European Research Studies Journal
Volume XXI, Issue 2, 2018

pp. 678-690

Influence of Logistics Efficiency on Economic Growth of the CIS Countries

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Abstract:

Logistics has become one of the foremost spheres that affect economic growth. In its reports, the World Bank analyzes the effectiveness of the LPI logistics index of the world, and states that the logistics sector plays an important role in the competitiveness of many countries.

The authors, using the example of the CIS countries, analyze the influence of LPI over 10 years, and carry out factor analysis, which considers both the logistics sector (transport, telecommunications) and economic indicators (GDP, trade, industry, etc.).

Groups of factors such as industry (general and agricultural), investment and trade: auto transport, freight turnover, communications; railway and air transport, service and mobile network and exports were identified based on the results of the study.

These factors are closely interrelated. This interrelation plays an important role in the development of economic growth of countries. It was revealed that the efficiency of logistics affects over not only economic growth, but also the further development of a country in the global world.

Keywords: *Logistics sector, LPI index, economic growth, economic development, the CIS countries, factor analysis.*

JEL Classification: *M1.*

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1. Introduction

At present, logistics plays a huge role in the economy of the majority of developing countries, influencing various areas, such as transport networks, storage systems, information and communication devices, packaging services, supply chain management, industry and products, exports and imports of services and so on. Hayaloglu (2015) interpreted that logistics is now becoming an important element of trade, taking an active role in this development. Accordingly, development in the logistics sector plays a significant role, providing advantages in terms of growth and development, logistical investments change the functioning of a company and countries in general. Bensassi *et al.* (2015) described that the lack of a generally accepted definition of the logistics industry, both nationally and regionally, can explain the relative lack of analyzes that directly determine the quantitative assessment of the impact of this sector on international trade. Most of the existing studies consider only the impact of certain aspects of the supply chain on international trade (Akopova *et al.,* 2017; Bondarenko *et al.,* 2017).

To understand the influence of the logistics sector, this article aims to analyze not only the transport sector, but also telecommunications and national components that include households, government spending, gross capital formation or, in other words, investment, general population, employment level and so on.

2. Review of the CIS Countries

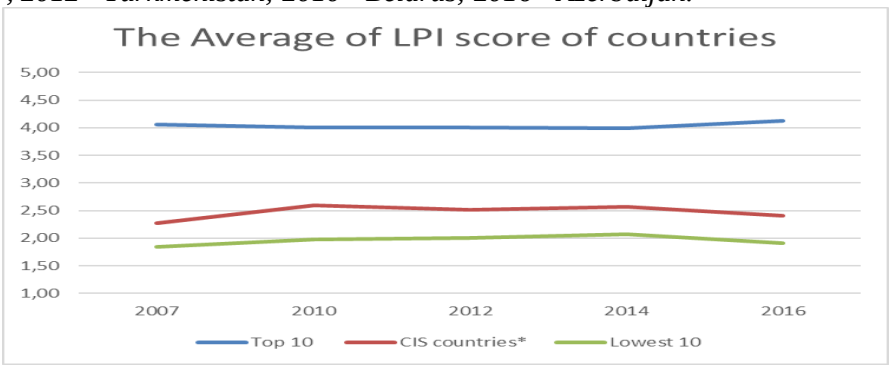
As is known, LPI index plays a central role in the economic growth and competitiveness of countries in both international and domestic trade. Moreover, the logistics sector is now recognized as one of the main sectors in the economic development of a state (Arvis *et al.,* 2016). The first version of measuring effectiveness of international supply chain LPI was published in 2007, as known, and since 2010, the World Bank publishes it every 2 years. We compare the total LPI of the CIS countries with the top 10 countries and the lowest 10 countries from 2007 to 2016 (Figure 1). The top ten positions each year include different countries, but mainly for the period of the last 10 years, they are as follows. Germany, Singapore, the Netherlands and the UK have not changed their positions. Sweden in 2012 and Japan in 2016 were missing only one year in the list of the top 10 countries. Hong Kong (China) and the United States were absent for two years (2007 and 2010) while other countries, such as Austria, Switzerland, Belgium, Canada, Luxembourg, Norway, Denmark and Finland, generally change every two years.

