Zaninović, V. Zaninović, and H. Pavlić Skender, "The effects of logistics performance on international trade: EU15 vs CEMS," *Economic Research-Ekonomska Istraživanja,* vol. 34, no. 1, pp. 1566-1582, 2021. https://doi.org/10.1080/1331677X.2020.1844582

[9] J. H. Havenga, I. E. Witthöft, and Z. P. Simpson, "Macrologistics instrumentation: Integrated national freight-flow and logistics cost measurement," *Transport Policy,* vol. 124, pp. 106-118, 2022. https://doi.org/10.1016/j.tranpol.2019.10.014

[10] R. Yergaliyev and Z. Raimbekov, "The development of the logistics system of Kazakhstan as a factor in increasing its competitiveness," *Procedia Economics and Finance,* vol. 39, pp. 71-75, 2016. https://doi.org/10.1016/S2212-5671(16)30242-8

[11] J. Falciola, M. Jansen, and V. Rollo, "Defining firm competitiveness: A multidimensional framework," *World Development,* vol. 129, p. 104857, 2020. https://doi.org/10.1016/j.worlddev.2019.104857

[12] S. Park, "Quality of transport infrastructure and logistics as source of comparative advantage," *Transport Policy,* vol. 99, pp. 54-62, 2020. https://doi.org/10.1016/j.tranpol.2020.07.016

[13] M. Bieńczak, M. Piosik, H. Sawicka, P. Sawicki, W. Walerjańczyk, and P. Żmuda-Trzebiatowski, "Behavior of customers using cep infrastructure," *Contemporary Challenges in Supply Chains,* vol. 1, pp. 65-80, 2020. https://doi.org/10.17270/B.M.978-83-66017-88-7.6

[14] B. S. Sergi, V. D'Aleo, S. Konecka, K. Szopik-Depczyńska, I. Dembińska, and G. Ioppolo, "Competitiveness and the logistics performance index: The ANOVA method application for Africa, Asia, and the EU regions," *Sustainable Cities and Society,* vol. 69, p. 102845, 2021. https://doi.org/10.1016/j.scs.2021.102845

[15] M. E. Civelek, N. Uca, and M. Çemberci, "The mediator effect of logistics performance index on the relation between global competitiveness index and gross domestic product," *European Scientific Journal May,* vol. 11, no. 13, pp. 1-8, 2015.

[16] J. H. Havenga, "Logistics and the future: The rise of macrologistics," *Journal of Transport and Supply Chain Management,* vol. 12, no. 1, pp. 1-10, 2018. https://doi.org/10.4102/jtscm.v12i0.336

[17] J.-F. Arvis, L. Ojala, B. Shepherd, D. Ulybina, and C. Wiederer, "Connecting to compete 2023: Trade logistics in an uncertain global economy-the logistics performance index and its indicators," The World Bank Group. (No. 39760), 2023.

[18] H. Gleissner, J. C. Femerling, H. Gleissner, and J. C. Femerling, *IT in Logistics*. Springer. https://doi.org/10.1007/978-3-319-01769- 3_9, 2013.

[19] World Bank, *Logistics performance index*. New York: Oxford University Press, 2023.

[20] J. Korinek and P. Sourdin, "To what extent are high-quality logistics services trade facilitating?," 2011. https://doi.org/10.1787/5kggdthrj1zn-en

[21] Ş. Ö. Ekici, Ö. Kabak, and F. Ülengin, "Linking to compete: Logistics and global competitiveness interaction," *Transport Policy,* vol. 48, pp. 117-128, 2016. https://doi.org/10.1016/j.tranpol.2016.01.015

[22] Y.-C. Yang and S.-L. Chen, "Determinants of global logistics hub ports: Comparison of the port development policies of Taiwan, Korea, and Japan," *Transport Policy,* vol. 45, pp. 179-189, 2016. https://doi.org/10.1016/j.tranpol.2015.10.005

[23] O. Cadot, J. Gourdon, and F. Van Tongeren, "Estimating ad valorem equivalents of non-tariff measures: Combining price-based and quantity-based approaches," OECD Trade Policy Papers, No. 215. Paris: OECD Publishing, 2018.

