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EFFECTS OF THE SUB-DIMENSIONS OF LOGISTICS PERFORMANCE INDEX ON FOREIGN TRADE COVERAGE RATIO

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Abstract:
The main purpose of this study is to explain the effect of each sub-dimension of the logistics performance index on foreign trade coverage ratio. The multiple regression method was used to decompose the effect of each sub-dimension. In the study, secondary data prepared by international institutions was used. SPSS program was used to perform the analyses. Although this study initially predicted that the LPI sub-dimensions had a positive effect on the coverage ratio, all the hypotheses, except for the infrastructure, were rejected. As a result of this study, positive effect of infrastructure on foreign trade coverage ratio has been found to be statistically significant.

Keywords:
Foreign Trade Coverage Ratio, Sub-Dimensions of Logistics Performance Index

1. Introduction

The main purpose of this research is to examine the effect of the Logistics Performance Index sub-dimensions on the foreign trade coverage ratio. While examining these concepts, Trade Map and World Bank data, which are acknowledged in the world, were used. Countries that need to explore new markets by increasing their export share in international trade have been trying to increase their competitive power by strengthening their economic structures. Logistics, which allows countries to increase their competitiveness, has become an indispensable part of countries, and thus, has gained importance, especially in the 21st century having manifested significant development with globalization.

According to the Council of Supply Chain Management Professionals (CSCMP), logistics is a supply chain process stage that manages, plans and controls the active and efficiently flow and storage of goods and services from the production area to the consumption area in order to meet customer needs (Uca, 2017).

The logistics sector is one of the fastest growing sectors of our day and has become a sector that new masses are beginning to use every day. For this reason, performance measurement is of great importance in the logistics industry. Among various indicators, the International Logistics Performance Index (LPE) is considered to be one of the most comprehensive indicators that measures the performance of logistics processes. (Çelebi and Civelek, 2018).

The research question in the present study is to examine the effect of the Logistics performance index sub-dimensions on foreign trade. In the light of this research question, a hypothesis has been proposed.

2. Logistics Performance Index and Sub-Dimensions

Logistics performance index (LPE) data and key indicators published by the World Bank every two years create a unique dataset to measure country performance in various dimensions of logistics and to compare this logistics performance with 150 countries. These also provide an empirical basis for understanding and comparing differences in trade logistics and informing policies on difficult bottlenecks and trade-offs (Arvis et al., 2007).

2.1. Coverage of Logistics Performance Index

The Logistics Performance Index is initially created and presented in a report by the World Bank, together with its academic and professional partners to improve their competitiveness and help of countries develop logistics reform programs, close the information gap and to identify the opportunities and challenges faced by countries in logistics performance. The LPE and its data, created with the knowledge and experience of professionals, allow a comprehensive assessment of logistical advantages and / or shortcomings between countries. Professionals around the world provide a comprehensive analysis of the performance of supply chain rings, from customs process, the ability to track and trace shipments, logistics cost and infrastructure quality, competence of the domestic logistics industry, and timely delivery to destination. Logistics quality and cost is not only related to the performance of infrastructure and public institutions, but also to private services. Besides from the time and cost to deliver the goods, predictability and reliability of the supply chain are increasingly important factors (Güleryüz, 2019).

The LPE data published for the first time in 2007 allow comparisons between 150 countries in 2007, 155 countries in 2010 and 2012, and 160 countries in 2014, 2016 and 2018. The LPE is based on the research and experience of worldwide operators (global freight carriers and express carriers) who provide feedback on the logistics "intimacy" of the countries in which they operate and the countries they do trade with. They combine in-depth knowledge of the countries in which they operate with conscious qualitative assessments of other countries in which they do trade and experience the global logistics environment. Within this context, there are certain opportunities and challenges faced by countries in logistics performance (Logistics Performance Index, 2020).

