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Logistics performance of European Union markets: Towards the development of entrepreneurship in the transport and storage sector

A. Mesjasz-Lech

Faculty of Management, Czestochowa University of Technology, Częstochowa, Poland

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ABSTRACT

The markets globalization is one of the factors creating conditions for the development of entrepreneurship. Entrepreneurship does not have one generally accepted definition. Most often, entrepreneurship is perceived as the ability to increase the number of enterprises. Entrepreneurship can be understood as the potential to identify and use development opportunities regardless of the own resources. Entrepreneurship is therefore associated with such areas as new organizational forms, stimulation of innovation and cooperation with the entrepreneurial environment. Unfortunately, enterprises face many difficulties which can have the supply and demand nature. These difficulties hinder the enterprise functioning on the market and its development. Logistics performance perceived as the implementation of the highest quality of logistics standards allows overcoming the difficulties of entrepreneurship, especially for the transport and storage sector. For this reason, the article aims to determine the relationship between logistics performance and the entrepreneurship rate for selected European Union countries. Logistics performance was determined by a synthetic measure of development estimated using numerical taxonomy methods for variables forming the Logistics Performance Index. The same method was used to build the entrepreneurship rate, accepting as variables selected entrepreneurship indicators for the transport and storage sector. The correlation analysis was performed with the use of the Spearman rank correlation coefficient. The years 2014-2016 were analyzed. The availability and completeness of data dictated the choice of years, countries and indicators for analysis.

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*Corresponding Author:
Email: *agata.mesjasz-lech@wz.pcz.pl*
agata.mesjasz@poczta.fm
Phone: +48 34 3250 388

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INTRODUCTION

Performance is a category measured in many areas of decision-making units. One of such areas is logistics which supports the functioning of supply chains (Kucukaltan *et al.,* 2016; Kain and Verma, 2018). Logistics includes activities aimed at guaranteeing the efficiency and effectiveness of all procedures related to the flow of all types of resources from the place of origin to the destination, while meeting the required quality of service, including the reliability of information and sensitivity to customer needs (Domingues *et al.,* 2015). Logistic operations are key to an efficient and effective solving of problems connected with transportation, storage, and packaging and, accordingly, to ensuring competitiveness of businesses and countries (Çakır, 2017; Kadłubek and Włodarczyk, 2017). Logistics supports domestic and foreign trade system and guarantees the continuity of business activity (Çemberci, *et al.*, 2015). Therefore, logistics performance should be seen as a strategic factor influencing customer satisfaction (Ltifi, Gharbi, 2015). Research on various aspects of logistics performance should be related to entrepreneurship in order to assess the development of the processes of the creation of new business entities and their orientation towards innovation on the scale of the regions of a country or the world. Logistics performance and entrepreneurship are the determinants of economic development in terms of the adaptation to the needs of markets which improves the competitiveness of the economy. Logistics performance creates conditions for creating new business entities which can meet market demand. Skilful use of these conditions by managers of economic entities will translate not only into maintaining economic stability, but also into the development and increase of competitiveness in the first place. The goal of the article is to determine the relationship between logistics performance and the entrepreneurship rate in the transport and storage sector for selected European Union countries. The analysis was limited to the transport and storage sector due to high sensitivity of the sector to the economic downturn (Włodarczyk, 2012) and the importance of the sector in the realization of physical flow processes in the supply chain. The subject literature offers many approaches to the measurement of performance (Kiseláková, *et al.*, 2018; Mason, *et al.*, 2015). Due to the fact that business entities define logistics performance in relation to their own strategies and goals, there is a number of different measures in this category (Akdoğan and Durak, 2016). The measures refer to processes or related activities that affect the entity's performance (Liebetruth, 2007). It is essential to note that the objective of the performance measures is to provide a balanced and concentrated presentation of information (Tracht, *et al.*, 2013). And that can be done using the logistics performance index (LPI), which in a sense expresses the reliability of the logistics of countries (Jane and Laih, 2012; Rezaei *et al.,* 2018). It allows to determine the logistics performance of countries with different levels of development (Gani, 2017) and indicate the areas of scalability of supply chains (Grondys, Dragolea, 2016). The index also determines the links between logistics performance and trade competitiveness (Vaillancourt, Haavisto, 2016) for different areas of economic activity, sectors and markets (Rashidi, Cullinane, 2019; Wong, *et al.*, 2018; Mariano, *et al.*, 2017; Bakar and Jaafar, 2016; Bulis and Škapars, 2013). Logistics performance, due to the way it is understood and measured, determines the development of the market. The international market requires flows to be organized and synchronized through strategic nodes and networks which facilitate warehousing and protection, and through any other added value services that are necessary due to the characteristics of the transported goods (Puertas, *et al.*, 2014). The organization of flows is the responsibility of entities operating on the market. Their ability to adapt to market changes also forces them to introduce changes to their economic structure which are determined by the entrepreneurial levels of business entities. Entrepreneurial activities are focused on creating a resource configuration which can facilitate competitive advantage. Due to the complex nature of entrepreneurship (Gaddefors and Anderson, 2017; Sabbaghi, 2018), it is difficult to define it unambiguously (Berglund and Johansson, 2007). The European Commission Enterprise Directorate General defines entrepreneurship as a way of thinking and a process aimed at creating new forms of economic activity and developing the existing ones by combining the skills of creativity, innovation and risk-taking with the right way of managing within a new or existing organization (Gołębiowski, 2014; Bridge, 2017). Unfortunately, entrepreneurship is limited by barriers connected with demand and supply. The elimination

