

Dr inż. Paweł Sobczak
 WSB University
 ORCID: 0000-0003-0995-1737
 e-mail: psobczak@wsb.edu.pl

Assessment of the effectiveness of storage services in Poland in 2006–2015

Ocena efektywności usług magazynowych w Polsce w latach 2006–2015

Abstract

The article presents a statistical analysis of storage services carried out in Poland in 2006–2015. The aim of the article is to assess the level of implementation of these services and attempt to identify the causes of the current state. The analyzes of dynamics and the trend of changes on the warehouse market were compared to the level of GDP in Poland. Statistical methods were used as a research method. The analyzes carried out allowed obtaining information on the current state and efficiency of warehouse services in Poland.

Key words:

Logistics services, warehousing services, condition and level of warehouse services, warehouse efficiency index

Streszczenie

W artykule dokonano analizy statystycznej usług magazynowych realizowanych w Polsce w latach 2006–2015. Celem artykułu jest ocena poziomu realizacji tych usług oraz próba określenia przyczyn obecnego stanu. Przeprowadzone analizy dynamiki oraz trendu zmian na rynku magazynowym przyrównano do poziomu PKB w Polsce. Jako metodę badawczą wykorzystano metody statystyczne. Przeprowadzone analizy pozwoliły na uzyskanie informacji o obecnym stanie i efektywności usług magazynowych w Polsce.

Słowa kluczowe:

Usługi logistyczne, usługi magazynowe, stan i poziom usług magazynowych, wskaźnik efektywności magazynowej

JEL: L81

Introduction

Services are one of the most important elements shaping the Polish and European economy. According to the definition of PKWiU (GUS 2016), services are:

- all activities carried out for the benefit of economic entities conducting production-type activities, i.e. services for production purposes not directly generating new material goods,
- all activities carried out for the benefit of national economy entities and for the benefit of the population, intended for individual, collective and general social consumption.

In European countries, services have a dominant role in the value added generated in the national economy.

According to GUS data from 2017 and Eurostat, gross value added obtained in services in Poland constituted as much as 63.9% of the total.

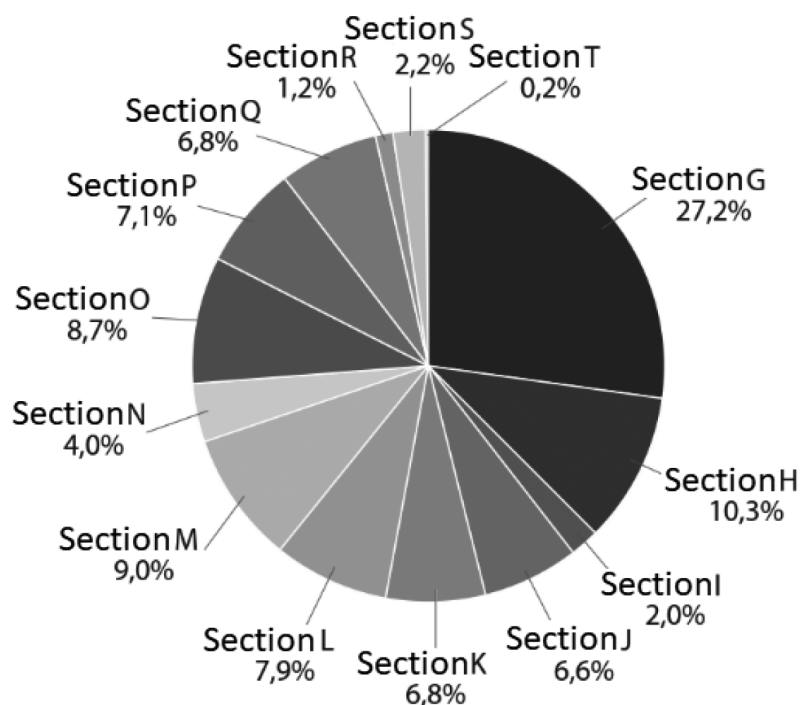
The detailed distribution of the gross added structure in services within the PKD is presented in figure 1.

According to the information presented in figure 1, the largest share in the gross added structure in services had Section G (Wholesale and retail trade, repair of motor vehicles, including motorcycles) amounting to 27.2% and Section H (Transport and storage), whose share was 10,3% (GUS, 2017).

In connection with the above, these elements constitute a very interesting area to be analyzed in terms of relevance for the development of the economy.

Figure 1

The structure of gross value added in services according to the PKD section in 2017



Source: GUS. Rynek wewnętrzny w 2017.

Trade and logistics services

Trade services are one of the most important elements of the functioning of the country's economy. This is visible in the structure of Gross Domestic Product (GDP) where the share of trade for 15 years oscillates in the range of 15.7 to 17%, and the share of trade in the value added of GDP varies from 17.6 to 19.4%. Detailed changes in value are presented in table 1.