[24] D. Elliott and C. Bonsignori, "The influence of customs capabilities and express delivery on trade flows," *Journal of Air Transport Management,* vol. 74, pp. 54-71, 2019. https://doi.org/10.1016/j.jairtraman.2018.09.007

[25] G. Gereffi, "What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies," *Journal of International Business Policy,* vol. 3, no. 3, p. 287, 2020. https://doi.org/10.1057/s42214-020-00062-w

[26] T. Chen, Y. Qiu, B. Wang, and J. Yang, "Analysis of effects on the dual circulation promotion policy for cross-border e-commerce B2B export trade based on system dynamics during COVID-19," *Systems,* vol. 10, no. 1, p. 13, 2022. https://doi.org/10.3390/systems10010013

[27] E. Alda, V. Giménez, I. G. Paz Castro, and A. I. Zamora Torres, "Modernization plans for the Mexican customs system: Have they really worked? A productivity impact assessment," *Applied Economics,* vol. 56, no. 7, pp. 796-811, 2024. https://doi.org/10.1080/00036846.2023.2172521

[28] D. M. Gligor *et al.*, "Utilizing blockchain technology for supply chain transparency: A resource orchestration perspective," *Journal of Business Logistics,* vol. 43, no. 1, pp. 140-159, 2022. https://doi.org/10.1111/jbl.12287

[29] J. Wessel, K. Karymshakov, and B. Sulaimanova, "Infrastructure and trade: A two-way causal relationship," *The Journal of International Trade & Economic Development,* vol. 30, no. 7, pp. 1087–1109, 2021. https://doi.org/10.1080/09638199.2021.1930491

[30] I. U. Rahman, M. Shafi, L. Junrong, E. T. M. Fetuu, S. Fahad, and B. P. Sharma, "Infrastructure and trade: An empirical study based on China and selected Asian economies," *Sage Open,* vol. 11, no. 3, p. 21582440211036082, 2021. https://doi.org/10.1177/21582440211036082

[31] J. Wessel, "Evaluating the transport-mode-specific trade effects of different transport infrastructure types," *Transport Policy,* vol. 78, pp. 42-57, 2019. https://doi.org/10.1016/j.tranpol.2019.04.002

[32] K. Karymshakov and B. Sulaimanova, "The impact of infrastructure on trade in Central Asia," *Asia European Journal,* vol. 19, no. S1, pp. 5–20, 2021. https://doi.org/10.1007/s10308-021-00613-7

[33] F. U. Rehman, Y. Ding, A. A. Noman, and M. A. Khan, "The nexus between infrastructure and export: An empirical evidence from Pakistan," *Global Journal of Emerging Market Economies,* vol. 12, no. 2, pp. 141-157, 2020. https://doi.org/10.1177/0974910120930529

[34] A. M. Olyanga, I. M. Shinyekwa, M. Ngoma, I. N. Nkote, T. Esemu, and M. Kamya, "Export logistics infrastructure and export competitiveness in the East African Community," *Modern Supply Chain Research and Applications,* vol. 4, no. 1, pp. 39-61, 2022. https://doi.org/10.1108/MSCRA-09-2021-0017

[35] F. Zhou, H. Wen, and C.-C. Lee, "Broadband infrastructure and export growth," *Telecommunications Policy,* vol. 46, no. 5, p. 102347, 2022. https://doi.org/10.1016/j.telpol.2022.102347

[36] B. Kamguia, M. Ndjakwa, and S. Tadadjeu, "Does infrastructural development foster export upgrading in Africa?," *African Development Review,* vol. 35, no. 1, pp. 79-94, 2023. https://doi.org/10.1111/1467-8268.12684

[37] S. Djankov, C. Freund, and C. S. Pham, "Trading on time," *The review of Economics and Statistics,* vol. 92, no. 1, pp. 166-173, 2010. https://doi.org/10.1162/rest.2009.11498

[38] G. Kovács and S. Kot, "New logistics and production trends as the effect of global economy changes," *Polish Journal of Management Studies,* vol. 14, no. 2, pp. 115-126, 2016. https://doi.org/10.17512/pjms.2016.14.2.11.2016.14.2.11

[39] T. F. Halaszovich and A. Kinra, "The impact of distance, national transportation systems and logistics performance on FDI and international trade patterns: Results from Asian global value chains," *Transport Policy,* vol. 98, pp. 35-47, 2020. https://doi.org/10.1016/j.tranpol.2018.09.003

[40] F. Ž. Bugarčić and V. Skvarciany, "Logistics influence on FDI:'hard'versus' soft'infrastructure components," *European Journal of International Management,* vol. 24, no. 3-4, pp. 590-608, 2024. https://doi.org/10.1504/EJIM.2022.10051618

[41] Acimovic, "Logistics system as a factor of business development: The cas of the Republic of Serbia," *Ekonomika Preduzeca,* vol. 70, no. 5-6, pp. 325-334, 2022. https://doi.org/10.5937/EKOPRE2206325A

