
Transport Systems and their Impact on Trade Facilitation, Logistics Performance and Competitiveness: An Analytical Approach

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Abstract:

Purpose: The main aim of the research is to: 1/ identify and analyze the key components determining countries' level of trade facilitation achieved, as well as their efficiency of logistics macrosystems and competitiveness on the global scale, 2/ indicate how the efficiency of the transport system affects trade facilitation, as well as the logistic efficiency and competitiveness of the economies, 3/ compare the selected countries in terms of their competitiveness, logistics efficiency and trade facilitation.

Design/Methodology/Approach: At conducting this research, the following methods were applied: 1. critical literature analysis, 2. factor analysis (FA), 3. mining of data obtained from international reports of the World Bank and the World Economic Forum, 4. PEST and comparative analysis (CA). In addition, there has been applied in-depth analysis of such indicators as logistics performance indices (LPI), trade facilitation indices (ETI) and countries' competitiveness indexes (CI).

Findings: The obtained research results indicate that within the selected group of countries there are still significant differences in the required level of development and efficiency of their transport and logistics systems in relation to their position in the world trade. Due to the underdevelopment of their transport and logistics systems, some of them are unable to use this resources effectively as a factor capable of creating significant facilitations in the flow of goods and building the competitiveness of their economies. As a result, they incur additional indirect costs resulting from a logistics ineffectiveness of servicing huge commodity flows generated in export and import. Moreover, such costs are transferred within the global supply chains onto final consumers of imported goods.

Practical Implications: The study reveals the significant inconsistencies existed between transport sector's productivity and trade requirements in several leading global trading countries. Therefore, mainly these countries as well as international intergovernmental organisations, aimed at removing trade barriers and reducing logistics indirect costs of transporting goods in the global scale should support more actively the development of smart and green transport systems, while improving the quality of transport services in logistics terms.

Originality/Value: The research that may be treated as a kind of case study, highlights the interdependencies that exist between the efficiency of transport and logistics systems and the level of trade facilitation as well as the competitiveness of economies on a global scale. It

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can contribute to enriching the theory on the transport system as a pole of growth via accelerating trade and improving competitiveness of economies in the global environment.

Keywords: *Trade facilitation, logistics performance, competitiveness, transport system, quality of transport infrastructure and services.*

JEL classification: *F13, O31, P42, P52.*

Paper Type: *Research article.*

1. Introduction

The globalization processes of various development rate observed since 2000, stimulated by economic deregulation and liberalisation of freight and transport markets, exert significant impact on the last ones. On the one hand, they have created new perspective of dynamic development of national transport systems and their further integration within the global scale, and on the other, several new challenges concerning the required quality as well as capacity and productivity of the national transport sectors, determined by the increasing global trade in volume terms.

In the framework of common logistics standards of handling the flow of goods and the development of global smart and green supply chains, this concept has strongly been anchored in the global logistics system. As a result, we can observe gradual, real integration of transport and logistics sector, on both the national, regional and global scale, based on the formula of integrating its markets with commodity markets.

Consequently, a number of facilitation instruments as well as improvements' tools and procedures (border, customs, etc.) has been developed to ensure efficient and effective transfer of goods in the global trade. They are oriented towards meeting the already applied standards of logistics efficiency in the global commodity flows and aimed at improving the access to comprehensive, high quality transport services within the global value chains.

It is estimated that today, at the beginning of the third decade of the 21st century, global value added chains cover already over 68 % of the world trade commodity flows (WTO, 2024b). For comparison, at the beginning of the first decade it was only 42 % (OECD, 2015).

However, despite visible progress, the integration of freight and transport markets, and consequently the development of globally coherent transport and logistics area failed to reach the development level and quality indispensable to ensure the highest standard of global trade cargo handling (Zaninovic *et al.*, 2021).

Subsequently, the reduction of still too high logistics indirect costs, resulting from constantly occurring congestion and transport disruptions, affect seriously global supply chains, limiting potential economic benefits generated by global trade (Grzelakowski, 2018b).

Therefore, exporters and importers as well as international economic organizations are forced to take further efforts in order to accelerate the processes of smooth moving of the huge cargo volume of the world leading exporting and importing countries. Their activities focus on identifying the possibilities for further facilitation of the world trade services. The activities mainly involve limiting or eliminating the existing administrative, customs, tax and fiscal, and other border barriers, including transport and logistics ones (Bilgin, 2022; Celebi, 2019; WEF, 2016).