As shown in table 1, the percentage share of commercial services has fluctuated slightly over the years. A slight downward trend has recently been seen.

As shown in figure 1, trade as well as storage and transport services are an important element of the structure of services provided in Poland, but what is important in the modern world trade can practically not exist without the support of storage and transport services, which constitute the main core of logistics services.

Logistics services in the form of transport of goods, moving them from point A to point B (from the point of production to the point of consumption) are a very important element of the implementation of commercial services. Nowadays efficient transport services that allow Us to deliver goods to their recipients at the time when there is a need for them.

Table 1

Changes in the share of trade in GDP and in gross value added

Year	1995	2000	2003	2004	2005	2006	2007	2008	2009
Share of Trade in GDP in %	16.3	17.3	16.8	16.8	16.7	16.6	16.1	15.8	16.7
Share of Trade in gross value added in %	18.5	19.5	19.0	18.9	18.9	18.9	18.3	18.0	18.8
Year	2010	2011	2012	2013	2014	2015	2016	2017	
Share of Trade in GDP in %	17.1	16.4	17.0	17.0	15.9	15.7	15.9	15.3	
Share of Trade in gross value added in %	19.4	18.7	19.2	19.2	17.8	17.6	18.0	17.4	

Source: Own calculation based on GUS. Rynek wewnętrzny — documentation from years 2007–2017

However, transport itself is not the only element of logistic services. The second very important element are warehouse services, which, through a series of undertaken operations enable the economically and organisationally effective implementation of transport activities. Thanks to the warehouse services provided in storage facilities there is possibility to eliminate numerous factors that interfere with the efficient implementation of commercial activities. Warehouses enable, among others (Stępnicka, Bąkowska, 2013; Coyle J., Bardi E., Langley C., 2010):

- economically viable (at the assumed level of acceptance of costs) maintaining stocks of goods in order to eliminate temporary differences between demand and supply;
- reduction of costs related to the purchase and transport of goods through appropriate coordination activities (eg use of economies of scale, consolidation of freight in transport to reduce the cost of unitary transport, etc.);
- improving the quality of services provided (eg by shortening the delivery time by shortening the distance between the potential customer and the place where the inventory is stored).

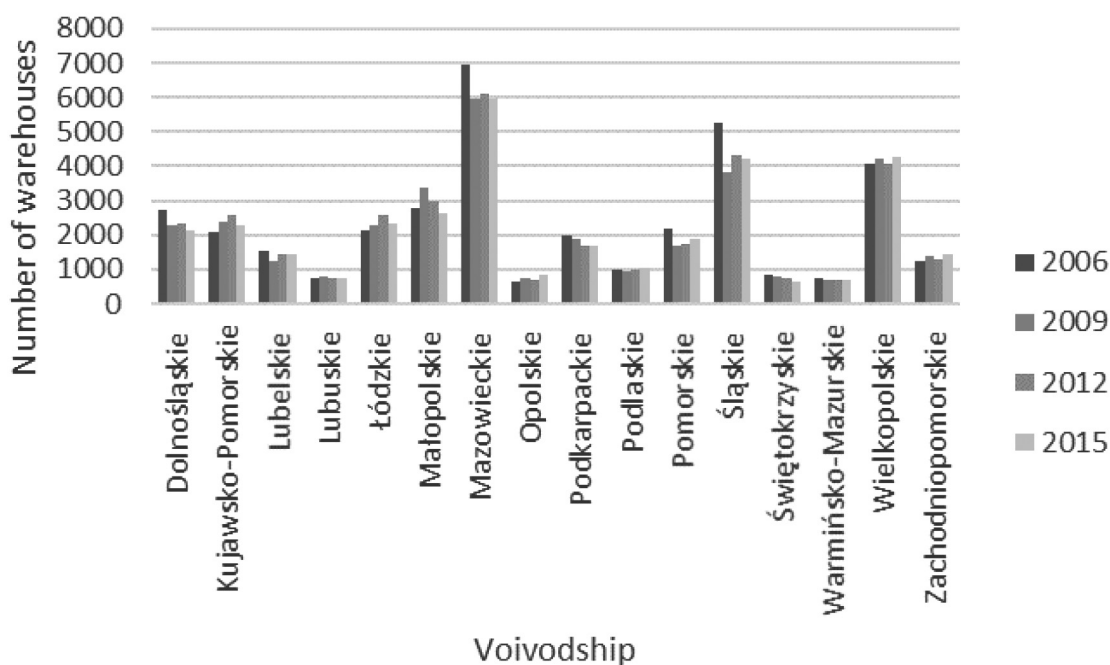
In connection with the above, the purpose of the assessment of commercial services should be made, among others analysis of the warehouse services market in Poland and try to evaluate the

effectiveness of the activities undertaken. Indicators and indicator methods that enable effective comparison of individual analyzed objects or areas are very helpful in such activities. Indicative assessments are widely described in the literature (e.g. Twaróg, J., 2005), they form the basis for the assessment of an enterprise (Chamier-Gilszczyński, N. and Staniuk, W. and Staniuk M., 2018) so they can also be used for assessment of the effectiveness of warehouse services. Examples of index assessment of warehouse processes are described in the literature (e.g. Bartosiewicz, S., 2018).