of these barriers is fostered by the implementation of the highest logistic standards which also determine logistics performance.

MATERIALS AND METHODS

In order to evaluate entrepreneurship rate and logistics performance of the European Union countries, the linear ordering method from the area of multidimensional data analysis was used. It was assumed that both quantities should be characterized by many features which can be expressed as a synthetic variable. The transport and storage sectors of 20 European Union countries in 2012, 2014 and 2016 were analyzed. The choice of the countries and years for the analysis was dictated by the completeness and availability of data in the databases of The World Bank and the Eurostat European Statistical Office. In order to compare the dynamics of changes in entrepreneurship rate and logistics performance three years were analyzed. Two-year intervals allowed to reveal changes in the analyzed phenomena taking account of the dynamics of the environment.

Logistics performance was described with the elements comprising logistics performance index (Martí *et al.,* 2017):

- Customs - the efficiency of customs and border management clearance,
- Infrastructure - the quality of trade and transport infrastructure,
- International shipmen - the ease of arranging competitively priced shipments,
- Logistics competence and quality - the competence and quality of logistics services-trucking, forwarding, and customs brokerage,
- Tracking and trading - the ability to track and trace consignments,
- Timeliness - the frequency with which shipments reach consignees within scheduled or expected delivery times.

All features show stimulant characteristics which means the higher their values the better.

Entrepreneurship rate was characterized by the following features:

- Employment share of 3 year old enterprises - number of persons employed in enterprises newly born in t-3 having survived to t, divided by the number of persons employed in the population of active enterprises in t - percentage,
- Employment share of 5 year old enterprises - Number of persons employed in enterprises newly born in t-5 having survived to t, divided by the number of persons employed in the population of active enterprises in t - percentage,
- Birth rate - number of enterprise births in the reference period (t) divided by the number of enterprises active in t - percentage,
- Death rate - number of enterprise deaths in the reference period (t) divided by the number of enterprises active in t - percentage,
- Survival 3 rate - number of enterprises in the reference period (t) newly born in t-3 having survived to t divided by the number of enterprise births in t-3 - percentage,
- Survival 5 rate - number of enterprises in the reference period (t) newly born in t-5 having survived to t divided by the number of enterprise births in t-5 - percentage,
- 3 year old enterprises' share of the business population - percentage,
- 5 year old enterprises' share of the business population - percentage.

The death rate feature is a destymulant in character, the other features are stimulants. Estimates of synthetic variables were carried out with the use of the development pattern method. That involved the following actions:

1. Variables constituting a given complex category (entrepreneurship rate and logistics performance) were unitarized in order to free variables from their titre and unify the values accepted by them, in accordance with Eq. 1.

$$z_{ij} = \frac{x_{ij} - \overline{x}_j}{s_j}, \ (i=1, 2, \ldots, n; j=1, 2, \ldots, m) \quad (1)$$

Where, n – the number of countries,
m – the number of variables,
z_{ij} – standardized value of variable X_j,
$\overline{x}_j$ – arithmetic average of variable X_j,
s_j – standard deviation of variable X_j.