Furthermore, we compare the lowest 10 countries. In this list, mostly third world countries are present. In 2007, they were five countries of Africa (Chad, Niger, Sierra Leone, Djibouti, and Rwanda), two South-East Asian countries (Timor-Leste

and Myanmar), and two countries of Central Asia (Tajikistan and Afghanistan) and one country of South America (Guyana). In 2016, the group of the lowest 10 countries has not been changed much: six countries in Africa (Lesotho, Sierra, Leone, Equatorial Guinea, Mauritania, Somalia, and Zimbabwe), one country in South-East Asia (Lao PDR), two countries in Central and West Asia (Tajikistan and Syria) and one country in the Caribbean (Haiti).

The first TOP 10 high-income countries strengthened their positions in the LPI from 4.06 to 4.13 points (1.7%), while the last 10 low-income countries and the worst LPI indicators improved their performance by 3.7 % - from 1.86 to 1.93 points. That is a slow process of reducing the gap due to the economies of scale and geography, through integration with global supply chains and country-based measures to improve LPI (Logistics Performance Index. International LPI, 2017). In the CIS countries, the average LPI index increased by 5.7% (from 2.28 to 2.41 points).

***Figure 1**. The average score of countries (the highest is 5, the lowest is 1). * Absent: 2007, 2012 - Turkmenistan; 2010 - Belarus; 2016 - Azerbaijan.*



Thus, the CIS countries include 11 countries (Azerbaijan, Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan and Uzbekistan), but the following countries are absent from the LPI index in the folowing years: 2007, 2012 - Turkmenistan; 2010 - Belarus; 2016 - Azerbaijan. In addition, Tajikistan is present in two categories, both among the CIS countries and among the 10 lowest countries.

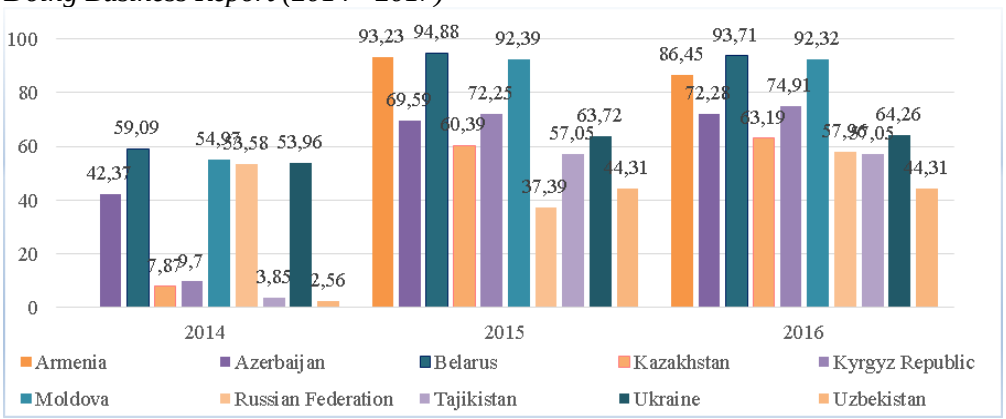
The World Bank in its reports divides the countries into cumulative density, all issues of *"Connecting to Compete"*; LPI points are divided into four categories, according to the evaluation quintiles, which are used as follows: 1) Logically unfriendly, least developed countries with serious logistical constraints (low indicators of the country of the LPI quintile, points between 2.00-1.00); 2) Partial executors: low- and middle-income countries with a small number of logistical constraints (third-country, scores between 3.00-2.50 and fourth-country quintile LPI, points between 2.50-2.00); 3) Agreed executors: with greater logical performance

than the majority of others in their income group (second-country LPI quintile, points between 3.50-3.00); 4) Logistic-friendly: mostly high-income countries (countries with a higher quintile, points between 4.25-3.50) (Arvis et al., 2016).