2.2. Sub-Dimensions of Logistics Performance Index

The International Logistics Performance Index consists of questionnaires containing the qualitative evaluations of logistics experts. The LPE scores the country's logistics and trade profile between 1 (worst) and 5 (best). More than 6000 logistics professionals working in more than 1000 international shipping agencies evaluate the 8 countries where the most trade is carried out and analyse the data collected. A separate country score is calculated for each dimension. The 6 dimensions of LPE are shown in below (Uca et al., 2019);

1. Efficiency of the customs clearance process (speed, simplicity, predictability of formalities at customs and customs control points)
2. Quality of transportation and commercial infrastructure (ports, information technologies, etc.)
3. Ease of shipments and competitive pricing
4. Quality and adequacy of logistics services (Customs and carriers)
5. Traceability of shipments
6. The frequency with which the shipment is delivered to the recipient in the planned time

The LPI sub-dimensions were created based on theoretical and empirical research and practical experience of logistics professionals engaged in international transport. The LPI sub-dimensions table is shown below (Arvis et al., 2018).

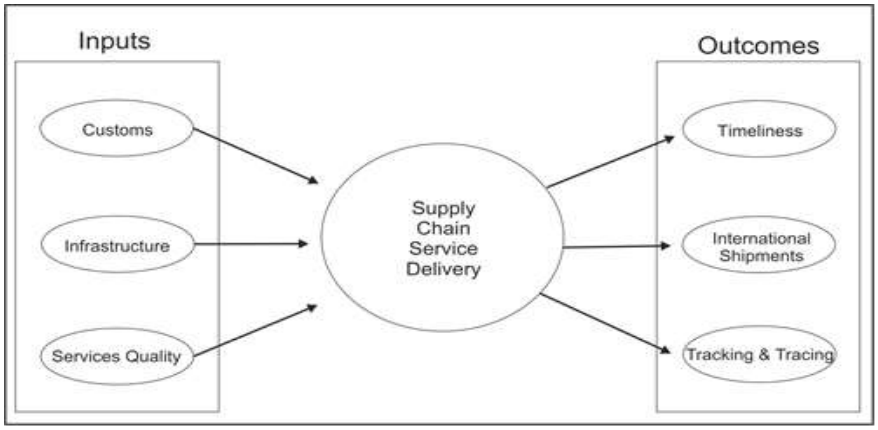

Figure 1: LPE Indicators as Inputs and Outcomes
Source: (Arvis, et al., 2018).

In the LPE survey conducted in 2018, 62 percent of the respondents were from either low-income countries (3 percent) or middle-income countries (59 percent). The lack of representation of low-income countries is due to their more marginal role in world trade and the difficulty in effectively communicating with operators on the ground (Arvis et al., 2018).

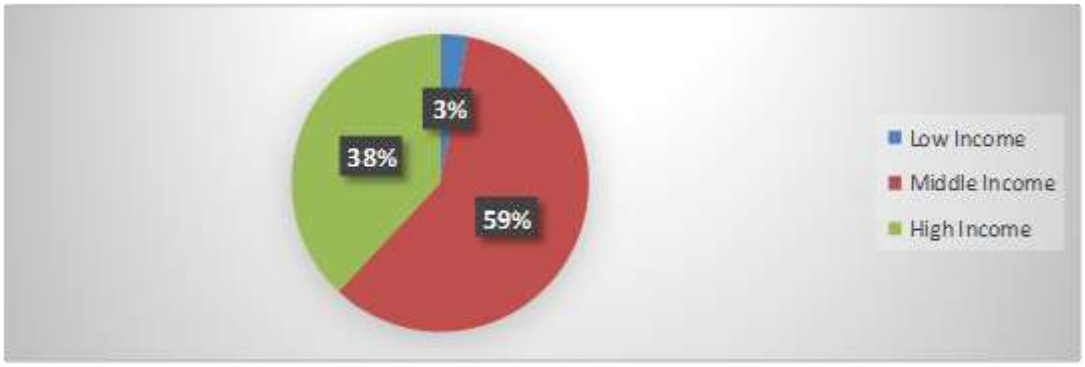

Figure 2: LPE 2018 Demographic Rates

According to the LPE reports between 2010 and 2018, most of the high-income countries in Europe were ranked in the top 10 in the LPE ranking and are shown in Table 1. Countries with developed economies are also at the top of the latest 2018 LPE reports. For example, in the 2018 LPE ranking, Germany ranks first with 4.20 points, while Sweden ranks second after Germany with 4.05 points. Countries generally at or below middle income rank lower in the LPE rankings, and the lowest 10 countries are shown in Table 2. Afghanistan is in the last place with 1.95 points in the LPE ranking. The countries ranked last usually have vulnerable economies affected by political instability, armed conflicts, and natural disasters, or these are countries facing economies of scale or adverse geographical conditions in their global supply chain (Güleryüz, 2019)