2. A pattern was generated according to Eq. 2 and an anti-pattern was generated according to Eq. 3.

$$z_{0j} = \begin{cases} \max\limits_i z_{ij} \ for \ stimulants \\ \min\limits_i z_{ij} \ for \ destimulants \end{cases} \quad (2)$$

$$z_{_0j} = \begin{cases} \min\limits_i z_{ij} \ for \ stimulants \\ \max\limits_i z_{ij} \ for \ destimulants \end{cases} \quad (3)$$

3. The Euclidian distances of individual objects from the benchmark were determined in accordance with Eq. 4.

$$d_{i0} = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_{0j} \right)^2} \quad (i = 1, \ldots, n) \tag{4}$$

4. For every object a measure of development was estimated according to the Eq. 5:

$$m_i = 1 - \frac{d_{i0}}{d_0}. \quad (i = 1, \ldots, n) \tag{5}$$

where: d_0 – the distance between the pattern and anti-pattern of development determined on the basis of Eq. 6.

$$d_0 = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_{_0j} \right)^2} \quad (i = 1, \ldots, n) \tag{6}$$

The objects were ordered according to the decreasing values of the development measure; if the development measure is higher, the object is closer to the benchmark and the values of the measures are in the range [0; 1]. In the distance measurement process weights were not considered as it was assumed that all variables affect the level of the analyzed phenomenon with the same force. In order to verify the assumption about the interdependence of entrepreneurship results and logistics performance in individual European Union countries, the similarity of synthetic development measures in the selected years was checked. That required the estimation of the Spearman rank correlation coefficient calculated according to Eq. 7.

$$r_S = 1 - \frac{6 \cdot \sum d_i^2}{n \cdot (n^2 - 1)} \tag{7}$$

Where, d_i – difference between ranks assigned to individual variables, n - the size of the statistical sample. In addition, it was checked whether the analyzed countries show an increase in effects in the area of entrepreneurship and logistics performance.

Table 1: Results of linear classification – synthetic measure of development of the entrepreneurship rate

Country	Years					
	2012		2014		2016	
	Development measure	Ranking position	Development measure	Ranking position	Development measure	Ranking position
Austria	0.24627	7	0.296172	9	0.334729	15
Belgium	0.190969	12	0.232904	14	0.345485	13
Bulgaria	0.484853	1	0.552703	1	0.519992	3
Czech Republic	0.171245	14	0.16577	18	0.245524	18
Estonia	0.117494	18	0.239082	12	0.34751	12
Finland	0.159404	15	0.207116	15	0.241741	19
France	0.318082	3	0.437939	4	0.507386	4
Germany	0.098491	20	0.13469	20	0.185231	20
Hungary	0.112327	19	0.195103	16	0.337766	14
Italy	0.201861	11	0.28329	11	0.383405	10
Lithuania	0.29781	6	0.444344	3	0.533449	2
Luxembourg	0.217599	9	0.308605	8	0.409787	8
Netherlands	0.304918	4	0.320165	7	0.423891	6
Poland	0.298868	5	0.352849	5	0.410679	7
Portugal	0.154647	16	0.149705	19	0.282547	16
Romania	0.348954	2	0.503681	2	0.701929	1
Slovak Republic	0.216009	10	0.351372	6	0.500482	5
Slovenia	0.234344	8	0.285844	10	0.39503	9
Sweden	0.177958	13	0.234192	13	0.375085	11
United Kingdom	0.133661	17	0.168056	17	0.276453	17

Table 2: Results of linear classification – synthetic measure of development of the logistics performance

Country	Years					
	2012		2014		2016	
	Development measure	Ranking position	Development measure	Ranking position	Development measure	Ranking position
Austria	0.757724	9	0.488431	9	0.796017	6
Belgium	0.899066	4	0.832508	2	0.828417	5
Bulgaria	0.322127	14	0.151354	19	0.030259	20
Czech Republic	0.259498	16	0.379994	13	0.556944	11
Estonia	0.053431	20	0.246222	16	0.3588	16
Finland	0.904225	3	0.450837	10	0.667631	9
France	0.793787	6	0.682986	7	0.689471	8
Germany	0.915219	1	0.851615	1	0.844731	4
Hungary	0.271936	15	0.376285	14	0.411988	14
Italy	0.670419	10	0.554294	8	0.605987	10
Lithuania	0.138391	19	0.125465	20	0.53794	12
Luxembourg	0.782443	7	0.77007	5	0.887558	1
Netherlands	0.9115	2	0.812434	3	0.846866	3
Poland	0.492061	12	0.420033	12	0.412614	13
Portugal	0.546962	11	0.436072	11	0.392648	15
Romania	0.171541	18	0.229194	17	0.135026	19
Slovak Republic	0.185639	17	0.223471	18	0.357111	17
Slovenia	0.378958	13	0.27429	15	0.251509	18
Sweden	0.766643	8	0.76607	6	0.863782	2
United Kingdom	0.838006	5	0.799766	4	0.779442	7