There are annual “Doing Business” reports in the World Bank in the field of logistics that have been published since 2004 and have a wide range of subnational research, as well as a number of special reports relating to individual regions or thematic categories that compare business regulation to domestic firms in 190 countries, and also reflects several important aspects of the regulatory environment that apply to local firms. These reports include 11 sets of indicators of which Trade across borders (TAB) consider the logistical aspects of a country.

International trade has evolved into a complex network of participants both inside and outside sovereign borders. In trading processes, not only state bodies and private companies are involved, but also customs brokers, commercial banks, suppliers, insurance companies and forwarders. If we consider the dynamics of the TAB of the CIS countries for 2014-2016, we can see the DTF indicator for trade across borders (0-100 scale) and Trade across borders (the highest rank is -1.00). The first indicator illustrates the distance of an economy to the "border", which represents the best performance, and the economy's distance to the border is indicated on a scale of 0 to 100, where 0 is the lowest productivity and 100 is the highest productivity limit. The second indicator reflects the time and cost associated with the logistics process of exports and imports of goods; measures time and cost (excluding tariffs) associated with the three sets of procedures - document compliance, border compliance and internal transport - as part of the overall process of export or import of goods, which is indicated by the ranking between 1 and 190, where 1 rank is the highest indicator, respectively 190 is the lowest indicator of logistical processes of countries (Doing Business, 2014-2017).

***Figure 2**. DTF score for trading across borders (0-100) of the CIS countries for 2014-2016. *absent: 2014, 2015, 2016 – Turkmenistan; 2014 – Armenia. Source: Doing Business Report (2014 - 2017)*



In terms of DTFs for trade across borders (0-100) and Trade across borders (highest rank -1.00), Singapore was the highest in 2014, and, the Netherlands, Belgium, Austria, Luxembourg in 2015 and 2016. Turkmenistan is not included in the CIS countries and Armenia is absent in 2014. If in 2014 almost all the CIS countries were above 145 of 190 countries, then there is a significant improvement in some countries in 2015 and 2016, in addition, according to the Doing Business report (2014-2017) in 2015 and 2016, the economy of the country that demonstrated the most noticeable improvement Kazakhstan and Belarus came from the CIS countries.

***Table 2**. Trade across borders (highest rank -1.00) of the CIS countries for 2014-2016. Source: Doing Business Report (2014-2017)*

Trading across borders (rank 1-highest)	**2014**	**2015**	**2016**
Armenia	-	29	48
Azerbaijan	166	94	83
Belarus	145	25	30
Kazakhstan	185	122	119
Kyrgyz Republic	183	83	79
Moldova	152	33	34
Russian Federation	155	170	140
Tajikistan	188	132	144
Ukraine	154	109	115
Uzbekistan	189	159	165

***Table 3**. Time and cost for export and import of the top countries and CIS countries for 2014-2016. Source: Doing Business Report (2014-2017).*Absent: Turkmenistan*

Countries	*Time(time/day(t/d) and time/hour(t/h)) and cost to export(cost/US$(c/U))*						*Time(time/day(t/d)) and time/hour(t/h)) and cost to import (cost/US$(c/U))*					
	2014		2015		2016		2014		2015		2016	
	t/d	*c/U*	t/h	*c/U*	t/h	*c/U*	t/d	*c/U*	t/h	*c/U*	t/h	*c/U*
Top-countries												
Singapore	6	915	18	584	14	584	4	440	37	471	38	260
Netherlands	7		4	315	1	315	6	975	4	315	1	0
Belgium	9	460	3	265	1	265	8	1,4	3	265	1	0
Luxembourg	8	1265	2	188	1	188	7	1140	2	188	1	188
Austria	19		3	60	3	60	7	1420	3	60	3	0
CIS countries												
Armenia	-	-	10	521	41	250	-	-	10	471	43	110
Azerbaijan	9	3460	77	1175	62	514	25	3450	79	1023	68	623
Belarus	8	1460	13	410	9	248	30	2265	9	229	5	0

