Changes in logistics performance indexes of European Union countries for 2023 to the period before the Covid-19 pandemic

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Abstract: The main objective of the paper is to find out, based on the secondary investigation carried out by the author, how the logistics performance of the countries of the European Union changed in 2023 in comparison with the year 2018, i.e. with the period before the Covid-19 pandemic, when author also commented on the possibilities of increasing logistics performance through the European Parliament of its committees. Logistics performance is expressed in the contribution using the country logistics performance indexes for 2023 and 2018, which have been published by the World Bank since 2017. Here, not only changes in the overall LPI indexes are monitored, but also changes in their six sub-criteria, which are Customs, Infrastructure, International Shipments, Logistics Competence and Equality, Timeliness, Tracking and Tracing. As a result, the author analyses which countries of the European Union have improved in terms of logistics performance compared to 2018, which have worsened, and which sub-parameters have the main influence on the detected positive or negative change in overall logistics performance.

Keywords: logistic performance, European Union, Covid-19 pandemic, World Bank, Logistics Performance Index.
JEL Classification: F15, F21, F23, M16

1 Introduction

The logistics performance of a country or a certain group of countries is an important prerequisite for its successful involvement in international trade and thus also a guarantee of its further economic prosperity. "Typical indicators of logistics performance are delivery times, reliability of deliveries, completeness of deliveries and logistics productivity. This leads to consider the logistics performance as one of the key factors of international trade." (Medina, Selva & Menendez, 2014, p. 77) Therefore, since 2007, the World Bank has also focused on evaluating the logistics performance of countries that presented using the Logistics Performance Index (LPI). The last published values of that index come from 2023, when the WHO announced the end of the pandemic. "The LPI is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in the performance on trade logistics and what they can do to improve their performance. The LPI 2023 allows for comparisons across 139 countries." (The World Bank, 2023). The penultimate evaluation by this index took place in 2018, that is, in the period relatively close to the onset of the Covid-19 pandemic. The corona crisis meant a period of great and unprecedented changes for logistics. The impact of the Covid-19 pandemic has been particularly sensitive for supply chains, as the situation, where demand greatly exceeds supply and stocks are running low, appeared to be highly unusual until this time. It thus meant a significant burden for the supply process as a whole, and not only on the health and hygiene needs market.

The European Union has and should function as an integrated whole. Therefore, it is quite logical that the European Parliament (its Committee on Transport and Tourism and Committee on the Environment, Public Health and Food Safety) deals with increasing the logistic performance of the countries of the European Union, which, among other things, in 2018:

1. Emphasizes that in order to develop the internal market, prosperity and economic, social and territorial cohesion of the European Union, it is important to ensure the free movement of people, goods and services, also through an efficient and sustainable freight transport system.

2. Is concerned about the negative impact that the closure of internal borders related to the humanitarian and migration crisis and the threat of terrorist attacks in the European Union has on the logistics sector and thus on regional development and growth.

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3. Emphasizes that logistics plays a key role in ensuring efficient and sustainable freight transport operations in the European Union.

4. Emphasizes that the implementation of the TEN-T network, with special emphasis on cross-border connections and within the set deadlines with completion by 2030, will lead to the elimination of bottlenecks, improve interoperability between individual modes of transport and contribute to the realization of a model of integrated multimodal freight transport in the European union.

5. Notes that national planning of the global network must be in place in line with the core network to integrate it with national, regional and local infrastructure, which should be completed by 2050 at the latest.

6. It notes that if there is no effective harmonization and timely implementation of relevant activities by member states and if there is no balanced political cooperation between neighbouring member states, this can seriously complicate cross-border projects.

7. Points to the key role of multimodality in freight logistics and therefore calls for multimodal platforms to be more involved in the planning of member states and in the further development of corridors.

8. Points out that member states too often decide on their national infrastructure plans without regard to the TEN-T objectives.