For this purpose, the values of individual synthetic variables from 2014 and 2016 were compared with their levels from 2012 and 2014. The measurement was carried out for the same countries, i.e. for the same element of the population. The sign test and the Wilcoxon rank test were used. They both allow for the study of the significance of differences between two interdependent samples and do not require the assumption about the normality of the distribution of differences. Based on the results the hypothesis that both samples come from the same population was verified. In the case of the sign test, the signs taken into account were the ones connected with the comparison between the results in pairs, whereas for the measurable data only the signs of differences, not their values, were considered. The Wilcoxon pairs rank test considers the sign, value and order of differences. Therefore, the differences were first ordered increasingly and then ranked. The ranks for the negative and the positive differences were summed separately. The lower of the obtained sums determined the value of the Wilcoxon test.

RESULTS AND DISCUSSION

First, the synthetic measures of development for the categories of entrepreneurship rate and logistics performance were estimated. The results are presented in Table 1.

Countries ranked highest according to the entrepreneurship rate are the developing ones: Bulgaria and Romania. This result should not be surprising given the variables that make up this indicator which mostly refer to young, three- and five-year-old enterprises. Regardless of the place in the ranking, all countries and years show low values of development, far from unity. This means that none of the countries is a development benchmark in terms of entrepreneurship rate. Subsequent years, however, show higher values of the development measure compared to the previous year which leads

to the conclusion that the entrepreneurship in the countries was increasing in the subsequent years of the period 2012-2016. Completely different results were obtained for the assessment of the level of logistics performance in selected European Union countries (Table 2).

The highest value of the logistics performance development measure is observed in Germany and Netherlands. The high value of the development measure (close to unity) indicates that these countries may constitute a development benchmark. The fact that the economically developed countries take top positions in the logistics performance ranking shows that a stable economy supports the growth of logistics performance. Similarly to the entrepreneurship rate ranking, the values of the development measure increase in the subsequent years in relation to the previous year, which proves the continuous improvement in logistics performance. In order to investigate whether there is a relationship between the level of entrepreneurial rate and logistics performance, the Spearman rank correlation coefficient was estimated. The results are shown in Table 3.

The analysis of the values of the Spearman rank correlation coefficient leads to the conclusion that a statistically significant relationship is observed only between the development measure for the entrepreneurship rate and the logistics performance in 2014. However, this dependence is negative, which means that with the growth of the logistics performance the entrepreneurship rate decreases. Based on the research, it can be stated that logistics performance does not translate into the development of entrepreneurship measured by the entrepreneurship rate. There is, however, stability in the level of entrepreneurship rate and logistics performance in particular years, as evidenced by statistically significant Spearman correlation coefficients between the distinguished variables in subsequent years. In order to check whether the selected EU countries show an increase in the level of entrepreneurship rate and logistics performance, the values of individual variables from 2014 and 2016 were compared with their level in 2012 and 2014 respectively. The measurement was carried out for the same countries, i.e. for the same element of the population. The results of the analysis with the use of the sign and Wilcoxon test are presented in Table 4 (with the consideration of variables expressed by the

Table 4: Sign test and Wilcoxon test for development measures of entrepreneurship rate and logistics performance

A pair of variables	Sign test			Wilcoxon test		
	v<V	Z'	p value*	T	Z	p value
EI_2014 & EI_2012	10.0	3.354102	0.000796	3.000000	3.807932	0.000140
EI_2016 & EI_2014	5.0	3.801316	0.000144	1.000000	3.882598	0.000103
LPI_2014 & LPI_2012	75.0	2.012461	0.044171	55.00000	1.866633	0.061954
LPI_2016 & LPI_2014	40.0	0.670820	0.502335	54.00000	1.903966	0.056915

v<V – percent of the number of variables for which the difference is negative, Z' – critical value of sign test, p – p-value for the tests; T – critical value of Wilcoxon test for group size n≤25, Z – critical value of Wilcoxon test for group size n>25. *If the test probability (p-value) is lower than the set significance level, the null hypothesis should be rejected.

Table 5: Sign test and Wilcoxon test for ranking of entrepreneurship rate and logistics performance

A pair of variables	Sign test			Wilcoxon test		
	v<V	Z'	p value*	T	Z	p value
EI_2014 & EI_2012	41.66667	0.288675	0.772830	39.00000	0.00	1.000000
EI_2016 & EI_2014	71.42857	1.336306	0.181449	46.00000	0.408047	0.683239
LPI_2014 & LPI_2012	56.25000	0.250000	0.802587	57.00000	0.568796	0.569495
LPI_2016 & LPI_2014	41.17647	0.485071	0.627626	71.00000	0.260360	0.794587

EI – entrepreneurship index, LPI – logistics performance index

v<V – percent of the number of variables for which the difference is negative, Z' – critical value of sign test, p – p-value for the tests. T – Critical value of Wilcoxon test for group size n≤25, Z – critical value of Wilcoxon test for group size n>25. *If the test probability (p-value) is lower than the set significance level, the null hypothesis should be rejected.

synthetic measure of development).