Kazakhstan	10	5285	313	1285	261	894	67	5265	92	1595	8	0
Kyrgyz Republic	9	4760	56	785	41	590	73	6000	68	792	73	712
Moldova	9	1510	53	198	51	120	27	1870	10	322	6	124
Russian Federation	9	2401	153,8	2369,1	121,4	857	19.4	2595	153,8	2369	138,5	1277,5
Tajikistan	11	9050	144	1076	141	643	70	10650	237	916	234	483
Ukraine	8	1880	127	667	122	367	28	2455	225	692	240	312
Uzbekistan	11	5090	338	1635	286	570	104	6452	287	628	285	570

Consequently, in Table 3 can be seen the total time and cost spent on exports and imports of the CIS countries and the top 5 countries for 2014-2016. If in 2014 the cost of exports and imports was calculated for one container, then from 2015, the value of exports and imports consists of the above items. In addition, the time of export and import for 2014 was measured in days, then from 2015 are indicated in hours. According to World Trade Organization (WTO) research, through the import of technology and related productivity growth into its simple recommendations, such as automation of trade and customs processes, can reduce costs for developing income groups by 2.1-2.4% (UNCTAD, 1994). According to the “Doing Business” data for 2017, among trade reformers, many countries have simplified cross-border trade by improving existing electronic systems for both imports and exports, which reduces the cost and time of compliance with documentary and border crossings (Doing Business, 2015).

3. Factor and Registration Analysis of the CIS Countries

The impact of the development of the logistics sector on economic growth was carried out in 2007 and 2016. Variable GDP was adopted as a criterion for economic growth, and its "average" of the CIS countries was used as a growth criterion for 10 years. In addition, the following indicators were used as independent indicators (Table 4).

Hayaloglu (2015) selected the logarithms of 13 components, such as GDP, total government spending on consumption, population size, enrollment, higher education, employment level (%), total investments in inland transport infrastructure, rail transport (million T-km), road transport (million T-km), air transport, (million T-km), telephone lines (per 100 people), mobile cellular subscription (for 100 people), fixiro bathroom broadband Internet subscription (for 100 people) and Internet users (per 100 people). Martí *et al.* (2014) also used the export and import of developing countries in Africa, South America, the Far East, the Middle East and Eastern Europe in her research. We also selected Hayaloglu’s GDP, rail transport, road transport, Air transport, Telephone lines, Mobile cellular subscription, and Internet users, instead of the total investment in the infrastructure

of inland transport, included gross capital formation of the CIS countries. In addition to the above variables, we also included trade, freight turnover, agriculture, industry, production and services because we believe that logistics influences these variables as well. In this connection, we have 16 variables to find out whether there are relations between dependent variable and independent variables or not, whether they are interrelated, how they influence each other. Thus, in order to reveal the influence of the logistics sector on economic growth, we made a factor analysis of our variable, which was collected in 2007-2016 from the CIS countries (World Development Indicators database, 2017).

***Table 4**. The variables of the CIS countries between 2007-2016. Source: World Development Indicators database (2017). Absent: Turkmenistan, Tajikistan and Uzbekistan*

N	Variable	Unit of measure	Full name of Variables
1	GDP	current billion US$	Gross domestic product
2	GCInv	% of GDP	Gross capital formation
3	AIR	million ton-km	Air freight services
4	RAIL	million ton-km	Rail transportation
5	Mob	per 100 people	Subscriptions to mobile cellular
6	Tel	per 100 people	Fixed telephone subscription
7	IntUse	% of population	Persons using the Internet
8	Import	% of GDP	Import of goods and services
9	Export	% of GDP	Export of goods and services
10	FrTURN	millions of ton-kilometers	Freight turnover of transport
11	Trade	% of GDP	Trade
12	ROAD	million ton-km	Auto roads, goods transported
13	Agri	% of GDP	Agriculture, value added
14	Indus	% of GDP	Industry, Value Added
15	Manuf	% of GDP	Manufactory, Value Added
16	Serv	% of GDP	Services, Value Added

As a result of the research, we will focus on the following points of interest: Cronbach's Alpha results; Kaiser-Meyer-Olkin test; Own values and cumulative factors; Factor template before variation; Factor pattern after Varimax rotation; Anova (Test for equality of means between series).