The latter constitute the main subject of research. The main research problem is focused on measuring, analysing and assessing the currently existed level of effectiveness of transport systems as well as quality of their services rendered by their providers in the leading global economies, being also the top exporters and importers in world commodity trade.

Taking this criterion into account, the study of the analysed interdependencies was carried out on the example of the five most advanced economies in world trade, i.e., China, USA, Germany, Netherlands and Japan. The share of these countries in global exports in value terms accounts for 36.2%, and in imports 36.9%. The absolute leader in this respect is China with a 14.4 % share in exports and 10.6% in world imports (WTO, 2024a).

Only three of them, i.e., China, the USA and Germany, participate in world trade in the amount of almost 30% of its value, i.e., on the export side their share is 29.3% and on the import side 29.9%. The remaining 7% of world trade value goes to the Netherlands and Japan (WTO, 2024b). These five countries also generate the volume of global trade in goods almost in proportion to their share in the value of world trade, i.e., approximately 5 billion tonnes (UNCTAD, 2023; WTO, 2024a).

Handling these huge flows of goods requires in each of these countries as well as in their trading partners construction of efficient transport system, capable of ensuring the efficient and effective flow of commodities. Whether and to what extent each of these leading exporting countries is sufficiently prepared in terms of transport and logistics efficiency to meet this requirement, is the basic question that author tries to answer.

The aim of the conducted study is to identify the nowadays still existed in those countries transport and logistics barriers to smooth global trade commodities' flows which usually also significantly reduce both the quality and efficiency of their logistics systems as well as the competitiveness of their economies. What is more, plummeting and slowing down their economic development, is being impacting

negatively the efficiency of global logistics system as well as the further world economy growth. Such as imbalance between commodity markets and transport markets, expressed both in the lack of appropriate transport capacity and the required quality of transport services, becomes a source of disruptions in global supply chains and, as a consequence, an increase in direct and indirect costs transferred to final recipients of investment and consumer goods moved by all modes of transport (Grzelakowski, 2019).

In order to minimize and then eliminate the existing disproportions between both types of markets, it is therefore necessary to take permanent actions on a global scale to improve the functioning of the transport systems of the countries that generate significant flows of goods in the world trade. Such activities, both of an investment as well as regulatory and logistic nature, should inspire, coordinate and support such economic organizations and institutions as WTO, UNCTAD, OECD, WB, EIB, ICC, EU and WEF.

For this reason, the main research hypothesis being a subject to verification by the author involves the notion, providing that it is necessary to intensify both the investment as well as regulatory and coordination related activities within the area of transport and logistics on a global scale, in order not only to eliminate there the existing barriers, but also to provide subsequent necessary facilitation instruments for the smooth development of international trade and logistics sector which are the driving forces of increasing competitiveness of main economies mostly committed in the evolvement of global commodity trade.

To fulfil the objectives of research and verify the research hypothesis, the author applied the method of statistical analysis of data sourced from the reports of international economic organizations (WTO, WEF, WB, UNCTAD, OECD). The final results of conducted research and findings are presented in the conclusions.

2. Literature Review

In order to study the relations existing between transport sector, the quality of its infrastructure and services offered by operators, and the level of trade facilitation created by individual countries as well as the quality of their logistics space and competitiveness, it was necessary, first of all, to use reports of reputable international organizations and institutes which periodically analyse such issues.

In this case, mainly reliable, as up-to-date as possible and available sources were used, such as: reports of: 1. WTO i.e., World Trade Report and World Trade Statistical Review (WTO, 2023a; 2023b), WEF and Global Alliance for Trade Facilitation, The Global Enabling Trade Report (WEF, 2016), The Global Competitiveness Report 2019 (WEF, 2019) and The Global Competitiveness Report. Special Edition 2020 (WEF, 2020) 3. IMD World Competitiveness Ranking 2023 – An overview (IMD, 2024), 4. WB: Connecting to Compete.

Trade Logistics in the Global Economy (WB, 2023a) and Logistics Performance Index 2023 (WB, 2024), 5. UNCTAD: Handbook of Statistics 2023 (UNCTAD, 2023a) and Review of Maritime Transport 2023. Towards a green and just transition (UNCTAD, 2023b; Kadłubek *et al.*, 2022).