The market of warehouse services in Poland

The warehouse services market in Poland has undergone dynamic changes over the past years. This market is currently in a good condition (Trzop, Smoleń, 2018). One of the main parameters determining the quality of logistics and warehousing services in Poland is the number of warehouses of commercial enterprises and the size of these warehouses used for the purpose of commercial services. These parameters vary widely depending on the country's area, which may also have a significant impact not only on the provision of services in a given region, but may also have an

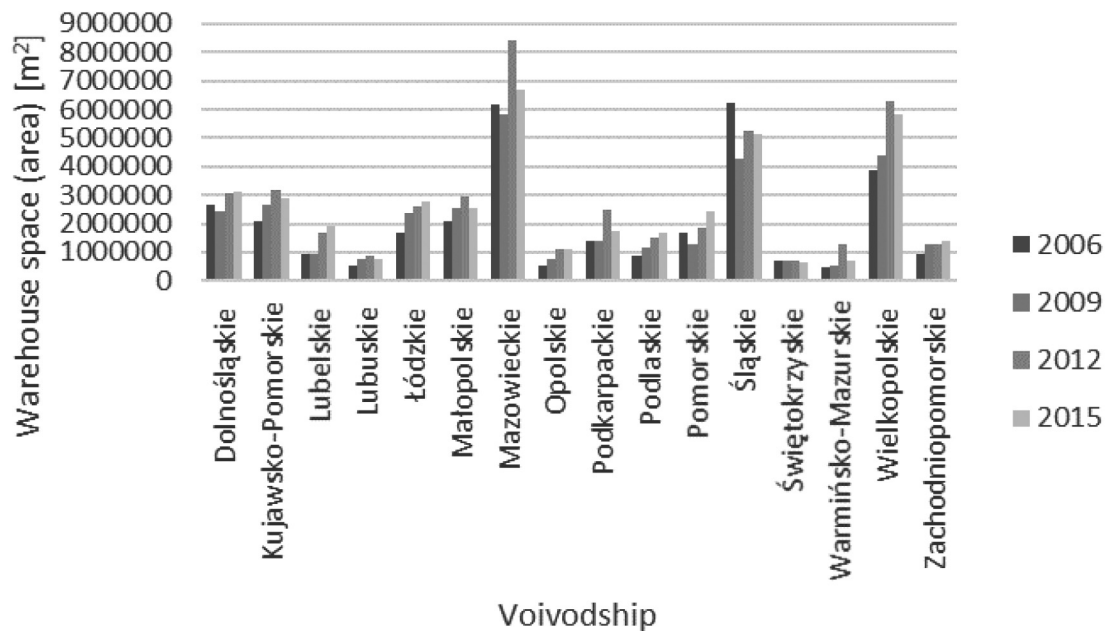
Figure 2
The change in the number of warehouses in individual voivodships



Source: Own study based on data from GUS Reports. Rynek wewnętrzny for years 2006–2017.

Figure 3

The change in warehouse space (area) in each Voivodship in years 2006–2015



Source: Own study based on data from GUS Reports. Rynek wewnętrzny for years 2006–2017.

impact on the development of services throughout the country.

The figures below present changes in the number of commercial warehouses and their areas for the years 2006–2015, broken down by individual voivodships. At the time of preparing the article for publication (August 2019), unfortunately, the GUS data on the area and structure of warehouses for 2018 were not known yet.

The structure of commercial warehouses and their areas in 2006–2015 is shown in figures 2 and 3.

Figure 2 shows the change in the number of warehouses in individual voivodships, while figure 3 shows the change in warehouse space (area) in individual years.

As shown in figures 2 and 3, in all provinces over the years, a decrease in the total number of warehouses and the total value of warehouse space is noticeable. The above data do not fully agree with the information provided in the media with a constant increase in warehouse space, but according to the author, the data obtained from the GUS should be considered the most reliable in this area. Important is also the uneven distribution of both the number and warehouse space in Poland. The largest warehouse spaces can be observed in the Mazowieckie, Śląskie and Wielkopolskie Voivodships. What is important for the Mazowieckie Voivodship is the largest decrease in warehouse space between 2012 and 2015, however, the area in 2015 is larger than in 2009 or in 2006. Declines in the number of warehouses and warehouse space can be

considered as small and are most likely related to the stabilization of the warehouse services market in Poland at a stable level. Minor fluctuations in these parameters are also in line with slight fluctuations in the share of trade in GDP and in gross value added.