According to the factor analysis, the following results are derived:

Alpha-Cronbach, equal to 0.76, this means that the chosen variables are acceptable. Alfa-Cronbach, α-coefficients there are several scales: for example, $\alpha \geq 0.9$ - excellent, $0.9 > \alpha \geq 0.8$ - good, $0.8 > \alpha \geq 0.7$ - acceptable, $0.7 > \alpha \geq 0.6$ - doubtful, $0.6 > \alpha \geq 0.5$ - poor, $0.5 > \alpha$ - unacceptable (Using and Interpreting Cronbach's Alpha, 2017).

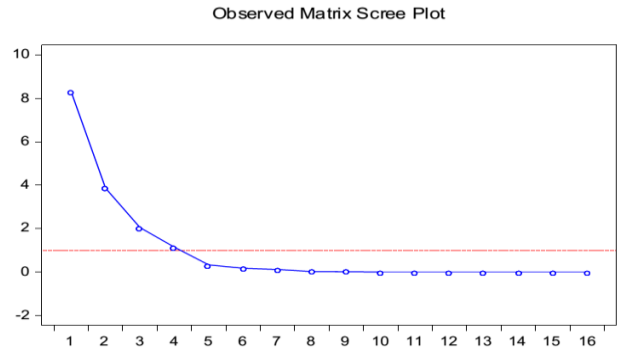
Kaiser-Meier-Olkin (KMO) shows an indicator of the adequacy of the sample, if the sample is between 0.90 and 1.00, then this sample is remarkable; if between 0.80 to 0.89 - deserved; between 0.70 and 0.79 is the average; between 0.60 to 0.69 is an intermediary; between 0.50 to 0.59 - satisfactory; between 0.00 to 0.49 is not affected (Abdi, 2017). KMO - 0.508 - is satisfactory.

***Table 5**. Eigenvalues and cumulative factors*

	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Eigenvalue	8,302	3,861	2,048	1,144
Proportion	0,519	0,241	0,128	0,072
Cumulative %	0,519	0,760	0,882	0,960

Table 5 shows the eigenvalues obtained because of factor analysis, and as a result, we have 4 factors, out of 16 possible factors (Figure 3). When performing factor analysis on a correlation matrix, the variables are standardized, which means that each variable has a variance of 1, and we choose a coefficient that is greater than 1 scale, or in other words, the eigenvalue is greater than 1. Thus, in our case we choose 4 factors, and we see that with 4 factors we retain 96% of the variability of the original data.

***Figure 3**. Scatter-graph of eigenvalues of factors*



Non-rotating loads are determined by the method of the Basic factors, where the usual correlation was used. Kaiser Guttmann's method and anterior commonness are a square of multiple correlation, and then we use the rotating varimax method, convergence after 34 iterations, we obtain the following results (Table 6). In addition, the factor model can be elucidated by "Rotating varimax" factors in the F-dimensional space. Consider the following hypothetical two-factor solution, including 16 variables. Varimax, developed by Kaiser (1958), is by far the most popular method of rotation. If rotation is requested, the rotation results are displayed with a rotation matrix first applied to the factor loads. The modified percentages of variability associated with each of the axes associated with rotation follows then (Abdi, 2017).

Table 6 shows that the first factor is very positively associated with Agri, GCF, Import, Trade, Manuf, moreover, the final community of the given is 1.00, which connects the indicators (Figure 5). We can name the factor 1 - agriculture, industry, trade (including exports and imports) with investment. The second factor is positively related to FrTURN, Mob, ROAD, GDP and Tel. GDP and Transport freight turnover has a positive effect on each other and is called cargo transportation. The third factor AIR, RAIL, Serv and IntUser have a positive effect on each other, but with the rest of the indicators have a negative effect. Railway and air transport with Internet users and country service. The fourth factor is only one indicator - Export.