9. It emphasizes that the transport infrastructure not only needs reconstruction and modernization, but must also be regularly maintained.

10. Asks the Commission to report regularly to Parliament on the conclusions and actions taken within the Digital Transport and Logistics Forum in order to further promote the digitization of freight transport and logistics. It emphasizes that it is necessary to guarantee that the planned infrastructure corresponds to the real needs of sustainable logistics and does not unsustainably burden the environment. (European Parliament, 2018).

In view of the above-mentioned critical situation, the aim of the author of the conducted investigation is to find out how the logistics performance of the countries of the European Union changed in 2023 compared to 2018, i.e. before the pandemic. Whether and which countries have used this difficult situation to improve their logistics performance and which have not. At the same time, it is important to pay attention to the factors that had the greatest effect on changes in the logistics performance of successful countries and which, on the contrary, were critical for unsuccessful countries.

2 Methods

In order to fulfil the above objective, secondary research was conducted. At the beginning of 2023, LPIs for the period 2007 to 2018 were publicly available (The World Bank, 2018). From 2010 to 2018, the LPI was published every two years. In 2018, indexes of 160 countries were published (Lukoszová, 2020). Based on the communication of the author of the article with representatives of the World Bank, it was found in the first quarter of 2023 that the publication of new LPIs for 2023 is being prepared, which actually happened not long ago.

In order to calculate changes in logistics performance, the logistics performance indexes of 2018 and 2023 were selected for all 27-member states of the European Union. As mentioned earlier, a total of 139 countries were included in the logistics performance index in 2023 (The World Bank, 2023).

The LPI is calculated on the basis of a global survey of global freight forwarding companies and logistics carriers. It is an online benchmarking tool developed by the World Bank that measures productivity across the entire supply chain of logistics within a country. (Arvis, Ojala, Wiederer, Shepherd, Raj, Dairabayeva, & Kiski, 2018)

“The Logistics Performance Index (LPI), created by the World Bank, is a benchmark tool used to determine the threats and opportunities faced by countries in their logistics performances and to improve their performance. Countries aim to increase their LPI scores and rank higher on the LPI list while developing their strategies.” (Senir, 2021, p. 193).

“The empirical model is based on the theory of gravity model extended to include the six subcomponents of the Logistics Performance Index (LPI).” (Górecka, Skender & Zaninović, 2022, p. 1)

The international LPI is an overall measure of the efficiency of the logistics sector, combining data on six key performance indicators into a single aggregated measure (Lukoszová, 2021). Some respondents do not or cannot provide information on all six indicators, so statistical interpolation is used to determine missing values. Missing values are replaced by the country's average answer for each question, adjusted by the average deviation of the respondent from the average level of the country in the answers to the questions. The six key indicators are: the efficiency of customs and border management clearance (“Customs”), the quality of trade and transport infrastructure (“Infrastructure”), the ease of

arranging competitively priced shipments ("Ease of arranging shipments"), the competence and quality of logistics services—trucking, forwarding, and customs brokerage ("Quality of logistics services"), the ability to track and trace consignments ("Tracking and tracing"), and the frequency with which shipments reach consignees within scheduled or expected delivery times ("Timeliness"). (Beseybaev & Dus, 2020) „The LPI is based on these six indicators and calculated using Principal Component Analysis (PCA), a standard statistical method used to reduce the dimension of a data set. In the LPI, the input data for the PCA are the scores for countries averaged over all respondents providing data on a foreign market. Estimates are normalized by subtracting the mean of the sample and dividing by the standard deviation before performing the PCA. The output from PCA is the LPI, which is the weighted average of these indicators. To then build the international LPI, the normalized scores for each of the six original indicators are multiplied by their component weights and then summarized. Since the weights are the same for all six components, the international LPI is close to the arithmetic mean of the indicators. "(Beseybaev & Dus, 2020, p. 36)