Table 1. Top 10 Countries in LPE Scoring Between 2010 and 2018

	2018		2016		2014		2012		2010	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Germany	1	4,20	1	4,23	1	4,12	4	4,03	1	4,11
Sweden	2	4,05	3	4,20	6	3,96	13	3,85	3	4,08
Belgium	3	4,04	6	4,11	3	4,04	7	3,98	9	3,94
Austria	4	4,03	7	4,10	16	3,81	11	3,89	19	3,76
Japan	5	4,03	12	3,97	10	3,91	8	3,93	7	3,97
Netherlands	6	4,02	4	4,19	2	4,05	5	4,02	4	4,07
Singapore	7	4,00	5	4,14	5	4,00	1	4,13	2	4,09
Denmark	8	3,99	17	3,82	17	3,78	6	4,02	16	3,85
United Kingdom	9	3,99	8	4,07	4	4,01	10	3,90	8	3,95
Finland	10	3,97	15	3,92	24	3,62	3	4,05	12	3,89

Source: (Logistics Performance Index, 2020)

Table 2. 10 Worst Countries in LPE Scoring Between 2010 and 2018

	2018		2016		2014		2012		2010	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Central Africa Rep	151	2,15	N/A	N/A	134	2,36	98	2,57	N/A	N/A
Zimbabwe	152	2,12	151	2,08	137	2,34	103	2,55	N/A	N/A
Haiti	153	2,11	159	1,72	144	2,27	153	2,03	98	2,59
Libya	154	2,11	137	2,26	118	2,50	137	2,28	132	2,33
Eritrea	155	2,09	144	2,17	156	2,08	147	2,11	154	1,70
Sierra Leone	156	2,08	155	2,03	N/A	N/A	150	2,08	153	1,97
Nigeria	157	2,07	100	2,56	130	2,39	87	2,69	106	2,54
Burundi	158	2,06	107	2,51	107	2,57	155	1,61	N/A	N/A
Angola	159	2,05	139	2,24	112	2,54	138	2,28	142	2,25
Afghanistan	160	1,95	150	2,14	158	2,07	135	2,30	143	2,24

Source: (Logistics Performance Index, 2020)

3. Definition and Elements of Foreign Trade

In order to have more goods and services, people have used their scarce resources jointly and produced in cooperation with each other. Thanks to these collaborations that people have made with each other for a long time, production factors have developed and specialization has emerged. Some of the produced goods are used for the needs of the producers and the surplus goods are used in barter with other producers. In this way, producers are enabled to specialize in the products they produce and at the same time, commercial interaction is kept alive. With this barter transaction, an increase in living standards is achieved on both sides. These clearing transactions are defined as trade. Increased production and consumption as a result of barter transactions increase the welfare of societies (Eken, 2019). Countries produce depending on the products they specialize in and products with excess supply are sold to a different country in demand. In this system, the process of supplying a product from a different country with the need for a product is called import, and the process of selling a product to a different country is called export.

3.1. Historical Development of Foreign Trade

The foreign trade theory that dominated the world in the 15th and 16th centuries was Mercantilism. According to this view of trade opinion, countries advocated that trade should be done by the state and follow protective policies against foreign countries while attaching importance not to going beyond their borders until the end of the 17th century. In the 18th century, the Physiocratic period theories, in which state protection and protectionism against foreign trade were partially softened, and passed on (Ateş B, 2015).