***Table 6**. Factor pattern after Varimax rotation*

Variables	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Agri	**0,764601**	0,371848	0,246802	-0,01911
AIR	-0,90662	0,089342	**0,258691**	-0,11039
Export	0,356824	-0,12284	0,238261	**0,794682**
Frturn	-0,14167	**0,918922**	-0,28718	0,031118
GCF	**0,94652**	-0,0275	0,219944	-0,11171
GDP	-0,01581	**0,902147**	0,37559	0,164821
Import	**0,678186**	0,311378	0,319276	0,499192
Indus	**0,870862**	-0,15753	-0,12978	0,385621
Intuser	-0,89287	0,181382	**0,303818**	-0,2511
Manuf	**0,852201**	-0,42346	-0,07869	0,252137
Mob	-0,77145	**0,417124**	0,127623	-0,21508
Rail	-0,19115	-0,04856	**0,926068**	0,160876
Road	-0,17632	**0,806113**	0,186119	-0,46771
Serv	-0,93815	0,033182	**0,037623**	-0,26826
tel	-0,07219	**0,968765**	-0,12913	-0,06192
Trade	**0,553737**	0,085986	0,231411	0,491917

Thus, we identified 4 important factors, and we named them as follows: Factor 1 - industry (general and agricultural), investment and trade; Factor 2 - auto transport, turnover, communication; Factor 3 - rail and air transport, service and mobile network; Factor 4 - export.

***Table 7**. Anova (Test for equality of means between series)*

	df	value	Probability
Anova F test	5; 54	186,38	0.0000
Welch F-test	5; 21,5616	71,26	0.000
variance	df	sum of sq	mean sg
between	5	37 873 979,00	7 574 796,00
Within	54	2 194 665,00	40 641,95
Total	59	400 068 644,00	679 129,60
	mean	std.dev	std.err of mean
GDP	2 132,36	493,8091	156,1562
F4	-5,04E-15	0,99623	0,312946

LPI	2,46	0,138591	0,043826
F1	1,64E-15	1,038178	0,328301
F3	-4,23E-15	1,031175	0,326086
F2	-4,09E-15	1,048649	0,331612
All	355,80	824,0932	106,39

ANOVA test is single-factor, between subjects, analysis of variance (ANOVA). The basic idea is that if subgroups have the same mean value, the variability between samples means (between groups), should be the same as the variability within any subgroup (within the group) (Abdi, 2017). The F-statistic has an F-distribution with numerical degrees of freedom and degrees of freedom of the denominator under the null hypothesis of independent and identical normal distributed data with equal means and variances in each subgroup (Charles, 2017).

When subgroup variances are heterogeneous, we can use the version of the test statistics of Welch (1951). For tests with only two subgroups, EViews also reports t-statistics, which is simply the square root of the F-statistics with one degree of freedom of the numerator. Note that for two groups, the Welch test is reduced to the Satterthwaite test (1946) (Abdi, 2017). The upper part of the output contains the ANOVA results for testing the equality of means for GDP, classified by the four groups defined in the F1, F2, F3, F4 and LPI series.

***Table 8**. Regression analysis after factor analysis*

Dependent variable GDP	**GDP = β_0 + β_1 F1 +β_2 F2 +β_3 F3 + β_4F4 + β_7*LPI***			
Variable	*coefficient*	*std error*	*t-stat*	*prob*
F1	0,771928	53,67328	0,014382	0,9892
F3	169,9146	47,02551	3,613243	0,0225
F2	408,3655	63,07021	6,474777	0,0029
F4	74,75637	53,65978	1,393154	0,236
LPI	141,7629	546,1803	0,259553	0,808
β_0	1783,582	1344,545	1,326532	0,2553
R-sq	0,962211	*mean depend var*		2132,363
Adj R-sq	0,914975	*s.d. depend var*		493,8091
S.E. of reg	143,99	*akaike info criterion*		13,06107
Sum squared resid	82932,49	*schwarz criterion*		13,24263
Log likelihood	-59,30537	*Hannan-Quinn criter*		12,86191
F-Stat	20,37025	*Durbin-Watson stat*		2,635646
Prob F-stat	0,006013			