In the future, further objectification of the LPI determination is expected. „In the future, the World Bank and logistics experts expect further objectification of the LPI calculation. "As one of the solutions, it is proposed to calculate LPI of an individual monitored country on a semi-annual basis with a variable set of respondents. Further, the methodology for calculating the index should meet the requirements of completeness, reliability, relevance, and sufficiency of information on the development of digital technologies individual monitored countries. This will allow in the form of a generalized indicator to compare the logistics indicators occurring in each study region." (Janno, Mochalina, Ivankova, Labanova, Lationina, Safulina & Uukkivi, 2021, p. 153)

The individual values of the LPI indexes always range from 0 to 5, with a value of 5 indicating the maximum assessment of logistics performance.

Base indexes were used to calculate changes in partial (criterion) LPI

$$I_i = (\text{LPI } 2023_i / \text{LPI } 2018_i)\ 100\ (\%) \quad (1)$$

where:

I_i the base index of the sub-LPI of the i-th country in percent

$\text{LPI } 2023_i$ partial logistics performance index of the i-th country in 2023

$\text{LPI } 2018_i$ partial logistics performance index of the i-th country in 2018

An improvement is represented by an I_i value greater than 100 %, a steady state is expressed by a value equal to 100 %, and a deterioration is signalled by a value less than 100 %.

The calculation of the change in the total LPI for individual countries was carried out according to the formula

$$Z_i = [(\text{LPI } 2023_i / \text{LPI } 2018_i)\ 100] - 100\ (\%) \quad (2)$$

where:

Z_i change in the total LPI index of the i-th country in percent

$\text{LPI } 2023_i$ the overall logistics performance index of the i-th country in 2023

$\text{LPI } 2018_i$ the overall logistics performance index of the i-th country in 2018

A positive Z_i index value indicates an improvement in the country's aggregate LPI, a negative value a deterioration, and a value (close to or) equal to 0 indicates no change in the aggregate LPI index.

3 Research results

The result of the investigation, analysis and processing of information using the mentioned methods is, first of all, the determination of the partial indexes of logistics performance of the countries of the European Union in 2018 and 2023, which can be considered the years representing the period before and after the Covid-19 pandemic. Based on these sub-indexes, their percentage changes are then calculated.

3.1 Sub-indexes of logistic performance of European Union countries before and after the Covid-19 pandemic

Table 1 shows the values of partial indexes of logistics performance of European Union countries according to individual criteria for 2018 and 2023. The monitored criteria are: C1 – Customs, C2 – Infrastructure, C3 – International Shipments, C4 – Logistics Competence and Equality, C5 - Timeliness, C6 – Tracking and Tracing.

