VERSLAS: TEORIJA IR PRAKTIKA / BUSINESS: THEORY AND PRACTICE
ISSN 1648-0627 / EISSN 1822-4202
http://btp.press.vgtu.lt
2017 18: 1–13
https://doi.org/10.3846/btp.2017.001

AN EMPIRICAL ANALYSIS ON LOGISTICS PERFORMANCE AND THE GLOBAL COMPETITIVENESS

Turkay YILDIZ[1]

[1]*Izmir Yuksek Teknoloji Enstitusu, Gulbahce kampusu, 35430 Urla, Izmir, Turkey*
E-mail: [1]*turkayyildiz@iyte.edu.tr*

Received 02 September 2015; accepted 21 October 2016

Abstract. Logistics has been identified as an area to build cost and service advantages. Therefore, companies are more focused on customer needs and trying to find ways to reduce costs, improve quality and meet the growing expectations of their clients. Indeed, the global competition has led managers to begin to address the issue of providing more efficient logistics services. In this regard, this paper presents an empirical study on logistics performance and global competitiveness. This paper also identifies the associations between logistics performances and global competitiveness. The results indicate that some variables in global competitiveness scores contribute much higher to the logistics performances than the other variables through analysis. The variables that contribute much higher than the other variables to the logistics performances are shown.

Keywords: logistics performance, transportation, supply chain, competitiveness, developing countries.

JEL Classification: L91, L98, L25.

Introduction

Supply chains cover multiple continents and include suppliers and customers. They are complex structures, involving sea, air, rail and road movements, and different types of storage needs, as well as the multitude of other related activities. With increasingly fierce competition between companies, companies have focused on providing products and services in a very efficient manner (Yi 2012). To do this, an essential way is to design and coordinate the supply and distribution networks, namely the main issue is the efficient management of the supply chain (Yi 2012). Globalization and fierce competition are among the factors that led managers begin to consider the question of providing more efficient logistics services. The complex and changing environment, the demand for diversified markets require companies to engage in this competition (Yi 2012). With the challenges of global competition, business enterprises are more focused on customer needs and finding ways to reduce costs, improving quality and meeting the growing expectations of their customers (Lai and Cheng 2009). For this purpose, many of them have found the logistics as the area for reducing the costs and improving services efficiency (Lai and Cheng 2009).

The current research was undertaken to address the issue of how logistics performances and global competitiveness relate to each other. Are there any significant relationships between logistics performance score and global competitiveness? Which pillars of global competitiveness highly correlate with the logistics performances? Based on the income levels of group of countries, are there any significant changes in the mean values of global competitiveness over the seven-year period? Which pillars of global competitiveness are showing significant differences?

The remainder of this paper is organized as follows. Section 1 reviews the literature on logistics. Section 2 introduces the data and methods used for the analyses by using various measures drawn from the World Bank (2016) and World Economic Forum (WEF)'s (2016) Global Competitiveness Index (GCI) database. It investigates the

To link to this article: https://doi.org/10.3846/btp.2017.001

associations between logistics performance indicators and WEF's GCI scores. Section 3 presents and discusses the empirical findings. The paper is concluded in the last Section.

1. Literature review

Studies of logistics, business and transport performance in relation to the competitiveness have been made by many researchers. Current research reflects the increasing amount of international literature in this area based on different viewpoints. For example, Puertas et al. (2014) investigated the European experience of logistics performance and export competitiveness. Feng and Notteboom (2013) studied the peripheral challenge by small and medium sized ports in multi-port gateway regions in the northeast of China. Alexis et al. (2010) performed the measurement of logistics performance of the autonomous port of Cotonou in Berlin. Wong et al. (2014) assessed a cross-border logistics policy using a performance-measurement-system framework in Hong Kong and the Pearl River Delta region.

Li (2011) studied the effective management of the cost and the time of logistics quick response. Li et al. (2008) studied the systematic view of the logistics quick response factors and the importance sequence in China. Green et al. (2008) researched the impact of logistics performance on organizational performance in a supply chain context. Li and Hanafi (2013) investigated the eco-performance of logistics services in food supply chains. Bulis and Skapars (2013) investigated the development of international freight transit in Latvia. Trupac (2008) researched competitiveness of Slovenia and its companies through the Slovenian transport logistics cluster. Dylewski and Filipiak (2013) examined the types of information used in shaping competitiveness of logistics companies in Poland, Germany and Belorussia. da Silva et al. (2013) characterized the logistics performance of dairy industries located at Zona da Mata and Campo das Vertentes in Brazil. Qiu et al. (2007) researched logistics performance evaluation based on factor analysis and fuzzy comprehensive evaluation model. Liu J. J. et al. (2008) studied performance improvements of third-party logistics providers and applied an integrated approach with a logistics information system. Li and Xiao (2013) applied grey relational analysis method for urban logistics. Liu X. L. et al. (2008) performed an empirical study on port logistics competitiveness based on FCE-AHP. Berrisch et al. (2012) performed an analysis of the logistics performance measurement with Data Envelopment Analysis. Ye et al. (2006) studied logistics performance measurement of third parties based on BSC and SCOR model.

Dinu and Curea (2008) analyzed competitiveness in logistics. Brown (2008) studied logistics costs and competitiveness. Lei et al. (2007) researched trade competitiveness and logistics challenges in Asia. Liu et al. (2013) investigated global impacts of the Asian logistics competitiveness and risk management. Liu (2011) investigated the competitiveness of logistics service providers by examining cross-national management practices in China and the UK. Spillan et al. (2013) performed a comparison of the effect of logistic strategy and logistics integration on firm competitiveness in the USA and China. Liu et al. (2010) examined the contribution of capabilities to the competitiveness of logistics service providers and presented a perspective from China. Han et al. (2013) evaluated western China's city logistics competitiveness. Huang et al. (2008) explored the coupling relationship between Beijing logistics development and urban competitiveness upgrade. Yun and Li (2011) explored the cultivation of job-hunting competitiveness of students in logistics department. Huang et al. (2013) researched the evaluation of regional logistics competitiveness. Sheng (2014) researched the evaluation of regional logistics competitiveness of agricultural products in China and spatial analysis on the differences. Li (2008) performed combinational evaluation on the competitiveness of logistics enterprise. Liu et al. (2014) examined the contents and evolution of the composing factors of logistics enterprise competitiveness. Zhang et al. (2010) studied evaluation of the competitiveness of logistics enterprise based on niche. Yang et al. (2008) presented a study on multidimensional diagnosis model of logistics enterprise's quality competitiveness. Piasecka-Gluszak (2013) studied the use of selected management methods in logistics provided to improve the competitiveness of Polish enterprises on the international scene. Zhen (2008) examined the method to improve enterprise core competitiveness. Ding et al. (2013) studied the analysis and prediction of logistics enterprise competitiveness by using a real GA-based support vector machine.