According to the results of the test, only entrepreneurship rate shows an increase in its level in 2014 compared to 2012 and in 2016 compared to 2014. This means an increase in the measure of development in the European Union countries selected for the analysis, and thus one can speak of increased effects comprising the entrepreneurship rate. When it comes to logistics performance an increase in the level of effects on the basis of which a synthetic measure was set for it was observed only in 2014 in relation to 2012. This increase was not observed for the selected group of countries in 2016 in relation to 2014. The lack of significant differences in the level of synthetic measure of development for logistics performance results from the fact that the countries selected for the analysis had already reached very high levels of factors comprising logistics performance. Although one can speak of statistically significant differences in the level of development measures of entrepreneurship rate and logistics performance in the analyzed years, these differences do not appear in the rankings of countries based on the measure of development (Table 5).

This means that the positions that individual countries occupy in the rankings in the analyzed years are stable and the level of entrepreneurship rate and logistics performance measured by the measure of development is increasing. The increase, however, is observed in all analyzed countries and has no impact on their positions in the ranking.

CONCLUSION

The changes taking place on the market point to the need for interpenetration of productivity and entrepreneurship and the need to consider them jointly. It seems that high productivity should be conducive to the development of entrepreneurship. Entrepreneurship and logistics performance ensure success not only for the enterprises themselves but also for the regions, creating appropriate development conditions for enterprises. Understanding logistics performance and entrepreneurship as complementary issues encourages research to assess the relationships between these two phenomena. However, finding the method of measuring performance and entrepreneurship is a difficult task due to their multidimensionality. The synthetic measures of logistics performance and entrepreneurship proposed in the article were referred to the understanding of these categories most popular in the literature. The analyses carried out allowed to formulate the following conclusions: 1) The high level of performance is observed for highly developed countries, while the development measure for entrepreneurship rate is the highest for developing countries; 2) Negative dependencies between the logistics performance and the entrepreneurship rate are observed, but only for one of the analyzed years. Logistics performance, therefore, does not translate into entrepreneurship development measured by the entrepreneurship rate. There is, however, stability in the level of entrepreneurship rate and logistics performance in individual years; 3) There is an increase in the measure of development for entrepreneurship rate in the European Union countries selected for the analysis, and thus one can speak of increased effects comprising the level of entrepreneurship rate; 4) There are no significant differences in the level of synthetic measure of development for logistics performance which results from the achievement of very high levels of factors in the logistics of the analysed countries. The mutual interpenetration of logistics performance and entrepreneurship indicates the need to consider them jointly. Seeing logistics performance and entrepreneurship as mutually complementary prompts research into their mutual influence. It is important, however, to determine the way of measuring entrepreneurship and logistics performance, which is a difficult task due to the multidimensionality of both phenomena. The measures of entrepreneurship and logistics performance proposed in the article were compared with the most common understanding of these categories found in the literature. The spatial layout of the research made it possible to identify the relationship between the logistics performance and the entrepreneurship rate for individual countries. Future research should focus on the impact of logistics performance on the development of enterprises and their financial and economic results.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

d_0	Distance between the pattern and anti-pattern of development
d_i	Difference between ranks assigned to individual variables
d_{i0}	Euclidian distances of individual objects from the benchmark
EI	Entrepreneurship index
LPI	Logistics performance index
m	Number of variables
m_i	Measure of development for the *i* country
n	Number of countries
r_s	Spearman rank correlation coefficient
s_j	Standard deviation of variable X_j
T	Critical value of Wilcoxon test for group size n≤25
$v<V$	Percent of the number of variables for which the difference is negative
$\overline{x}_j$	Arithmetic average of variable X_j
Z	Critical value of Wilcoxon test for group size n>25
Z'	Critical value of sign test, p – p-value for the tests
z_{ij}	Standardized value of variable X_j
z_{0j}	Benchmark
z_{-0j}	Anti-benchmark

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AUTHOR (S) BIOSKETCHES

Mesjasz-Lech, A., Ph.D., Associate Professor, Faculty of Management, Czestochowa University of Technology, Częstochowa, Poland. Email: *agata.mesjasz-lech@wz.pcz.pl*

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