Adam Smith, who is regarded as the founder of Classical Liberalism, started the Classical Economic Period in 1776 by putting forward his work named "The Wealth of Nations". Smith argued in his book The Wealth of Nations that liberalization of foreign trade and international specialization are beneficial. In addition, according to the "Absolute Advantages Theory", countries should specialize in whatever product they can produce at the lowest cost and import the product that constitutes a high cost of production.

It can be said that David Ricardo, who corrected the deficiencies of Adam Smith's Theory of Absolute Advantages and published his book "On the Principles of Political Economy and Taxation" in 1817, laid the foundations of foreign trade in modern terms (Yüksel and Sarıdoğan, 2011).

John Stuart Mill provided the determination of foreign trade gains by including the Demand factor, which the previous ones had neglected, into the analysis and put forward the Mutual Demand Law, which would later be developed by neoclassical thinkers. He argued that mutual demand will also accelerate technological developments (Bayraktutan, 2003).

Classical Foreign Trade Theories emphasized the labor-value theory and assumed labor as a homogeneous production factor. However, entrepreneurship, capital and natural resources are also included in the concepts that affect the cost of a good. Gottfried Haberler introduced the concept of opportunity cost by criticizing the labor-value concept to overcome these shortcomings of the theory. (Gülmez, 2019)
In the 1930s, modern foreign trade theories began to emerge. In this period, the contributions of two Swedish economists, Heckscher (1919) and Ohlin (1933) are seen. According to the Heckscher-Ohlin theorem, a country should produce in the field in which it has a comparative advantage in production resources. For products with scarce production resources, it should turn to imports (Bayraktutan, 2003).
As a continuation of these studies, the Skilled Workforce theory was developed by Keesing and Kenen. According to this theory, countries with professional or high-quality labor will specialize in qualified labor-intensive goods and export these goods, while countries with more unqualified labor will specialize in the production of goods produced with unqualified labor and will export these goods (Deviren, 2004).

3.2. Definition of Export

Export is defined as the sale of a product to foreign countries or to places / persons in foreign country status in exchange of foreign currency. Exporting countries show that they have raised their production quality to the level of international competition and compete to get a share from the world's wealth (Melemen, 2016). According to the export regulation, export covers all the processes of exporting a good or economic value in accordance with the applicable customs legislation and export legislation, and bringing the price to the country except for free export according to the foreign exchange legislation (Olhan, 2009).

Table 3. The data of the last 3 years of the 10 countries with the highest export figures (USD)

Country / Year	2016	2017	2018
China	2.097.637.172	2.263.370.504	2.494.230.195
USA	1.451.023.530	1.546.272.961	1.664.055.581
Germany	1.340.752.046	1.446.642.435	1.557.176.334
Japan	644.932.439	698.132.787	738.188.768
Netherlands	570.931.867	651.696.797	723.347.390
South Korea	495.465.606	573.716.618	605.169.190
Hong Kong	516.588.131	549.861.455	569.105.740
France	488.885.072	523.385.133	568.448.540
İtaly	461.748.767	507.195.651	546.910.558
United Kingdom	411.463.356	442.065.707	487.069.299

Source: (TradeMap, 2020)

3.3. Definition of Import

Import is defined as bringing any product into the country from foreign countries or free zones in accordance with the current customs legislation and import legislation (www.gumrukleme.com.tr). Import is divided into three categories: import with payment, import without charge and temporary import.

Table 4 The data of the last 3 years of the 10 countries with the highest import figures (USD)

Country / Year	2016	2017	2018
USA	2.249.943.875	2.408.475.702	2.614.273.313
China	1.587.920.688	1.843.792.939	2.134.987.265
Germany	1.060.672.017	1.167.753.355	1.287.199.098
Japan	606.924.047	671.892.311	748.361.565

United Kingdom	636.367.936	641.332.436	669.640.211
France	560.554.863	613.132.640	658.950.640
Netherlands	501.026.975	574.098.648	646.591.021
Hong Kong	547.124.448	589.317.440	627.327.031
South Korea	406.059.974	478.413.948	535.172.391
India	356.704.792	444.052.638	507.580.001

Source: (TradeMap, 2020)