Zu and Hai (2008) performed studies on developing regional logistics industry to promote regional economic competitiveness. Du et al. (2008) performed an empirical study on regional logistics industry's competitiveness based on factor analysis. Du and Yan (2009) presented an empirical study on the competitiveness of logistics industry in china's middle region. Zhu (2006) explored logistics impact competitiveness between industry clusters. Basile (2012) evaluated effectiveness of airport logistics system as a driver of firm's competitiveness and presented empirical evidence for peripheral areas. Chen (2013) studied the competitiveness of aviation logistics industry. Peng and Zhan (2011) studied the evaluation of airport logistics competitiveness based on AHP. Alarcon et al. (2012) presented a theoretical approach and some application in the central region of Mexico on logistics competitiveness in a megapolitan network of cities. Li and Che (2013) evaluated competitiveness of urban logistics using fuzzy logic. Lim et al. (2012) presented studies on competitiveness securing plan for port logistics industry in Busan area using Analytic Hierarchy

Process (AHP). Liu (2012) applied fuzzy theory and AHP to port urban logistics competitiveness evaluation. Fan (2009) applied fuzzy theory and AHP to port logistics competitiveness evaluation. Mihi-Ramirez and Morales (2011) studied improving competitiveness trough creation of knowledge and reverse logistics. Andrade et al. (2014) reviewed the relationship between reverse logistics and competitiveness. Liu and Sun (2010) researched enhancing the competitiveness model of railway transport in the perspective of environmental logistics. Peng (2011) studied the evaluation on the competitiveness of logistics outsourcing in four cities in Yangtze River Delta. Wang and Yu (2008) evaluated the competitiveness of port logistics industry in Yangtze River Delta using hierarchical fuzzy process.

Based on the foregoing, the present study adds another dimension to the existing literature. In this regard, by using advanced statistical methods, this study contributes to a better understanding for policymakers. Specifically, it differs from previous works in that it investigates statistically significant relationships for logistics performance among the various global competitiveness pillars of developing and developed countries.

2. Data and methods

In this study, two main types of data sources are used, all of which are drawn from the World Bank and World Economic Forum (WEF)'s Global Competitiveness Index (GCI) database. First data are about the perceptions of countries' logistics efficiencies. Second data are about the pillars from the GCI.

The Logistics Performance Index (LPI) of the World Bank, which measures six aspects of the environment of logistics including transportation services, identifies areas where improvements are most needed (World Bank 2011). The composite LPI summarizes areas of performance. In brief, these variables are: CUST stands for the customs clearance process, INFR is the quality of trade and transport-related infrastructure, ITRN is the ease of arranging competitively priced shipments, LOGS is the quality of logistics services, TRAC is the ability to track and trace consignments, TIME is the frequency with which shipments reach the consignee within the scheduled time and OVRL is the overall logistics performance.

The WEF's GCI measures national competitiveness using a complex methodology involving raw data and executive opinions. The index rests on 12 pillars categorized in three groups, namely: *Basic requirements* (four pillars), *Efficiency enhancers* (six pillars) and *Innovation and sophistication factors* (two pillars). Countries are rated on a seven-point scale. Higher score indicates more competitiveness. These pillars are *A. Basic requirements:* 1 – Institutions, 2 – Infrastructure, 3 – Macroeconomic stability, 4 – Health and primary education. *B. Efficiency enhancers:* 5 – Higher education and training, 6 – Goods market efficiency, 7 – Labor market efficiency, 8 – Financial market sophistication, 9 – Technological readiness, 10 – Market size *C. Innovation and sophistication factors:* 11 – Business sophistication, 12 – Innovation.

This section next investigates correlations among these indicators and applies the appropriate procedures in the next subsections that are designed to explore and to retrieve the associations between logistics performances and global competitiveness.

2.1. Comparison of mean values of global competitiveness

Firstly, this procedure compares two samples of data. It calculates various statistics for each sample and runs several tests to determine whether there are any statistically significant differences between them. In this procedure, of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the samples come from normal distributions. Samples pass normality tests. In this case, variables seem to have standardized skewness values inside the normal range. Therefore, a test to compare means and therefore ascertain statistical significance is appropriate. Therefore, t-test is suitable for comparing mean values of two samples. For more details, see Tables in the Appendix section.

Secondly, a procedure is designed to compare two samples of data and runs a t-test to compare the means of the two samples. Statistically significant differences are highlighted in Table 1 between the means of the two samples at the 95% confidence level. Groups of countries are labeled as high-income countries (HIC), upper middle-income countries (UMC), lower middle-income countries (LMC), and low-income countries (LIC) (See for country classifications: The World Bank 2016).

In Table 1, the null hypothesis is mean value of GCI (2006–2007) equals mean of GCI (2013–2014). The alternative hypothesis is the mean values of GCI (2006–2007) not equal the mean value of GCI (2013–2014).

2.2. Structural equation modelling

Structural equation modeling (SEM) is a sophisticated and complex statistical procedure that can be used to perform both a confirmatory factor and a path analysis of quantitative variables (Cramer and Howitt 2004). It allows the determination of the statistical fit of the models showing the relationship between the variables (Cramer and Howitt 2004). Structural equation modeling allows us to look with more complexity than traditional modeling techniques or more levels (Muijs 2004) models. In this section, SEM analysis investigates the relationships between pillars of GCI

Table 1. Comparison of means. Statistically significant differences are highlighted (2014)

GCI's Pillars	HIC		UMC		LMC		LIC	
	Mean diff.	P	Mean diff.	P	Mean diff.	P	Mean diff.	P
Subindex A: Basic requirements	0.06	0.17	–0.05	0.45	–0.17	0.04	–0.15	0.01
1st pillar: Institutions	0.10	0.12	–0.14	0.07	–0.20	0.03	–0.02	0.84
1.A. Public institutions	0.04	0.55	–0.20	0.03	–0.26	0.01	–0.08	0.43
1.B. Private institutions	0.27	0.00	0.04	0.48	–0.03	0.70	0.18	0.07
2nd pillar: Infrastructure	–0.37	0.00	–0.51	0.00	–0.69	0.00	–0.31	0.00
3rd pillar: Macroeconomic environment	0.39	0.00	0.13	0.34	–0.01	0.95	–0.17	0.34
4th pillar: Health and primary education	0.10	0.03	0.32	0.00	0.23	0.02	–0.09	0.56
4.A. Health	0.02	0.03	–0.10	0.04	–0.10	0.10	–0.33	0.02
4.B. Primary education	0.18	0.05	0.73	0.00	0.56	0.01	0.16	0.52
Subindex B: Efficiency enhancers	0.00	0.92	–0.18	0.00	–0.25	0.00	–0.06	0.18
5th pillar: Higher education and training	–0.16	0.00	–0.31	0.00	–0.36	0.00	–0.12	0.08
5.A. Quantity of education	–0.44	0.00	–0.43	0.00	0.02	0.90	0.56	0.00
5.B. Quality of education	–0.03	0.71	–0.17	0.04	–0.45	0.00	–0.37	0.00
5.C. On-the-job training	–0.02	0.82	–0.32	0.00	–0.64	0.00	–0.54	0.00
6th pillar: Goods market efficiency	0.19	0.00	–0.09	0.15	–0.33	0.00	–0.24	0.00
6.A. Competition	–0.04	0.41	–0.24	0.00	–0.42	0.00	–0.32	0.00
6.B. Quality of demand conditions	–0.15	0.26	0.20	0.00	–0.15	0.26	–0.08	0.25
7th pillar: Labor market efficiency	–0.10	0.13	0.03	0.63	–0.10	0.13	0.03	0.65
7.A. Flexibility	0.14	0.14	0.11	0.19	0.14	0.14	0.22	0.04
7.B. Efficient use of talent	–0.35	0.00	–0.05	0.46	–0.35	0.00	–0.16	0.24
8th pillar: Financial market development	–0.11	0.19	–0.04	0.65	–0.11	0.19	0.07	0.55
8.A. Efficiency	–0.24	0.03	0.06	0.45	–0.24	0.03	–0.05	0.61
8.B. Trustworthiness and confidence	0.02	0.90	–0.13	0.33	0.02	0.90	0.20	0.32
9th pillar: Technological readiness	–0.66	0.00	–0.72	0.00	–0.66	0.00	–0.43	0.00
10th pillar: Market size	0.06	0.47	0.04	0.27	0.06	0.47	0.29	0.00
10.A. Domestic market size	0.34	0.00	0.27	0.00	0.34	0.00	0.64	0.00
10.B. Foreign market size	–0.77	0.00	–0.65	0.00	–0.77	0.00	–0.77	0.00
Subindex C: Innovation and sophistication	–0.25	0.00	–0.04	0.36	–0.25	0.00	–0.11	0.07
11th pillar: Business sophistication	–0.28	0.00	–0.03	0.42	–0.28	0.00	–0.15	0.02
12th pillar: Innovation	–0.22	0.01	–0.05	0.38	–0.22	0.01	–0.07	0.28
Overall Global Competitiveness Index	–0.14	0.02	–0.06	0.16	–0.14	0.02	–0.12	0.00