[42] S. Winkelhaus and E. H. Grosse, "Logistics 4.0: A systematic review towards a new logistics system," *International Journal of Production Research,* vol. 58, no. 1, pp. 18-43, 2020. https://doi.org/10.1080/00207543.2019.1612964

[43] Y. Y. Lee and M. Falahat, "The impact of digitalization and resources on gaining competitive advantage in international markets: Mediating role of marketing, innovation and learning capabilities," *Technology Innovation Management Review,* vol. 9, no. 11, pp. 26–38, 2019. https://doi.org/10.22215/timreview/1281

[44] E. Hofmann, H. Sternberg, H. Chen, A. Pflaum, and G. Prockl, "Supply chain management and Industry 4.0: conducting research in the digital age," *International Journal of Physical Distribution & Logistics Management,* vol. 49, no. 10, pp. 945-955, 2019. https://doi.org/10.1108/IJPDLM-11-2019-399

[45] R. Strange and A. Zucchella, "Industry 4.0, global value chains and international business," *Multinational Business Review,* vol. 25, no. 3, pp. 174-184, 2017. https://doi.org/10.1108/MBR-05-2017-0028

[46]   A. D. Adeitan, C. Aigbavboa, and E. E.-O. Agbenyeku, "Global logistics in the era of Industry 4.0," in *Proceedings of the Future Technologies Conference (FTC) 2019: Volume 2*, 2020: Springer, pp. 652-660.

[47]   M. Mathauer and E. Hofmann, "Technology adoption by logistics service providers," *International Journal of Physical Distribution & Logistics Management,* vol. 49, no. 4, pp. 416-434, 2019. https://doi.org/10.1108/IJPDLM-02-2019-0064

[48]   B. Ślusarczyk, M. Tvaronavičienė, A. U. Haque, and J. Oláh, "Predictors of Industry 4.0 technologies affecting logistic enterprises' performance: International perspective from economic lens," *Technological and Economic Development of Economy,* vol. 26, no. 6, pp. 1263-1283, 2020. https://doi.org/10.3846/tede.2020.13376

[49]   A. Lagorio, G. Zenezini, G. Mangano, and R. Pinto, "A systematic literature review of innovative technologies adopted in logistics management," *International Journal of Logistics Research and Applications,* vol. 25, no. 7, pp. 1043-1066, 2022. https://doi.org/10.1080/13675567.2020.1850661

[50]   M. Núñez-Merino, J. M. Maqueira-Marín, J. Moyano-Fuentes, and P. J. Martínez-Jurado, "Information and digital technologies of Industry 4.0 and Lean supply chain management: a systematic literature review," *International Journal of Production Research,* vol. 58, no. 16, pp. 5034-5061, 2020. https://doi.org/10.1080/00207543.2020.1743896

[51]   S. Bag, S. Gupta, and Z. Luo, "Examining the role of logistics 4.0 enabled dynamic capabilities on firm performance," *The International Journal of Logistics Management,* vol. 31, no. 3, pp. 607-628, 2020. https://doi.org/10.1108/IJLM-11-2019-0311

[52]   P. Dallasega, M. Woschank, J. Sarkis, and K. Y. Tippayawong, "Logistics 4.0 measurement model: Empirical validation based on an international survey," *Industrial Management & Data Systems,* vol. 122, no. 5, pp. 1384-1409, 2022. https://doi.org/10.1108/IMDS-11-2021-0694

[53]   M. Porter, *The five competitive forces that shape strategy*. New Delhi: Harvard Business Press, 1998.

[54]   J. Paul and R. Dhiman, "Three decades of export competitiveness literature: Systematic review, synthesis and future research agenda," *International Marketing Review,* vol. 38, no. 5, pp. 1082-1111, 2021. https://doi.org/10.1108/IMR-12-2020-0295

[55]   M. T. Nguyen and B. T. Khoa, "Improving the competitiveness of exporting enterprises: A case of Kien Giang province in Vietnam," *The Journal of Asian Finance, Economics and Business,* vol. 7, no. 6, pp. 495-508, 2020. https://doi.org/10.13106/jafeb.2020.vol7.no6.495

[56]   J. C. Nunnally, *Psychometric theory*. New York: McGraw-Hill, 1978.

[57]   C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research,* vol. 18, no. 1, pp. 39-50, 1981. https://doi.org/10.1177/002224378101800104

[58]   J. Hair, W. Black, B. Babin, and R. Anderson, *Multivariate data analysis*, 7th ed. New York: Prentice Hall, 2010.

[59]   C. A. McDaniel and H. C. Norberg, "Can blockchain technology facilitate international trade?," *Mercatus Research Paper,* 2019. http://dx.doi.org/10.2139/ssrn.3377708