3.4. Export – Import Coverage Ratio

Export-Import Coverage Ratio can be explained as the ratio of imports to be covered by dividing exports by imports. In this context, it can be expressed as the percentage difference between exports and imports. Especially in open economies, this concept is accepted as one of the most important criterion. Considering different currencies of different countries or different time zones in the same country, the foreign trade deficit may not give a reliable result. In this respect, it can be said that the ratio of exports to imports is more consistent. The share of exports in GDP (Gross Domestic Product) in a country is 10 percent, the share of imports is 15 percent; in the other, when we assume that the share of exports in GDP is 35 percent and the share of imports is 40 percent. Although the foreign trade deficit of the two countries is 5, the ratio of exports to imports for the first country is 67 percent, while the ratio for the other country is 80 percent (Aykaç and Civelek, 2019).

Table 5. 10 Countries with the Most Foreign Trade Surplus in 2018

Country / Value	Export (2018)	Import (2018)	Foreign Trade Balance
China	2.494.230.195	2.134.987.265	359.242.930
Germany	1.557.176.334	1.287.199.098	269.977.236
Russian Federation	449.347.157	238.151.375	211.195.782
Saudi Arabia	267.379.092	101.718.329	165.660.763
Netherlands	723.347.390	646.591.021	76.756.369
South Korea	605.169.190	535.172.391	69.996.799
Iraq	97.294.803	31.197.083	66.097.720
Ireland	167.017.888	106.931.073	60.086.815
Brazil	239.889.210	181.230.569	58.658.641
Qatar	82.713.417	28.894.531	53.818.886

Source: (TradeMap, 2020)

10 countries with the highest foreign trade surplus in 2018 are listed in Table 5 and the foreign trade surplus amount is calculated by subtracting the import figure from the export figures and being added to the table. When the data in the table are analysed, it does not seem possible to reach a result that is clear enough in terms of foreign trade performance.

Table 6. The Coverage Ratios of 10 Countries Giving Foreign Trade Surplus in 2018

Country / Value	Export (2018)	Import (2018)	Coverage Ratio
China	2.494.230.195	2.134.987.265	1.17
Germany	1.557.176.334	1.287.199.098	1,21
Russian Federation	449.347.157	238.151.375	1,89
Saudi Arabia	267.379.092	101.718.329	2,63
Netherlands	723.347.390	646.591.021	1,12
South Korea	605.169.190	535.172.391	1,13
Iraq	97.294.803	31.197.083	3,12
Ireland	167.017.888	106.931.073	1,56
Brazil	239.889.210	181.230.569	1,32
Qatar	82.713.417	28.894.531	2,86

Source: (TradeMap, 2020)

When the data in Table 5 are examined, a clear result cannot be obtained as a foreign trade performance. This is because when we examine the total volume and foreign trade surplus, we do not see a result as a percentage. In Table 6, on the other hand, we come across a more reliable healthier data since there is a proportioning situation.

4. Research Model and Hypothesis

By using the sources in the literature, hypotheses have been developed about the sub-dimensions of logistics performance index data of the countries and the coverage ratio of exports to import. Research model is shown in Figure 3.