and logistics performance variables. Maximum Likelihood (ML) estimation is used for both analyses, which is suitable for low sample sizes.

The significant relationships between the pillars of global competitiveness index and logistics performance are shown in Figure 1 and Table 2.

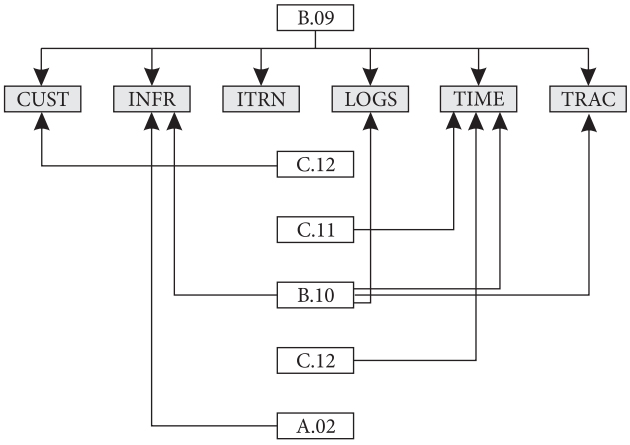

Fig. 1. The significant relationships – GCI vs. LPI (2014)

Table 2. Model Estimates – (SEM Data analysis: Covariance)

Indicator	Parameter Estimate	Standard Error	T Statistic	Prob. Level
B.09 → CUST	–0.292	0.065	–4.502	0.000
C.12 → CUST	0.141	0.063	2.239	0.025
A.02 → INFR	–0.157	0.063	–2.489	0.013
B.09 → INFR	–0.316	0.065	–4.840	0.000
B.10 → INFR	0.191	0.063	3.013	0.003
B.09 → ITRN	–0.208	0.064	–3.274	0.001
B.09 → LOGS	–0.281	0.065	–4.351	0.000
B.10 → LOGS	0.195	0.063	3.067	0.002
B.09 → TIME	–0.388	0.067	–5.808	0.000
B.10 → TIME	0.210	0.064	3.305	0.001
C.11 → TIME	–0.195	0.063	–3.079	0.002
C.12 → TIME	0.225	0.064	3.531	0.000
B.09 → TRAC	–0.252	0.064	–3.931	0.000
B.10 → TRAC	0.221	0.064	3.467	0.001

3. Research findings and highlighted discussions

Statistically significant differences are shown in Table 1 between the means of the two income groups. The comparison has been performed between the mean values of global competitiveness in year 2006–2007 and in years 2013–2014. Overall global competitiveness appears to increase in low and lower middle-income countries. In addition, there is a statistically significant increase in upper and high-income countries. On the other hand, the increase in upper middle-income countries is not statistically significant (See Table 1).

Developing countries have a worse than developed logistics infrastructure, according to the Logistics Performance Index (LPI), a survey based established and monitored by the World Bank index. See Figure 2.

Trade is an important engine of economic growth and development: integration into global markets allows producers to specialize and reap the benefits of economies of scale (McLinden et al. 2010). Seaport gateways and corridors that connect the widely dispersed hinterland are of vital importance and essential for international trade and the global economy (Hall et al. 2011). No economy can survive without trade and investment in fixed infrastructure prominently in the economic stimulus plans of countries around the world (Hall et al. 2011). At the same time, there will surely be a huge opportunity cost to pay to invest in or trade corridor wrong lane, or to invest in the wrong direction, especially if it locks in a suboptimal way or dependent on the development (Hall et al. 2011).

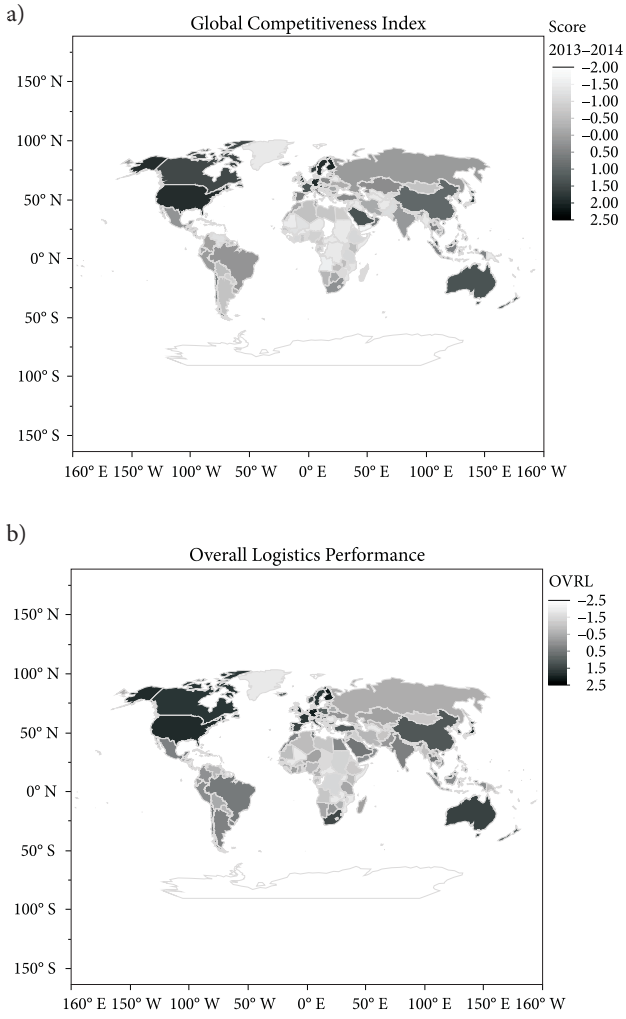

Fig. 2. In each figure, countries with darker grays indicate good performance; countries with lighter grays are not good performing countries. White regions/countries: unavailable data. (a) Global Competitiveness Index, (b) Overall Logistics Performance