These reports allowed obtaining basic data on all analysed components, specifying at the same time existed relationships between them, which potentially made it possible to examine the impact of the transport sector on the trade sector, logistics and the competitiveness of the selected economies.

Moreover, the reports allowed to determine the methodological basis for the construction of partial and aggregate indicators used to prepare rankings of the selected countries in each of the examined ranges and intervals. This provided a methodological basis for comparing the surveyed countries and identifying those that manage the transport sector most effectively and efficiently in terms of creating trade facilitation, building the efficiency of the logistics system and supporting competitiveness.

In addition, a number of publications were analysed, mainly articles and studies devoted to the analysis of some chosen aspects of the examined issues. In this category of literature, two main streams of research can be distinguished. The first one, concerning methodological issues relating to the indication of possible supplements to the indicators proposed by international organizations or the proposal of own measures and tools of transport efficiency.

The second one, concerns the presentation of the results of analyses conducted in selected areas, such as trade, logistics or competitiveness in various countries and regions of the world, taking into account existing partial and aggregated indicators used by the above-mentioned international organizations (WB, 2010; Senquiz-Díaz, 2021).

In the first group of the published sources, the following publications deserve special attention: (Zaki, 2014; Beysenbaev and Dus, 2020; Coskun and Civelek, 2020; Yildirim and Mercangoz, 2020; Kesavan and Deif, 2021; Sénquiz-Díaz, 2021) as well as (Acar and Torgalöz, 2022; Bilgin, 2022; Bilgin and Sunaoglu, 2022).

The second group includes a set of publications on various aspects presenting the impact of transport and logistics systems as well as already achieved trade facilitation on the competitiveness of the economies. These sources of literature are usually pointed out the special role of transport and the quality of transport infrastructure as a factor shaping trade facilitation, the efficiency of logistics operations and the competitiveness of economies, too.

In this rather large group of publications, the following are particularly noteworthy: (Bilotserkivska, 2014; OECD, 2015; Haque and Schramm, 2018; Çelebi, 2019;

Skender *et al.*, 2020; Yeo *et al.*, 2020; Atalan, 2020; Larson, 2021; Alnıpak *et al.*, 2021; Zaninovic *et al.*, 2021; Sanri and Piskin, 2022).

The literature related to the conducted study is, in fact, quite extensive. However, its specific feature involves the fact that apart from already mentioned reports of international organizations as well as numerous articles, there are practically no compact studies, i.e. books directly related to the presented research problem. In the author's opinion, however, this does not constitute a significant limitation that would prevent the implementation of this research subject.

3. Methodological Issues

In order to carry out the research process and achieve the established work goals of the conducted study, it was necessary to apply, in addition to critical analysis of literature, such methods and analytical techniques as factor analysis (FA), PEST analysis and comparative analysis (CA). The method of factor analysis is regarded as the best efficient tool when used to simplify complex data sets with many variables.

It is the practice of condensing many variables into just a few, so that the research data is easier to work with any kind of process that simplifies complexity, that is typical for the chosen research subject. There is a trade-off in this case between the accuracy of the data and how easy it is to work with. With factor analysis, the best solution is the one that yields a simplification that represents the true nature of the data, with usually minimum loss of precision.

On the other hand, PEST analysis was used to a comprehensive assessment of the impact of the country's transport performance on its ability to facilitate trade and build an efficient logistics space as well as competitiveness of the economy. It also facilitated gaining deeper insight into the various dimensions of the transport sector that determine its efficiency on the domestic and international level.

The research methods used allowed for better and more precise identification and analysis of key components determining the already achieved selected countries' level of trade facilitation as well as efficiency of their logistics macrosystems and competitiveness within the global scale. They also allowed to indicate how the efficiency of national transport systems affects their trade facilitation, as well as the logistic performance and competitiveness of the economies (Grzelakowski, 2028a).

Finally, there has been applied an in-depth analysis of such indicators as trade facilitation indices (ETI), logistics performance indices (LPI) and aggregate, cumulative competitiveness indexes (CCI). All these indices were selected from reports prepared by international economic organizations.

The effectiveness of the transport system perceived in smooth servicing of commodity flows is determined by numerous factors. Among them, at the time of

industrial revolution 4.0, a group of transport and logistics related factors are becoming increasingly important (WB, 2020).