Table 1 LPI sub-criteria values

Criterion / EU country	C1		C2		C3		C4		C5		C6	
	2018	2023	2018	2023	2018	2023	2018	2023	2018	2023	2018	2023
Austria	3.71	3.7	4.18	3.9	3.88	3.8	4.08	4.0	4.25	4.3	4.09	4.2
Belgium	3.66	3.9	3.98	4.1	3.99	3.8	4.13	4.2	4.41	4.2	4.05	4.0
Bulgaria	2.94	3.1	2.76	3.1	3.23	3.0	2.88	3.3	3.31	3.5	3.02	3.3
Croatia	2.98	3.0	3.01	3.0	2.93	3.6	3.10	3.4	3.59	3.2	3.01	3.4
Cyprus	3.05	2.9	2.89	2.8	3.15	3.1	3.00	3.2	3.62	3.5	3.15	3.4
Czechia	3.29	3.0	3.46	3.0	3.75	3.4	3.72	3.6	4.13	3.7	3.70	3.2
Denmark	3.92	4.1	3.96	4.1	3.53	3.6	4.01	4.1	4.41	4.1	4.18	4.3
Estonia	3.32	3.2	3.10	3.5	3.26	3.4	3.15	3.7	3.80	4.1	3.21	3.8
Finland	3.82	4.0	4.00	4.2	3.56	4.1	3.89	4.2	4.28	4.3	4.32	4.2
France	3.59	3.7	4.00	3.8	3.55	3.7	3.84	3.8	4.15	4.1	4.00	4.0
Germany	4.09	3.9	4.37	4.3	3.86	3.7	4.31	4.2	4.39	4.1	4.24	4.2
Greece	2.84	3.2	3.17	3.7	3.30	3.8	3.06	3.8	3.66	3.9	3.18	3.9
Hungary	3.35	2.7	3.27	3.1	3.22	3.4	3.21	3.1	3.79	3.6	3.67	3.4
Ireland	3.36	3.4	3.29	3.5	3.42	3.6	3.60	3.6	3.76	3.7	3.62	3.7
Italy	3.47	3.4	3.85	3.8	3.51	3.4	3.66	3.8	4.13	3.9	3.85	3.9
Latvia	2.80	3.3	2.98	3.3	2.74	3.2	2.69	3.7	2.88	4.0	2.79	3.6
Lithuania	2.85	3.2	2.73	3.5	2.79	3.4	2.96	3.6	3.65	3.6	3.12	3.1
Luxembourg	3.53	3.6	3.63	3.6	3.37	3.6	3.76	3.9	3.90	3.5	3.61	3.5
Malta	2.70	3.4	2.90	3.7	2.70	3.0	2.80	3.4	3.01	3.2	2.80	3.4
Netherlands	3.92	3.9	4.21	4.2	3.68	3.7	4.09	4.2	4.25	4.0	4.02	4.2
Poland	3.25	3.4	3.21	3.5	3.68	3.3	3.58	3.6	3.95	3.9	3.51	3.8
Portugal	3.17	3.2	3.25	3.6	3.83	3.1	3.71	3.6	4.13	3.6	3.72	3.2
Romania	2.58	2.7	2.91	2.9	3.18	3.4	3.07	3.3	3.68	3.6	3.26	3.5
Slovak Republic	2.79	3.2	3.00	3.3	3.10	3.0	3.14	3.4	3.14	3.5	2.99	3.3
Slovenia	3.42	3.4	3.26	3.6	3.19	3.4	3.05	3.3	3.70	3.3	3.27	3.0
Spain	3.62	3.6	3.84	3.8	3.83	3.7	3.80	3.9	4.06	4.2	3.83	4.1
Sweden	4.05	4.0	4.24	4.2	3.92	3.4	3.98	4.2	4.28	4.2	3.98	4.1

Source: Own processing

The countries of the European Union are listed here in alphabetical order, so their logistic performance is not considered.

3.2 Changes in values of sub-indexes of logistic performance of European Union countries before and after the Covid-19 pandemic

Table 2 shows the changes in the individual logistics performance criteria, i.e. their growth or decline. The calculation is made as a share of the value of the index for the year 2023 to the value of 2018.

Table 2 Changes in sub-criteria of the logistics performance index expressed using base indexes in %