The results of econometric analysis show a strong interrelation between LPI and GDP in the CIS countries. The value of the correlation coefficient is large enough,

which indicates that LPI significantly affects the economic development of the CIS countries. In addition, the values of R Square and Adjusted R Square are quite high. The values of the statistical test Student and Fisher show the actual econometric model. The value of F is very small, and the value of F-Stat is large enough to say that the model is statistically correct. In addition, factors 2, 3 and 4 show a high impact on GDP in the CIS countries. This means that the growth of indicators as transport, communications, service and exports have a positive impact on GDP growth in the CIS countries.

Table 9*. GDP and LPI index of CIS countries for 2016. Source: World Development Indicators database and from CIS countries (2017)*

CIS countries	**GDP 2016 (current billion US$)**	**LPI (2014)**	**LPI (2016)**
Russia	1 283,16	2,69	2,57
Kazakhstan	133,66	2,70	2,75
Ukraine	93,27	2,98	2,74
Belarus	47,43	2,64	2,40
Azerbaijan	37,85	2,45	-
Armenia	10,55	2,67	2,21
Moldova	6,75	2,65	2,61
Kyrgyzstan	6,55	2,21	2,16
Turkmenistan	36,18	2,30	-
Tajikistan	6,95	2,53	-
Uzbekistan	67,22	2,39	-

The econometric model shows that at the CIS level there is a strong and stable interrelation between logistic characteristics and economic development. If you take 6 LPI components, such as, customs efficiency; infrastructure; international shipping; logistics services; the ability to monitor and track the cargo; timeliness are very important factors of economic development. It should be noted that in the CIS countries GDP and LPI are very different. If in Russia GDP for 2016 amounted to 1 283.16 billion dollars, and Kyrgyzstan this figure equals 6.55 billion dollars. Despite this, only Kazakhstan compared to other countries improved LPI in 2016, while in other countries LPI index decreased compared to 2014. Of course, the reverse interrelation is also valid as logistic indicators are more developed in countries with higher economic indicators have positive indicators.

4. Conclusion

In conclusion, we can clearly see that the development of logistics largely correlates with the overall level of the country's development. Our research conducted at the level of the CIS countries in the period from 2007 to 2016 allows us to draw the following conclusions regarding the development of logistics and increasing its attractiveness in the EEA countries.

This concerns investing in the development of logistics and improving their components: the quality of the infrastructure and the competence of specialists, tracking the passage of goods and the timeliness of deliveries, reducing border and trade barriers for passing cargo. It will require institutional improvements to improve the level of integration, and regulation of the industry, market access and security.

Factor analysis showed that the model constructed is statistically correct, and the results of econometric analysis show a strong interrelation between the factors 2, 3, 4, LPI and GDP in the CIS countries. At the top of the CIS countries, Russia is in terms of GDP, but Kazakhstan occupies a leading position in the LPI index, and Kyrgyzstan has the lowest productivity. However, countries with low GDP tend to have low logistical efficiency, as evidenced by the positions of countries such as Moldova, Kyrgyzstan, Tajikistan and Armenia. To reduce imbalances in the CIS, the LPI components in their countries continue to be significantly improved, for example, the quality of trade and transport infrastructure, the efficiency of the clearance process, the ease of supply organization at competitive prices, the competence and quality of logistics services.

In conclusion, confirmed by our econometric analysis: an effective, implementing a logistics system is the determining factor of sustainable economic growth, but only the level of income in the country does not explain all the different levels of logistics efficiency, as politics is also an important factor.

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