Due to the lack of necessary network capacity and high quality transport infrastructure as well as transport and logistics services, able to meet the required global logistics standards, the economies oriented towards gaining higher share in global trade, fail to achieve expected results of pursuing such a strategy (WB, 2020).

Therefore, the underdevelopment of transport macro-systems in their both quantitative and qualitative aspects, becomes the barrier for stimulating exports as well as the development of highly efficient logistics macro-systems, and consequently improving competitiveness. As a result, economies affected by such constraints, suffer usually from significant reduction in the scale of benefits they could draw from participating in the global trade (MDS, 2018; WEF, 2016).

Such types of barriers and constraints try to identify already mentioned international economic organizations and associations (fora) which at the same time analyse their grounds and effects, indicating necessary reparatory measures. In this context, particularly important are, WTO, WEF and WB. In analysing their annual reports and statements as well as specialized publications with a number of detailed indices it is possible in indirect way to identify factors that usually cause transport and transport-related barriers, and define activities necessary to their reduction or elimination (Bilgin and Sunaoglu, 2022).

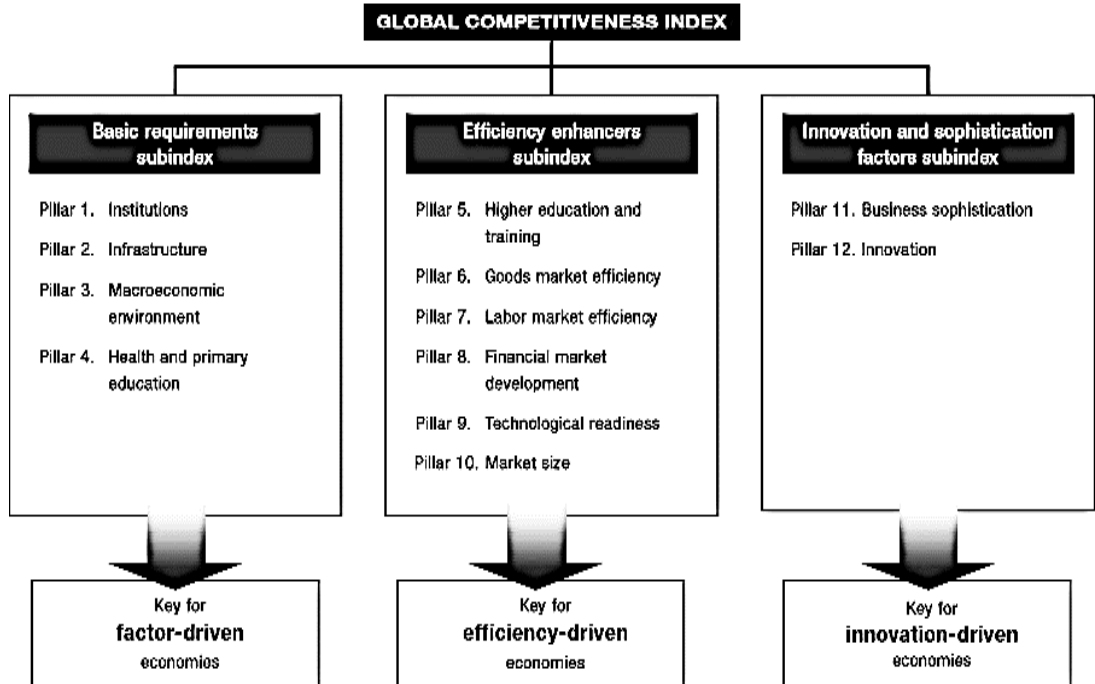
By conducting research on the competitiveness of economies on a global scale since 2005, the World Economic Forum, under detailed surveys and analyses of macroeconomic indices of usually about 140 countries in the world, provides annually an itemized report, presenting the ranking of particular countries, developed under the so-called Global Competitiveness Index - GCI (WEF, 2019).

This is the most thorough as well as reliable report in the world, meticulously developed regarding the methodology and content-related aspects. GCI contains detailed characteristics of each country with the developed set of statistical data, indispensable for calculating the competitiveness indices and developing the global ranking. The competitiveness is defined as an external effect of joint activity of a number of institutional, political and other, e.g. economic factors defining the efficiency of each country on a global scale.