EU country (alphabetically)	C1 2023/2018	C2 2023/2018	C3 2023/2018	C4 2023/2018	C5 2023/2018	C6 2023/2018
Austria	99.73	93.30	97.94	98.04	101.18	102.69
Belgium	106.56	103.02	95.24	101.69	95.24	98.77
Bulgaria	105.44	112.32	92.88	114.58	105.74	109.27
Croatia	100.67	99.67	**122.87**	109.68	89.14	112.96
Cyprus	95.08	96.89	98.41	106.67	96.69	107.94
Czechia	91.19	86.71	90.67	96.77	89.59	86.49
Denmark	104.59	103.54	101.98	102.24	92.97	102.87
Estonia	96.39	112.90	104.29	117.46	107.89	118.38
Finland	104.71	105.00	115.17	107.97	100.47	97.22
France	103.06	95.00	104.23	98.96	98.80	100.00
Germany	95.35	98.40	95.85	97.45	93.39	99.06
Greece	112.68	116,72	115.15	**124.18**	106.56	**122.64**
Hungary	80.60	94.80	105.59	96.57	94.99	92.64
Ireland	101.19	106.38	105.26	100.00	98.40	102.21
Italy	97.98	98.70	96.87	103.83	94.43	101.30
Latvia	117.86	110.74	116.79	**137.55**	**138.89**	**129.03**
Lithuania	112.28	**128.20**	**121.86**	**121.62**	98.63	99.36
Luxembourg	101.98	99.17	106.82	103.73	89.74	96.95
Malta	**125.93**	**127.59**	111.11	**121.43**	106.31	**121.43**
Netherlands	99.49	99.76	100.54	102.69	94.12	104.48
Poland	104.62	109.03	89.67	100.56	98.73	108.26
Portugal	100.95	110.77	80.94	97.04	87.17	86.02
Romania	104.65	99.66	106.92	107.49	97.83	107.36
Slovak Republic	114.70	110.00	96.77	108.28	111.46	110.37
Slovenia	99.42	110.43	106.58	108.20	89.20	91.74
Spain	99.45	98.96	96.61	102.63	103.45	107.05
Sweden	98.77	99.06	86.73	105.53	98.13	103.02

Source: Own processing

Values lower than 90 percent are considered critical from the point of view of assessing changes, while values higher than 120 percent are, on the contrary, perceived as significant improvements.

It can be seen from Table 2 that the Czech Republic and Portugal experienced clearly the most significant deterioration in sub-criteria, in three criteria. The Czech Republic in the evaluation of Infrastructure, Timeliness and Tracking and Tracing. Similarly, Portugal also deteriorated in International Shipments, Timeliness and Tracking and Tracing. Croatia (Logistics Competence and Equality), Hungary (Customs), Luxembourg (Timeliness), Poland (International Shipments), Slovenia (Timeliness) and Sweden (International Shipments) experienced a more noticeable partial deterioration. On the contrary, Latvia recorded the most significant improvement: in the criteria Logistics Competence and Equality, Timeliness, Tracking and Tracing. Furthermore, Malta in the criteria Customs, Infrastructure, Logistics Competence and Equality and Tracking and Tracing and Lithuania in the criteria Infrastructure, Logistics Competence and Equality and Timeliness. Furthermore, Greece improved more significantly (Logistics Competence and Equality and Tracking and Tracing) and in the International Shipment criterion Croatia also improved.

3.3 Values of the overall logistics performance index of European Union countries and their changes

The last Table 3 shows the ranking of the individual countries of the European Union based on the absolute value of the total LPI index in 2023. For these countries, among other things, the value of the base index is also monitored and finally the change in the LPI index in 2023 compared to 2018 is expressed in percentage (The World Bank, 2023) (The World Bank Group, 2018).

Table 3 Total LPI values and their changes

Ranking	EU country	LPI 2023	LPI 2018	LPI2023/LPI2018 (%)	Change (%)
1.	Finland	4.2	3.97	105.79	+5.79
2.-4.	Denmark	4.1	3.99	102.76	+2.76
2.-4.	Germany	4.1	4.20	97.62	-2.38
2.-4.	Holland	4.1	4.02	101.99	+1.99
5.-7.	Austria	4.0	4.03	99.26	0.00
5.-7.	Belgium	4.0	4.04	99.01	0.00
5.-7.	Sweden	4.0	4.05	98.77	-1.23
8.-9.	France	3.9	3.84	101.56	+1.56
8.-9.	Spain	3.9	3.83	101.83	+1.83
10.-11.	Greece	3.7	3.20	115.63	**+15.63**
10.-11.	Italy	3.7	3.74	98.93	0
12.-15.	Estonia	3.6	3.31	108.76	+8.76
12.-15.	Ireland	3.6	3.51	102.56	+2.56
12.-15.	Luxembourg	3.6	3.63	99.17	0
12.-15.	Poland	3.6	3.54	101.69	+1.69
16.	Latvia	3.5	2.81	124.56	**+24.56**
1 7.-18.	Lithuania	3.4	3.02	112.58	+12.58
17.-18.	Portugal	3.4	3.64	93.41	-6.59
19.-23.	Croatia	3.3	3.10	106.45	+6.45
19.-23.	Czechia	3.3	3.68	89.67	**-10.33**
19.-23.	Malta	3.3	2.81	117.44	**+17.44**
19.-23.	Slovakia	3.3	3.03	108.91	+8.91
19.-23.	Slovenia	3.3	3.31	99.7	0
24.-27.	Bulgaria	3.2	3.03	105.61	+5.61
24.-27.	Cyprus	3.2	3.15	101.59	0
24.-27.	Hungary	3.2	3.42	93.57	-6.43
24.-27.	Romania	3.2	3.12	102.56	+2.56