Research shows that improving logistics performance in low-income countries the average middle income can boost trade by 15 percent or more (Fardoust et al. 2010). In support of trade facilitation, aid for trade should be extended significantly (Fardoust et al. 2010). Public-private partnerships can make resources go further based on the dynamism of the private sector in trade capacity building (Fardoust et al. 2010). Taking the agenda of competitiveness, governments will play an increasingly active attempt to overcome transport, trade facilitation, and logistical constraints (Canuto et al. 2010). This will start by setting up the hardware and software infrastructure to facilitate the movement of goods (Canuto et al. 2010). Infrastructure improvements primarily affect direct transport costs, which are only a fraction of total transport costs faced by any exporter or importer in landlocked countries, their impact can be further diluted if one takes a broader view wide logistics costs by integrating overhead and the efficiency of the supply chain (Arvis et al. 2010). Services play a large and strategic role in the economy (Saez 2010). Low-cost, high quality services generate benefits for the economy (Saez 2010). Financial services, telecommunications and transport services allow a more efficient allocation of resources, are an input into the production of goods and other services, and, through them, contribute to economic growth and development countries (Saez 2010).

Since the 1990s, the path of commercial transactions and the economic environment has changed dramatically, and the development of technology and the outbreak of the formation of the world market have significantly changed the way of competition (Yi 2012). We are now entering a new era, the era of knowledge-based (Yi 2012) economy. The knowledge-based economy as a new economic form, compared to the traditional industry-based economy refers to an economy based on the production, distribution and use of knowledge in heart (Yi 2012). In parallel, global-trade negotiations have progressively raised the issue of trade facilitation as an essential element of economic development in poor countries (Raballand et al. 2012). Emphasis was placed on the simplification and transparency of border crossing procedures, and extensive programs have been undertaken to modernize customs administrations (Raballand et al. 2012).

The logistics performance is positively impacted by the management strategy of the supply chain and a direct impact on marketing performance, which in turn influences the financial performance (Green et al. 2008). These results confirm the positive relationship between logistics performance and organizational performance in the manufacturing sector (Green et al. 2008). Logistics management in the export/import is essential because shipping costs and shipping efficiency determine the competitiveness bottom line transaction (Cook et al. 2012). An efficient transport system can be achieved through an efficient use of transport modes, terminals, warehouses and all other resources, it also requires understanding and availability of options and alternatives and freight support and logistics service selection decisions (Islam et al. 2013). Compared to the vast empirical literature on policies affecting trade in goods, the empirical analysis of trade policy for services still in its infancy (Borchert et al. 2014). A major constraint was the lack of data on policies affecting trade in services, especially in developing countries (Borchert et al. 2014).

Indeed, the Organization for Economic Cooperation and Development (OECD 1992) defined national competitiveness as "*the degree to which a country can, under free and fair market conditions, produce goods and services which meet the rest of the international markets, while simultaneously maintaining and expanding the real incomes of its people over the long term*". This implies that the competitiveness is necessary because it holds the key to sustain economic prosperity, jobs and a higher standard of living (Lee 2002). On the other hand, the logistics performance has recently received much attention in the context of benchmarking initiatives globally to assess the ease of doing business in different countries, and efficiency of logistics and transportation services.

Conclusions

In this paper, an empirical study on the relationship between indicators of logistics performance and GCI variables was performed. This paper identified the relationships between indicators of logistics performance and GCI scores. Statistically significant differences are demonstrated. Tables show the relationships between the global competitiveness index and the logistics performance variables. Tables and Figures showed that some pillars are significantly related to some of the logistics performance variables. Some of the global competitiveness pillars significantly affect some of logistics variables. As evidenced by the analysis, some variables in GCI indicators highly contribute to overall logistics performance.

Logistics performance depends on many factors, as supply chains are complex systems with complex processes, such as services in business, regulations, investment climate, perceptions of enterprises and policymakers. Supply chain organizations are challenged to improve efficiency in the face of increasing complexity and competition in a global scale. Thus, it became necessary to determine the relationship and recognize the relevant indicators that contribute to high logistics performance. This article presented an empirical study on the relationship between indicators of logistics performance and global competitiveness indicators and defined the association between the indicators of logistics performance and those of global competitiveness. The results show that some of the variables in the global

competitiveness indicators data are correlated with the efficiency of logistics and that some variables in the global competitiveness indicators data contribute much higher to logistics performance than other variables via the canonical correlation analysis. The variables that contribute significantly higher than other variables in logistic performances have been shown.

Finally, it is essential for policymakers in the logistics field to take account of those variables that have higher contributions. By taking into the consideration of GCI indicators, the main areas for improvement of the logistics performances include focusing more on the highly contributing indicators to significantly improve outcomes.

References

Alarcon R, Antun JP, Lozano A (2012) Logistics competitiveness in a megapolitan network of cities: a theoretical approach and some application in the Central Region of Mexico. Procedia – Social and Behavioral Sciences 39: 739–752. https://doi.org/10.1016/j.sbspro.2012.03.144

Alexis A, Nie GH, Liu PF (2010) Measuring logistics performance of the Autonomous Port of Cotonou in Benin. In: 7th International Conference on Innovation and Management, Wuhan (China), 4–5 December 2010.

Andrade RP, Lucato WC, Vanalle RM, Vieira M (2014) Review of the relationship between reverse logistics and competitiveness. Advanced Materials Research 845: 614–617. https://doi.org/10.4028/www.scientific.net/AMR.845.614

Arvis JF, Marteau JF, Raballand G (2010) Directions in development: cost of being landlocked: logistics costs and supply chain reliability. World Bank Publications, Herndon, VA, USA. https://doi.org/10.1596/978-0-8213-8408-4

Basile A (2012) Evaluating effectiveness of airport logistics system as a driver of firm's competitiveness: empirical evidence for peripheral areas. Transformations in Business & Economics 11 (3): 90–108. https://doi.org/10.5897/ajbm12.193

Berrisch A, Klumpp M, Celebi D (2012) Logistics performance measurement with Data Envelopment Analysis (DEA). Eurosis, Ghent.

Borchert I, Gootiiz B, Mattoo A (2014) Policy barriers to international trade in services: evidence from a New Database. The World Bank Economic Review 28 (1): 162–188. https://doi.org/10.1093/wber/lht017

Brown T (2008) Logistics costs and competitiveness. Chemical Engineering Progress 104 (12): 4–4.

Bulis A, Skapars R (2013) Development of international freight transit in Latvia. Procedia – Social and Behavioral Sciences 99: 57–64. https://doi.org/10.1016/j.sbspro.2013.10.471

Canuto O, Giugale MM (Eds) (2010) The day after tomorrow: a handbook on the future of economic policy in the developing world. World Bank Publications, Herndon, VA, USA, 464 pp. https://doi.org/10.1596/978-0-8213-8498-5

Chen G (2013) On the competitiveness of aviation logistics industry. In: 2013 Fourth International Conference on Education and Sports Education (ESE 2013), Hong Kong, 11–12 April 2013, 139–143.