The level of competitiveness is measured by applying as many as 114 factors aggregated in 12 pillars, which co-determine the competitiveness to a different degree, scored within the range from 1,00 (min) to 7,00 (max). Among them, the important second place refers to widely understood technical infrastructure – including transport infrastructure, constituting grounds for the smart development of the national network industries (Figure 1).

On that basis, 114 detailed indices within this range are calculated; they constitute the statistical base applied to determine the synthetic index for each country (GCI).

Figure 1. Set of factors defining the global competitiveness index of economies



Source: WEF, 2010.

In the group of factors within the infrastructure (pillar 2), the key importance is attached to the technical infrastructure of transport and telecommunications. It is assumed that in each country they form the main transport and logistics base by determining the competitiveness level of economies on a global scale and consequently define the competitiveness of global economy. Under this criterion only, included in the aggregated global competitiveness index, the ranking of economies of particular countries is also provided, by categorizing them by the level of competitiveness of their transport infrastructure systems (Larson, 2021).

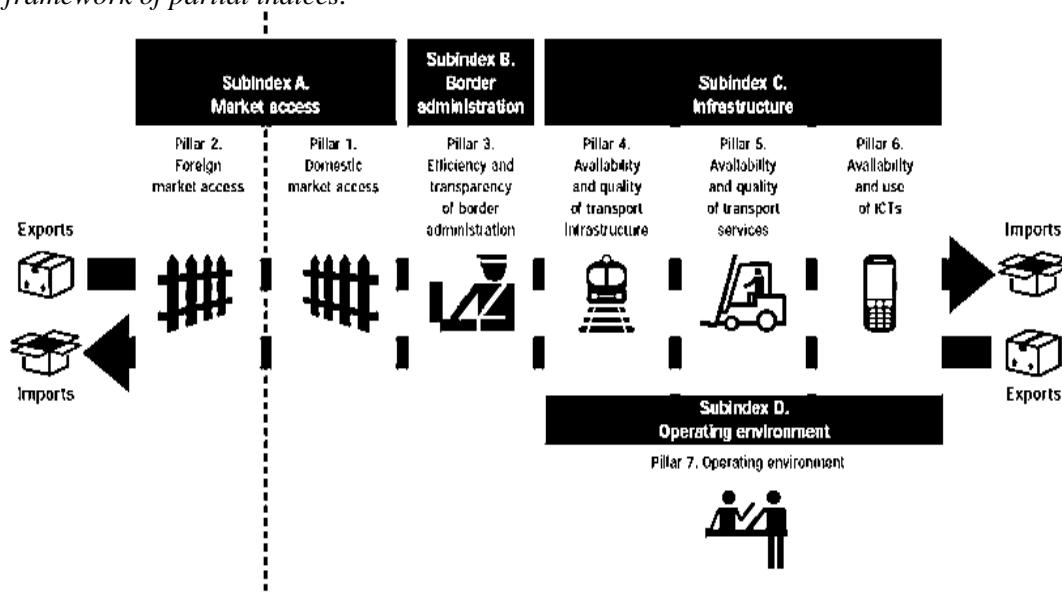
The networks of transport infrastructure and the quality of transport and logistics services affect not only the competitiveness level, but also the efficient flow of commodities in international trade. They can facilitate the trade in goods or constitute a significant barrier to handling the trade (Sénquiz-Díaz, 2021).

Therefore, within the Enabling Trade Programme, supported by WTO (“Bali Package”) and the World Economic Forum’s Supply Chain & Transport Industry Partnership, *The Global Enabling Trade Report* was developed. The report defines the basic factors which determine the level of benefits the countries may draw from

their participation in the global division of labour (WEF, 2016). By means of the developed synthetic index based on the standard of WTO and WEF - ETI (*Enabling Trade Index*), the report provides the ranking of countries in terms of provided trade facilitation instruments.

ETI, comprising a number of single partial indices, including partial index C – infrastructure (Figure 2), reflects the selected types of facilitation instruments, presenting thereby the level of facilitation, existing in a particular country, regarding the system of commodity exchange (Zaki, 2014).

Figure 2. Aggregate index of trade facilitation instruments – its structure and framework of partial indices.



Source: WEF, 2016.

A relatively significant level of importance in terms of determining ETI is attributed to subindex C, recognising that the quality of logistics, transport availability and efficiency of border administration are more important in providing trade facilitation instruments and defining costs of exchange than customs tariffs.