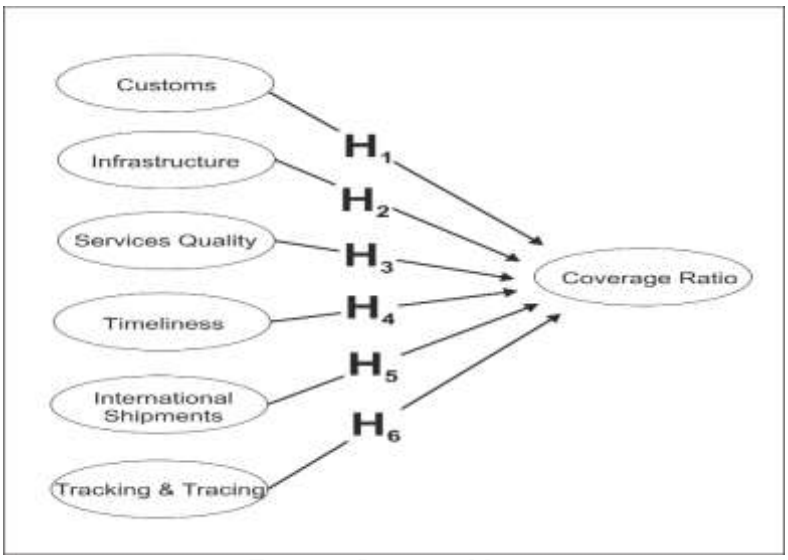

Figure 3: Research Model

The following hypotheses have been proposed within the scope of the research question:
H1: Customs rates have positive effects on Foreign Trade Coverage Ratio
H2: Infrastructure rates have positive effects on Foreign Trade Coverage Ratio
H3: Service Quality rates have positive effects on Foreign Trade Coverage Ratio
H4: Timelines rates have positive effects on Foreign Trade Coverage Ratio
H5: International Shipments rates have a positive effect on Foreign Trade Coverage Ratio
H6: Tracking and Tracing rates have a positive effect on Foreign Trade Coverage Ratio

5. Analysis Results

To test the hypotheses, multiple regression method was used. The effect of independent variable Sub-Dimension of Logistics Performance Index Rates on the dependent variable Foreign Trade Coverage Ratio was attempted to be clarified.

The sample consists of 5 years of data for 123 countries. In Table 7, regression coefficient of the relationship is shown. When we look at the coefficient table where LPI sub-dimensions are examined separately, it is seen that the Infrastructure value has a positive and significant effect on the ratio of exports to imports. Since the international shipments and tracking and tracing Beta values are negative, a negative effect of exports on the import coverage ratio has been determined. Since the Services Quality and Timelines Sig values were above 0.05, it was concluded that there was an insignificant relationship on the ratio of exports to imports. The sig value of customs is less than 0.05, which indicates that it has a significant effect on the coverage ratio of exports to imports. However, a negative Beta value means that it has an opposite effect on the coverage ratio of exports to imports. Thus, H2 hypothesis is supported. As for H1, H3, H4, H5, H6 hypothesis are not supported.

Table 3. Hypotheses Test Results

Relationships	Standardized Coefficients	Hypotheses	Results
Customs → Coverage Ratio	-0.366*	H_1	Not Supported
Infrastructure → Coverage Ratio	0.418*	H_2	Supported
Services Quality → Coverage Ratio	0.089	H_3	Not Supported
Timeliness → Coverage Ratio	0.109	H_4	Not Supported
International Shipments → Coverage Ratio	-0.032	H_5	Not Supported
Tracking & Tracing → CSA	-0.114	H_6	Not Supported

*$p < 0.05$

6. Conclusion

Within the scope of this research, a conceptual model has been established created to determine the foreign trade success criteria of the world countries and to evaluate their performance. In order to test this model, multiple regression analysis was performed on the sub-dimensions of the LPI rates and the coverage ratio of exports to imports of 123 countries for the years 2010, 2012, 2014, 2016 and 2018. As a result of the research, a significant relation was found between Infrastructure being the sub-dimension of logistics performance index data and the ratio of exports to imports. A significant relation could not be established between International shipments, Services quality, Tracking and tracing and Timeliness, being the sub-dimensions of logistics performance index and the ratio

of exports to imports. A positive but inverse relationship was found between customs clearance and the coverage ratio of exports to imports. This yields the conclusion that the customs investments would have a negative effect on the ratio of exports to imports. This unexpected result needs to be confirmation by the future research. This result can be stem from possible measurement errors in logistics performance index.

In line with these studies, it has been observed that the logistics infrastructure investments have a directly positive effect on the export-import coverage ratio of countries. The scientific contribution of this research is to establish a relation between the relevant concepts in the literature.

In line with the findings, important criteria of success emerge for a country that aims to increase its foreign trade performance. Logistics investments to be made by taking this analysis into consideration will contribute to the development of foreign trade. The most important result of this research is that the infrastructure investment is extremely crucial for building the welfare of a nation.

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