Cook TA, Alston R, Raia K (2012) Mastering Import and export management. 2nd ed. AMACOM Books, Saranac Lake, NY, USA.

Cramer D, Howitt DL (2004) SAGE Dictionary of Statistics: a Practical Resource for Students in the Social Sciences. SAGE Publications Inc., London, GBR.

da Silva AN, de Lima JE, Perez R (2013) Characterization and logistics performance of dairy industries located at Zona da Mata and Campo das Vertentes in Minas Gerais, Brazil, Ciencia Rural 43 (7): 1337–1343. https://doi.org/10.1590/S0103-84782013005000078

Ding N, Li HQ, Wang HQ (2013) Analysis and prediction of logistics enterprise competitiveness by using a real GA-Based Support Vector Machine. In: Zhang Z, Shang R, Zhang J (Eds). LISS 2012: Proceedings of 2nd Conference on Logistics, Informatics and Service Science. Springer Berlin Heidelberg, 267–272. https://doi.org/10.1007/978-3-642-32054-5_40

Dinu E, Curea C (2008) Analysis and competitiveness in logistics. Amfiteatru Economic 10 (24): 59–69.

Du XF, Yan XF (2009) Empirical study on the competitiveness of logistics industry in China's Middle Region. IEEE Computer Soc., Los Alamitos.

Du XF, Yan X, Soc IC (2008) Empirical study on regional logistics industry's competitiveness based on factor analysis. IEEE Computer Soc., Los Alamitos.

Dylewski M, Filipiak B (2013) Types of information used in shaping competitiveness of logistics companies in Poland, Germany and Belorussia – study results. Aktualne Problemy Podnikovej Sfery 2013, 102–108.

Fan XQ (2009) Fuzzy theory and AHP applied to port logistics competitiveness evaluation. In: EBISS '09 International Conference on E-Business and Information System Security, Wuhan (China), 23–24 May 2009. https://doi.org/10.1109/EBISS.2009.5137986

Fardoust S, Kim Y, Sepulveda CP (Eds) (2010) Postcrisis growth and development: a development agenda for the G-20. World Bank Publications, Herndon, VA, USA.

Feng L, Notteboom T (2013) Peripheral challenge by Small and Medium Sized Ports (SMPs) in Multi-Port Gateway Regions: the case study of northeast of China. Polish Maritime Research 20: 55–66. https://doi.org/10.2478/pomr-2013-0027

Green KW Jr, Whitten DR, Inman A (2008) The impact of logistics performance on organizational performance in a supply chain context. Supply Chain Management: an International Journal 13 (4): 317–327. https://doi.org/10.1108/13598540810882206

Hall P, Mccalla RJ, Comtois C, Slack B (Eds) (2011) Integrating seaports and trade corridors (transport and mobility). Ashgate Publishing Group, Farnham, Surrey, GBR.

Han M, Chen C, Han YH, Inc DEP (2013) Evaluation of Western China City Logistics Competitiveness. In: 2013 International Conference on Industrial Engineering and Management Science (ICIEMS 2013), Shanghai (China), 28–29 September 2013, 1259–1264.

Huang JY, Ji SW, Liu Y, Wang XH (2008) Study on coupling relationship between Beijing logistics development and urban competitiveness upgrade. Nanjing Univ Press, Nanjing.

Huang YC, Han YH (2013) Study on the Evaluation of Regional Logistics Competitiveness. In: International Conference on Transportation (ICTR), Xianning (China), 4–6 December 2013.

Islam DMdZ, Zunder TH, Jorna R (2013) Performance evaluation of an online benchmarking tool for European freight transport chains. Benchmarking: an International Journal 20 (2): 233–250.

Lai, K-H, Cheng TCE (2009) Just-in-Time Logistics. Ashgate Publishing Group, Abingdon, Oxon, GBR.

Lee S (Ed) (2002) Creating wealth in the connected economy. Emerald Group Publishing Ltd, Bradford, GBR, 77 pp.

Lei L, Goh M, de Souza R (2007) Trade Competitiveness and Logistics Challenges in Asia. In: Baumgarten H (Ed) Das Beste der Logistic: Innovationen, Strategien, Umsetzungen. Springer Berlin Heidelberg, 353–367.

Li D, Hanafi Z (2013) A study of eco-performane of logistics services in food supply chains. In: LISS 2012: Proceedings of 2nd Conference on Logistics, Informatics and Service Science. Springer Berlin Heidelberg, 223–228. https://doi.org/10.1007/978-3-642-32054-5_33

Li JB (2011) How to effectively manage the cost and the time of logistics quick response. In: Proceedings of the 2011 International Conference on Informatics, Cybernetics, and Computer Engineering, Melbourne (Australia), 19–20 November 2011. https://doi.org/10.1007/978-3-642-25185-6_27

Li JB, Gao Y, Ambaye D (2008) A Systematic View of the Logistics Quick Response Factors and the Importance Sequence in China. In: Proceedings of 2008 IEEE International Conference on Service Operations and Logistics, and Informatics, Beijing (China), 12–15 October 2008. https://doi.org/10.1109/SOLI.2008.4682893

Li JY, Che YQ (2013) Evaluating Competitiveness of urban logistics using fuzzy logic AHP. Applied Mechanics and Materials 357–360: 2688–2691. https://doi.org/10.4028/www.scientific.net/amm.357-360.2688

Li JY, Xiao Q (2013) Grey Relational Analysis Method for Urban Logistics. Applied Mechanics and Materials 321–324: 3065–3068. https://doi.org/10.4028/www.scientific.net/amm.321-324.3065

Li WD (2008) Combinational Evaluation on the Competitiveness of Logistics Enterprise. In: Proceedings of 2008 IEEE International Conference on Service Operations and Logistics, and Informatics, Beijing (China), 12–15 October 2008. https://doi.org/10.1109/SOLI.2008.4683024

Lim DS, Kang DW, An YM, Kwak KS, Nam KC (2012) Studies on competitiveness securing plan for port logistics industry in Busan area using Analytic Hierarchy Process (AHP). In: 2nd International Conference on Applied Social Science (ICASS 2012), Kuala Lumpur (Malaysia), 1–2 February 2012, 312–319.