The index defining the level of facilitation in terms of handling the commodity exchange from the perspective of trade and logistics conditions (subindex C – infrastructure), comprises a group of 19 properly weighted indices defining three main aspects of this parameter. They include: 1. availability and quality of transport infrastructure (railroad, road, air and seaport) – 7 indices in total, 2. availability and quality of transport services, including the presence and competences of logistics and transport companies and ease, timeliness and cost of shipment – 6 indices in

total, 3. availability and use of information and communications technology (ICT) and quality of these services – 7 indices (WEF, 2010; WEF, 2016; Zaki, 2014).

Based on each of the abovementioned partial indices as well as the overall subindex C, the ranking of particular countries is provided, regarding their commodity efficiency and the final ranking is presented, taking into account all other factors defining the achieved level of trade facilitation.

In the comparison of international standards between their quantitative and qualitative dimensions of the transport systems existed among the analysed countries, with respect of their impact on other sectors of the economy and the economy itself, special attention needs to be paid to the logistics standards. The last ones ought to be analysed in terms of the impact on the economy competitiveness and efficiency in handling international trade, too.

They are also evaluated in the global scale by means of the aggregated Logistics Performance Index - LPI which is composed of six partial indices (WB, 2023; Zaninovic *et al.*, 2021). The indices are developed by the World Bank, providing the ranking of countries in terms of their achievements in implementing the most important logistics standards.

The indicators reflect the weighted average of the achieved scores resulting from evaluating the said efficiency in usually more than 130 countries. The rankings of countries presented by the World Bank, regarding the obtained level of logistics efficiency measured by LPI parameter, apart from the synthetic indicator, also take into account a set of partial indices, calculated for each of the 6 separate fields. They co-define LPI, falling within the range from 1 to 5 (1 – the lowest level to 5 – the highest).

As a result, the evaluation covers six basic fields, i.e., main areas of logistics macrosystem's performance which together determine its performance and efficiency. They include: 1/ efficiency of border procedures – including customs clearance, 2/ quality of transport infrastructure important for handling international trade, 3/ ease of negotiating and arranging competitive prices, 4/ quality of logistics services and competence of companies rendering such services, mainly transport and logistics operators and forwarders, 5/ ability to track and trace consignment in real-time, 6/ timeliness of shipments in line with the scheduled or expected deadline (WB, 2023; 2024).

4. Research Results and Discussion

Assuming that the position of countries in world trade should be relatively equivalent to their place in terms of creating trade facilitation, supported by a well-functioning transport system, as well as the achieved level of their logistic efficiency

and, as a result, competitiveness, it would be expected that China already has or approaches also the leader category (master position) in each of these dimensions.

However, the research results based on the analysis of both aggregated GCI (2022), ETI (2016) and LPI (2022) indicators, as well as partial ones taking into account the efficiency and effectiveness of the transport sector, indicate that this is not the case (Table 1). This applies mainly to China, where the parameters of logistic efficiency and performance, the level of competitiveness as well as the accessibility and quality of transport infrastructure and transport services do not match the real needs resulting from the country's participation in the world trade.

The differences that exist in this area are particularly large and, despite the efforts made and significant effects already achieved in the transport sector development, they still remain at a quite high level. The consequences of this are borne by both the economy of this country as well as its trading partners and companies from the global transport and logistics sector participating in the handling of these large volumes commodity flows.

These are the so-called indirect costs of maladjustment of the transport and logistics sector to the dynamics of development of commodity markets (WEF, 2016; WTO, 2024b; Grzelakowski, 2018b).

Differences of this type and on such a scale as in China do not occur in the other four countries. However, in this group of countries they are most visible in the USA and Japan. In terms of transport and logistics efficiency in all dimensions examined, however, a greater degree of sustainability in all analysed aspects occurs in Japan.

Especially the level of transport efficiency, measured by partial ETI indices such as availability and quality of both transport infrastructure as well as transport services but also by aggregated LPI and LPI-Infrastructure achieved there are rated higher than in the USA, which in fact is reflected in all the rankings developed (WB, 2023; Ziaul Haque and Schramm, 2018).