Source: Own processing

When calculating the percentage change (see the last column of Table 3), it is considered that the 2023 values are published rounded to one decimal place, while the 2018 values were rounded to two decimal places. Calculation of index change, i.e. of its growth or decline in percentages (in the last column of Table 3), is therefore adjusted for this fact.

In the latest survey, Finland's position overtook the best Germany for a long time, as well as Denmark and the Netherlands, which equally occupied the 2nd to 4th place. Changes in order also occurred within the Visegrad Four, which was led by the Czech Republic in 2018. However, after the pandemic, Poland was the best ranked among the "four", followed by the Czech Republic and the same ranking (19th-23rd) is also occupied by Slovakia. The last of the mentioned group was placed by Hungary, which at the same time completes the entire "twenty-seven" together with Bulgaria, Cyprus and Romania.

Table 3 further shows that the greatest improvement during the Covid-19 pandemic was relatively surprisingly recorded by Latvia, followed by Malta and Greece. The alarming fact is that the Czech Republic shows the most significant deterioration in logistics performance of all the countries of the European Union. It follows from the partial indexes of logistic performance that this unfavourable situation was caused by the evaluation of up to three criteria: Infrastructure, Timeliness and Tracking and Tracing (see Table 2). Other countries showing significant deterioration are Portugal and Hungary.

4 Conclusions

A country's logistics performance is a significant factor in a country's competitiveness on a global scale. The logistics performance of the European Union as a whole is dealt with by the Parliament of the European Union and its relevant committees. Each of the member countries bears its share in the success of the European Union and in the fulfilment of the obligations that it has set out in accordance with the provisions of the Parliament.

How and to what extent the individual countries of the European Union contribute to the logistics performance of the whole can be seen from the results of the presented survey. Advanced countries such as Finland, Denmark, Germany and the Netherlands lead the ranking of the absolute ranking of logistics performance for 2023. Among the countries that saw a significant improvement in the post-pandemic period, Latvia is the first, followed by Malta and Greece. The country that recorded the most significant deterioration of all member states of the Union is the Czech Republic, which nevertheless ranks 19th to 23rd in the absolute ranking of logistics performance, together with Croatia, Malta, Slovakia and Slovenia. A significant deterioration was also recorded in Portugal, followed by Hungary.

From the point of view of the sub-criteria, the time parameter appears to be particularly critical, for which a significant deterioration was recorded in the largest number of countries in the observed period from 2018 to 2023. This criterion should therefore be given the greatest attention by the member countries. Paradoxically, this criterion was also the most significant improvement in the case of Latvia. Countries that have experienced a significant deterioration can be recommended to strictly comply with the requirements of the European Parliament (listed in Chapter 1 of this article). The government of the Czech Republic should consider reassessing its priorities towards the reconstruction, modernization and maintenance of the transport infrastructure, the condition of which has a direct impact on the time parameters of deliveries and therefore also on other evaluated criteria.

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