Liu CF, Kao TY, Chang YF, Tsai YR (2013) Global impacts of the Asian logistics competitiveness and risk management. Advanced Materials Research 785–786: 1511–1515. https://doi.org/10.4028/www.scientific.net/amr.785-786.1511

Liu JJ, So SCK, Choy KL, Lau H, Kwok SK (2008) Performance improvement of third-party logistics providers – an integrated approach with a logistics information system. International Journal of Technology Management 42 (3): 226–249. https://doi.org/10.1504/IJTM.2008.018105

Liu WH, Liu BL, Tang O, Chen LJ, Liu XY (2014) An empirical examination of the contents and evolution of the composing factors of logistics enterprise competitiveness: a perspective from China. International Journal of Logistics-Research and Applications 17 (6): 459–484. https://doi.org/10.1080/13675567.2014.913555

Liu XH (2011) Competitiveness of logistics service providers: a cross-national examination of management practices in China and the UK. International Journal of Logistics-Research and Applications 14 (4): 251–269. https://doi.org/10.1080/13675567.2011.636736

Liu XH, Grant DB, McKinnon AC, Feng YH (2010) An empirical examination of the contribution of capabilities to the competitiveness of logistics service providers: a perspective from China. International Journal of Physical Distribution & Logistics Management 40 (10): 847–866. https://doi.org/10.1108/09600031011093232

Liu XL (2012) Fuzzy theory and AHP applied to port urban logistics competitiveness evaluation. Applied Mechanics and Materials 121–126: 2769–2773. https://doi.org/10.4028/www.scientific.net/AMM.121-126.2769

Liu XL, Jiao XL, Ma TS, Society IC (2008) Empirical Study on Port Logistics Competitiveness Based on FCE-AHP. In: 2008 International Conference on Information Management, Innovation Management and Industrial Engineering, Taipei (Taiwan), 19–21 December 2008. https://doi.org/10.1109/ICIII.2008.103

Liu YJ, Sun Y (2010) The researches on enhancing the competitiveness model of railway transport in the perspective of environmental logistics. Donghua Univ Press, Shanghai.

McLinden G, Fanta E, Widdowson D (Eds) (2010) Border management modernization. World Bank Publications, Herndon, VA, USA.

Mihi-Ramirez A, Morales VJG (2011) Improving competitiveness trough creation of knowledge and reverse logistics. Inzinerine Ekonomika-Engineering Economics 22 (4): 443–450. https://doi.org/10.5755/j01.ee.22.4.719

Muijs D (2004) Doing Quantitative Research in Education with SPSS. SAGE Publications Inc. (US), London, GBR, 217 pp. https://doi.org/10.4135/9781849209014

Organisation for Economic Cooperation and Development (OECD) (1992) Programme on Technology and the Economy. Paris, France: OECD.

Peng JL (2011) Evaluation on the competitiveness of logistics outsourcing based on TOPSIS: 4 cities in Yangtze River Delta. Applied Mechanics and Materials 58–60: 7–12. https://doi.org/10.4028/www.scientific.net/AMM.58-60.7

Peng JL, Zhan CX (2011) A case study on evaluation of airport logistics competitiveness based on AHP. Advanced Materials Research 159: 307–312. https://doi.org/10.4028/www.scientific.net/AMR.159.307

Piasecka-Gluszak A (2013) The use of selected management methods in logistics provided to improve the competitiveness of Polish Enterprises on the international scene. Silesian Univ Opava, School Business Administration Karvina, Karvina.

Puertas R, Marti L, Garcia L (2014) Logistics performance and export competitiveness: European experience. Empirica 41 (3): 467–480. https://doi.org/10.1007/s10663-013-9241-z

Qiu XN, Feng YQ, Liu LW (2007) A research on logistics performance evaluation based on factor analysis and fuzzy comprehensive evaluation model. China Architecture & Building Press, Beijing.

Raballand G, Refas S, Beuran M (2012) Directions in development: why does cargo spend weeks in Sub-Saharan African Ports? Lessons from six countries. World Bank Publications, Herndon, VA, USA. https://doi.org/10.1596/978-0-8213-9499-1

Saez S (Ed) (2010) Directions in development: trade in services negotiations: a guide for developing countries. World Bank Publications, Herndon, VA, USA.

Sheng Z (2014) The evaluation of regional logistics competitiveness of agricultural products in China and spatial analysis on the differences. Pakistan Journal of Statistics 30 (5): 683–702.

Spillan JE, McGinnis MA, Kara A, Yi GL (2013) A comparison of the effect of logistic strategy and logistics integration on firm competitiveness in the USA and China. International Journal of Logistics Management 24 (2): 153–179. https://doi.org/10.1108/IJLM-06-2012-0045

Trupac I (2008) More competitiveness for Slovenia and its companies through the Slovenian transport logistics cluster. Promet-Traffic & Transportation 20 (1): 19–30.

Wang CX, Yu ZM (2008) Evaluation of competitiveness of port logistics industry in Yangtze River Delta using hierarchical fuzzy process. Orient Acad Forum, Marrickville.

Wong DWC, Choy KL, Chow HKH, Lin CH (2014) Assessing a cross-border logistics policy using a performance measurement system framework: the case of Hong Kong and the Pearl River Delta region. International Journal of Systems Science 45 (6): 1306–1320. https://doi.org/10.1080/00207721.2012.761468

World Bank (2011) World development indicators: world development indicators 2011. Herndon, VA, USA: World Bank Publications, 355 pp.

World Bank (2016) Bank Country and Lending Groups. http://data.worldbank.org/about/country-classifications

World Economic Forum (2016) Global Competitiveness Index (GCI) https://www.weforum.org/reports

Yang XO, He KT, Huang K (2008) Study on multidimensional diagnosis model of logistics enterprise's quality competitiveness. In: ICSMA 2008: International Conference on Smart Manufacturing Application, Kintex, Gyeonggi-do (Korea), 9–11 April 2008. https://doi.org/10.1109/ICSMA.2008.4505660

Ye Y, Lan XJ, Lu JS, Chen Y (2006) Third-party logistics performance measurement based on BSC and SCOR model. In: International Conference on Industrial Engineering and Engineering Management IEEM, Weihai (China), 12–14 August 2006.

Yi Z (2012) Innovative capability of Chinese enterprises. Singapore, Enrich Professional Publishing, SGP, 2–161.

Yun Z, Li L (2011) On the Cultivation of job-hunting competitiveness of students in logistics department – Chongqing Jiaotong university in case. Int Industrial Electronic Center, Sham Shui Po.

Zhang LR, Li YL, Ma YJ (2010) Evaluation of the competitiveness of logistics enterprise based on Niche. Aussino Acad Publ House, Marrickville.

Zhen X (2008) The method of improve enterprise core competitiveness – based on the technological innovation and take the example of logistics enterprise. Acad Serv Group Ltd, London.

Zhu FL (2006) How logistics impact competitiveness between industry clusters. Orient Acad Forum, Marrickville.

Zu DW, Hai F (2008) Developing regional logistics industry to promote regional economic competitiveness: analysis and suggestions on logistics industry competitiveness of Wuhan City. M D Forum, Allawah Nsw.