On the other hand, Germany and the Netherlands, in turn, should be included in the group of the most balanced countries in terms of the degree of their participation in world trade in relation to the level of trade facilitation and the achieved there performance and efficiency of the transport and logistics systems. Moreover, both countries achieve very similar performance indicators in terms of creating trade facilitation as well as the availability and quality of transport infrastructure and services (Larson, 2021; Senquiz-Diaz, 2021). This also applies to the threshold of logistics efficiency, which is at a similar level.

However, taking into account the differences in the economic potential of both countries, the Netherlands is the absolute leader in this comparison in relation to Germany, but also other countries (Table 1).

Table 1. Comparison of the economies leading in the world trade with their position in the global ranking in terms of creating trade facilitation, achieved level of logistic efficiency and competitiveness, including transport factors affected all these dimensions of their global performance (GT rank, GCI ranks and scores as well as LPI ranks and scores refer to 2022/23; all ETI ranks and scores concern the realities of 2016)

Country	GT Rank	GCI Rank	GCI-Transport Infrastructure	ETI Rank/Score	ETI-Inf. Rank/Score	ETI-AQTS Rank/Score	LPI Rank/Score	LPI-Infrastructure
China	1	21	21	61/4,41	12/5,58	32,4,94	20/3,7	4,0
USA	2	9	6	22/5,24	7/6,08	14/5,55	18/3,8	3,9
Germany	3	7	22	9/5,49	8/6,05	6/5,78	4/4,1	4,3
Netherland	4	5	5	2/5,70	9/6,04	4/5,88	5/4,1	4,2
Japan	5	35	23	16/5,28	5/6,10	9/5,68	14/3,9	4,2

Note: Keys: GT – rank in the global trade (based on exports), GCI – rank in the global competitiveness (based on Global Competitiveness Index), GCI-Transport Infrastructure – evaluation of the level of the transport infrastructure development in terms of its impact on the country’s competitiveness, ETI – rank and score regarding the level of trade facilitation, ETI-Inf. – rank and score of availability and quality of transport infrastructure, ETI-AQTS – rank and score regarding availability and quality of transport services, LPI – country’s rank and score in logistics performance; LPI-Infrastructure – transport infrastructure as a factor defining the level of the country logistics efficiency/performance.

Source: WTO, 2024a; WTO, 2024b; UNCTAD, 2023a; WEF, 2016; 2020; WB, 2023a; 2024).

The analysis of data presented in Table 1 unambiguously proves the existing disparity between the transport and logistics systems of the analysed countries as well as their efficiency and quality regarding real needs and requirements defined by the volume of trade created by them within the global scale. The disparities are particularly visible in the case of China, and partially USA and Japan.

They indicate the transport and consequently logistics barriers existing in these countries, limiting the scale of benefits the countries could potentially draw from the trade development and full participation in the international division of labour (Larson, 2021; Yeo *et al.*, 2020; OECD, 2015). As a result, it is reflected in the level of competitiveness of these economies on a global market (WB, 2020; UNCTAD, 2023b; Grzelakowski, 2018b).

5. Conclusions

The obtained results of conducted research indicate that on both the global and regional scale there are still in the significant majority of countries numerous transport barriers of infrastructural, organizational and operational, as well as regulatory character in the transport systems. They limit directly the efficiency and effectiveness of performed operational processes within the transport sector and logistics macrosystem of those countries, and consequently, reduce the already

achieved level of trade facilitation, impacting the efficiency of goods flows in foreign trade and their competitiveness on a global scale.

Moreover, these barriers resulting from the insufficient availability and quality of transport infrastructure and transport services, hinder seriously the development of the global economy, too.

Therefore, results of the conducted analysis allow to formulate general conclusion, providing that at the current stage of global economy development – at the time of still existed supply chain disruptions, their reconfiguration and slowly progressing reshoring and regionalization, industrial revolution 4.0 and dynamically progressing digitalisation, one shall take coherent and coordinated investment-related and regulatory activities not only on national but also on the international level, stimulating the development of transport macrosystems on a global scale (WB, 2020; UNCTAD, 2023b).

Since they become important components of both the global transport area and logistics supply chains, qualifying the increase in competitiveness of economic macrosystems, and concurrently ensuring the expected level of international trade facilitation as well as the required efficiency of the logistics macro-area. Only in this way, integrating smoothly transport and commodity markets can grounds for transport order, and consequently the logistics order be established, in the framework of global economic area.

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