APPENDIX

Table A1. Subindex A: Basic requirements

1st pillar: Institutions	**3rd pillar: Macroeconomic environment**
1.A. Public institutions	3.01 Government budget balance, % GDP
1.01 Property rights	3.02 Gross national savings, % GDP
1.02 Intellectual property protection	3.03 Inflation, annual % change
1.03 Diversion of public funds	3.04 General government debt, % GDP
1.04 Public trust in politicians	3.05 Country credit rating, 0–100 (best)
1.05 Irregular payments and bribes	**4th pillar: Health and primary education**
1.06 Judicial independence	4. A. Health
1.07 Favoritism in decisions of government officials	4.01 Business impact of malaria
1.08 Wastefulness of government spending	4.02 Malaria cases/100,000 pop.
1.09 Burden of government regulation	4.03 Business impact of tuberculosis
1.10 Efficiency of legal framework in settling disputes	4.04 Tuberculosis cases/100,000 pop.
1.11 Efficiency of legal framework in challenging regs.	4.05 Business impact of HIV/AIDS
1.12 Transparency of government policymaking	4.06 HIV prevalence, % adult pop.
1.13 Business costs of terrorism	4.07 Infant mortality, deaths/1,000 live births
1.14 Business costs of crime and violence	4.08 Life expectancy, years
1.15 Organized crime	B. Primary education
1.16 Reliability of police services	4.09 Quality of primary education
1.B. Private institutions	4.10 Primary education enrollment, net %
1.17 Ethical behavior of firms	
1.18 Strength of auditing and reporting standards	
1.19 Efficacy of corporate boards	
1.20 Protection of minority shareholders' interests	
1.21 Strength of investor protection, 0–10 (best)	
2nd pillar: Infrastructure	
2.A. Transport infrastructure	
2.01 Quality of overall infrastructure	
2.02 Quality of roads	
2.03 Quality of railroad infrastructure	
2.04 Quality of port infrastructure	
2.05 Quality of air transport infrastructure	
2.06 Available airline seat km/week, millions	
2.B. Electricity and telephony infrastructure	
2.07 Quality of electricity supply	
2.08 Mobile telephone subscriptions/100 pop.	
2.09 Fixed telephone lines/100 pop.	

Table A2. Subindex B: Efficiency enhancers

5th pillar: Higher education and training	**8th pillar: Financial market development**
5.A. Quantity of education	8.A. Efficiency
5.01 Secondary education enrollment, gross	8.01 Availability of financial services
5.02 Tertiary education enrollment, gross %	8.02 Affordability of financial services
5.B. Quality of education	8.03 Financing through local equity market
5.03 Quality of the educational system	8.04 Ease of access to loans
5.04 Quality of math and science education	8.05 Venture capital availability
5.05 Quality of management schools	8.B. Trustworthiness and confidence
5.06 Internet access in schools	8.06 Soundness of banks
5.C. On-the-job training	8.07 Regulation of securities exchanges
5.07 Availability of research and training services	8.08 Legal rights index, 0–10 (best)
5.08 Extent of staff training	**9th pillar: Technological readiness**
6th pillar: Goods market efficiency	9.A. Technological adoption
6.A. Competition	9.01 Availability of latest technologies
6.01 Intensity of local competition	9.02 Firm-level technology absorption
6.02 Extent of market dominance	9.03 FDI and technology transfer
6.03 Effectiveness of anti-monopoly policy	9.B. ICT use
6.04 Effect of taxation on incentives to invest	9.04 Individuals using Internet, %
6.05 Total tax rate, % profits	9.05 Fixed broadband Internet subscriptions/100 pop.
6.06 No. procedures to start a business	9.06 Int'l Internet bandwidth, kb/s per user
6.07 No. days to start a business	9.07 Mobile broadband subscriptions/100 pop.
6.08 Agricultural policy costs	**10th pillar: Market size**
6.09 Prevalence of trade barriers	10.A. Domestic market size
6.10 Trade tariffs, % duty	10.01 Domestic market size index, 1–7 (best)
6.11 Prevalence of foreign ownership	10.B. Foreign market size
6.12 Business impact of rules on FDI	10.02 Foreign market size index, 1–7 (best)
6.13 Burden of customs procedures	10.03 GDP (PPP$ billions)
6.14 Imports as a percentage of GDP	10.04 Exports as a percentage of GDP
6.B. Quality of demand conditions	
6.15 Degree of customer orientation	
6.16 Buyer sophistication	
7th pillar: Labor market efficiency	
7.A. Flexibility	
7.01 Cooperation in labor-employer relations	
7.02 Flexibility of wage determination	
7.03 Hiring and firing practices	
7.04 Redundancy costs, weeks of salary	
7.05 Effect of taxation on incentives to work	
7.B. Efficient use of talent	
7.06 Pay and productivity	
7.07 Reliance on professional management	
7.08 Country capacity to retain talent	
7.09 Country capacity to attract talent	
7.10 Women in labor force, ratio to men	

Table A3. Subindex C: Innovation and sophistication factors

11th pillar: Business sophistication	11.09 Willingness to delegate authority
11.01 Local supplier quantity	**12th pillar: Innovation**
11.02 Local supplier quality	12.01 Capacity for innovation
11.03 State of cluster development	12.02 Quality of scientific research institutions
11.04 Nature of competitive advantage	12.03 Company spending on R&D
11.05 Value chain breadth	12.04 University-industry collaboration in R&D
11.06 Control of international distribution	12.05 Gov't procurement of advanced tech products
11.07 Production process sophistication	12.06 Availability of scientists and engineers
11.08 Extent of marketing	12.07 PCT patents, applications/million pop.

Table A4. 2007 – Normality Test (Shapiro-Wilk)

Indicators	HIC			UMC			LMC			LIC		
	W	P	+/–	W	P	+/–	W	P	+/–	W	P	+/–
Global Competitiveness Index	0.944	0.036	–	0.940	0.066	+	0.986	0.971	+	0.907	0.076	+
Subindex A: Basic requirements	**0.955**	**0.088**	**+**	**0.933**	**0.044**	**–**	**0.986**	**0.975**	**+**	**0.922**	**0.141**	**+**
1st pillar: Institutions	0.964	0.198	+	0.978	0.711	+	0.963	0.485	+	0.943	0.329	+
1.A. Public institutions	0.969	0.294	+	0.981	0.819	+	0.974	0.734	+	0.940	0.295	+
1.B. Private institutions	0.931	0.012	–	0.938	0.061	+	0.967	0.569	+	0.978	0.926	+
2nd pillar: Infrastructure	0.963	0.180	+	0.974	0.588	+	0.956	0.344	+	0.951	0.436	+
3rd pillar: Macroeconomic environment	0.973	0.388	+	0.967	0.396	+	0.889	0.010	–	0.887	0.034	–
4th pillar: Health and primary education	0.983	0.770	+	0.861	< 0.001	–	0.775	< 0.001	–	0.883	0.029	–
4.A. Health	0.860	0.001	–	0.559	< 0.001	–	0.765	< 0.001	–	0.963	0.670	+
4.B. Primary education	0.981	0.696	+	0.980	0.795	+	0.831	0.001	–	0.958	0.555	+
Subindex B: Efficiency enhancers	**0.956**	**0.103**	**+**	**0.978**	**0.721**	**+**	**0.976**	**0.799**	**+**	**0.933**	**0.222**	**+**
5th pillar: Higher education and training	0.946	0.043	–	0.986	0.935	+	0.965	0.512	+	0.893	0.044	–
5.A. Quantity of education	0.967	0.247	+	0.965	0.366	+	0.969	0.624	+	0.809	0.002	–
5.B. Quality of education	0.978	0.563	+	0.961	0.270	+	0.954	0.311	+	0.969	0.777	+
5.C. On-the-job training	0.925	0.008	–	0.970	0.487	+	0.976	0.807	+	0.962	0.648	+
6th pillar: Goods market efficiency	0.951	0.063	+	0.981	0.820	+	0.976	0.789	+	0.931	0.204	+
6.A. Competition	0.988	0.917	+	0.970	0.467	+	0.985	0.965	+	0.900	0.057	+
6.B. Quality of demand conditions	0.881	0.001	–	0.980	0.783	+	0.978	0.837	+	0.973	0.849	+
7th pillar: Labor market efficiency	0.979	0.602	+	0.962	0.303	+	0.974	0.747	+	0.954	0.483	+
7.A. Flexibility	0.973	0.413	+	0.973	0.557	+	0.961	0.430	+	0.986	0.991	+
7.B. Efficient use of talent	0.965	0.216	+	0.969	0.460	+	0.967	0.560	+	0.952	0.449	+
8th pillar: Financial market development	0.978	0.574	+	0.977	0.684	+	0.939	0.139	+	0.974	0.861	+
8.A. Efficiency	0.974	0.441	+	0.964	0.339	+	0.923	0.059	+	0.973	0.849	+
8.B. Trustworthiness and confidence	0.963	0.172	+	0.974	0.603	+	0.970	0.639	+	0.976	0.903	+
9th pillar: Technological readiness	0.931	0.012	–	0.954	0.177	+	0.936	0.122	+	0.958	0.566	+
10th pillar: Market size	0.978	0.576	+	0.949	0.125	+	0.956	0.344	+	0.967	0.733	+
10.A. Domestic market size	0.979	0.599	+	0.947	0.112	+	0.979	0.868	+	0.971	0.813	+
10.B. Foreign market size	0.966	0.232	+	0.952	0.148	+	0.888	0.010	–	0.973	0.847	+
Subindex C: Innovation and sophistication	**0.947**	**0.048**	**–**	**0.957**	**0.206**	**+**	**0.937**	**0.128**	**+**	**0.980**	**0.946**	**+**
11th pillar: Business sophistication	0.936	0.018	–	0.974	0.588	+	0.945	0.198	+	0.933	0.217	+
12th pillar: Innovation	0.957	0.112	+	0.947	0.111	+	0.960	0.405	+	0.965	0.710	+

A test that fails indicates that the data varies significantly from the pattern expected if the data was drawn from a population with a normal distribution. A test that passes indicates that the data matches the pattern expected if the data was drawn from a population with a normal distribution.

Table A5. 2014 – Normality Test (Shapiro-Wilk)

Indicators	HIC			UMC			LMC			LIC		
	W	P	+/–	W	P	+/–	W	P	+/–	W	P	+/–
Global Competitiveness Index	0.950	0.045	–	0.974	0.457	+	0.985	0.911	+	0.973	0.717	+
Subindex A: Basic requirements	**0.970**	**0.262**	**+**	**0.957**	**0.113**	**+**	**0.984**	**0.879**	**+**	**0.967**	**0.569**	**+**
1st pillar: Institutions	0.952	0.053	+	0.983	0.786	+	0.974	0.584	+	0.884	0.008	–
1.A. Public institutions	0.954	0.064	+	0.979	0.611	+	0.975	0.607	+	0.874	0.005	–
1.B. Private institutions	0.951	0.046	–	0.971	0.353	+	0.979	0.750	+	0.959	0.394	+
2nd pillar: Infrastructure	0.976	0.430	+	0.973	0.421	+	0.974	0.594	+	0.936	0.119	+
3rd pillar: Macroeconomic environment	0.973	0.346	+	0.966	0.243	+	0.973	0.563	+	0.984	0.951	+
4th pillar: Health and primary education	0.964	0.160	+	0.837	0.001	–	0.867	0.001	–	0.951	0.262	+
4.A. Health	0.830	0.001	–	0.565	0.001	–	0.795	0.001	–	0.964	0.495	+
4.B. Primary education	0.954	0.065	+	0.949	0.060	+	0.878	0.001	–	0.919	0.049	–
Subindex B: Efficiency enhancers	**0.966**	**0.182**	**+**	**0.974**	**0.441**	**+**	**0.978**	**0.719**	**+**	**0.982**	**0.914**	**+**
5th pillar: Higher education and training	0.986	0.822	+	0.891	0.001	–	0.987	0.953	+	0.953	0.300	+
5.A. Quantity of education	0.937	0.014	–	0.904	0.002	–	0.975	0.602	+	0.656	0.001	–
5.B. Quality of education	0.979	0.535	+	0.970	0.333	+	0.931	0.034	–	0.943	0.177	+
5.C. On-the-job training	0.970	0.263	+	0.973	0.412	+	0.966	0.361	+	0.970	0.640	+
6th pillar: Goods market efficiency	0.966	0.179	+	0.947	0.052	+	0.970	0.467	+	0.979	0.874	+
6.A. Competition	0.984	0.764	+	0.956	0.108	+	0.981	0.798	+	0.983	0.937	+
6.B. Quality of demand conditions	0.972	0.321	+	0.977	0.539	+	0.970	0.463	+	0.975	0.775	+
7th pillar: Labor market efficiency	0.984	0.780	+	0.942	0.033	–	0.954	0.162	+	0.986	0.971	+
7.A. Flexibility	0.977	0.485	+	0.915	0.004	–	0.972	0.507	+	0.910	0.031	–
7.B. Efficient use of talent	0.976	0.434	+	0.953	0.081	+	0.972	0.510	+	0.946	0.199	+
8th pillar: Financial market development	0.978	0.509	+	0.978	0.578	+	0.966	0.355	+	0.986	0.976	+
8.A. Efficiency	0.965	0.171	+	0.967	0.269	+	0.978	0.718	+	0.972	0.707	+
8.B. Trustworthiness and confidence	0.973	0.343	+	0.978	0.569	+	0.969	0.443	+	0.963	0.470	+
9th pillar: Technological readiness	0.935	0.011	–	0.981	0.692	+	0.980	0.769	+	0.978	0.851	+
10th pillar: Market size	0.986	0.853	+	0.990	0.973	+	0.964	0.324	+	0.973	0.723	+
10.A. Domestic market size	0.984	0.762	+	0.989	0.951	+	0.967	0.379	+	0.974	0.735	+
10.B. Foreign market size	0.973	0.347	+	0.988	0.925	+	0.979	0.740	+	0.989	0.994	+
Subindex C: Innovation and sophistication	**0.950**	**0.045**	**–**	**0.969**	**0.305**	**+**	**0.981**	**0.806**	**+**	**0.957**	**0.357**	**+**
11th pillar: Business sophistication	0.961	0.118	+	0.977	0.542	+	0.972	0.532	+	0.952	0.273	+
12th pillar: Innovation	0.959	0.095	+	0.979	0.627	+	0.984	0.878	+	0.965	0.523	+

Turkay YILDIZ received his PhD from the Institute of Marine Sciences and Technology, Dokuz Eylul University, Izmir, Turkey. He has degrees in Electronics, Management, and he received his Master's Degree in Logistics Management from Izmir University of Economics. He has a number of peer reviewed publications and conference presentations at various countries in such fields as transportation, logistics and supply chains. He also has various levels of expertise in the applications of IT.