Data presented in Figures 2 and 3 present only and exclusively information on the number and area of warehouses, they do not refer to the area of provinces and the number of inhabitants. In order to verify whether there is any relationship between the size of commercial warehouses and the surface of provinces or the number of inhabitants, calculations have been made, the results of which are presented in the table 2.

According to the information provided in Table 2, the calculated indicator of the number of inhabitants per number of warehouses does not show any change trends. A similar lack of sensitivity is shown by two other indicators proposed and calculated for the analyzed data, ie the number of inhabitants per m² of warehouse space and the size of warehouse space in relation to the area of the voivodship.

Then, the analysis of warehouse space and the number of warehouses in relation to GDP for individual voivodships was made to find out if there is any relationship between these values.

Data and results of calculations are presented in table 3.

The calculated indicators are shown in figures 4 and 5.

As shown in Figures 4 and 5, the proposed ratios do not show dependence between GDP in the

Table 2

Data on voivodships, warehouses and storage areas along with calculated indicators

Voivodship	Area [km ²]	Number of inhabitants	Number of Warehouse inhabitants	Warehouses Area [m ²]	Inhabitants/Warehouse [person/warehouse]	Inhabitants/Warehouses [person/m ²]	Warehouse Area/Voivodship Area [m ² /km ²]
Poland (Country)	312679.67	38 437 239	34284	41451162	1121.142	0.927290	132.5675
Dolnośląskie	19946.74	2 904 207	2137	3112596	1359.011	0.933050	156.0453
Kujawsko-pomorskie	17971.34	2 086 210	2309	2906127	903.5123	0.717866	161.7090
Lubelskie	25122.46	2 139 726	1424	1922340	1502.617	1.113084	76.51878
Lubuskie	13987.89	1 018 075	770	779440	1322.175	1.306162	55.72249
Łódzkie	18218.95	2 493 603	2316	2757070	1076.685	0.904439	151.3298
Małopolskie	15182.79	3 372 618	2633	2567988	1280.903	1.313331	169.1381
Mazowieckie	35558.47	5 349 114	5937	6698489	900.9793	0.798555	188.3796
Opolskie	9411.87	996 011	857	1093538	1162.207	0.910815	116.1871
Podkarpackie	17845.76	2 127 657	1710	1762638	1244.244	1.207087	98.77069
Podlaskie	20187.02	1 188 800	1055	1700070	1126.825	0.699265	84.21600
Pomorskie	18310.34	2 307 710	1886	2417559	1223.600	0.954562	132.0324
Śląskie	12333.09	4 570 849	4218	5132583	1083.653	0.890555	416.1636
Świętokrzyskie	11710.5	1 257 179	626	670052	2008.273	1.876241	57.21805
Warmińsko-mazurskie	24173.47	1 439 675	695	717084	2071.475	2.007680	29.66409
Wielkopolskie	29826.5	3 475 323	4284	5838235	811.2332	0.595269	195.7399
Zachodniopomorskie	22892.48	1 710 482	1427	1375353	1198.6560	1.243668	60.07881

Source: Own calculations based on GUS Reports

Table 3

Data on the GDP of individual voivodships as well as warehouses and storage areas along with calculated indicators

Voivodship	Voivodship GDP [mld PLN]	Area of Voivodship [km ²]	Number of inhabitants	Number of Warehouses	Warehouses Area [m ²]	GDP/Warehouses [PLN]	GDP/Warehouse Area [PLN/m ²]
Polska (Country)	1888	312679.67	38 437 239	34284	41451162	55069420.14	45547.57717
Dolnośląskie	160.48	19946.74	2 904 207	2137	3112596	75095928.87	51558.24913
Kujawsko-pomorskie	83.10	17971.34	2 086 210	2309	2906127	35989605.89	28594.75859
Lubelskie	73.60	25122.46	2 139 726	1424	1922340	51685393.26	38286.67145
Lubuskie	41.50	13987.89	1 018 075	770	779440	53896103.90	53243.3542
Łódzkie	115.10	18218.95	2 493 603	2316	2757070	49697754.75	41747.21715
Małopolskie	147.20	15182.79	3 372 618	2633	2567988	55905810.86	57321.14013
Mazowieckie	419.10	35558.47	5 349 114	5937	6698489	70591207.68	62566.34892
Opolskie	39.60	9411.87	996 011	857	1093538	46207701.28	36212.73335
Podkarpackie	73.60	17845.76	2 127 657	1710	1762638	43040935.67	41755.59587
Podlaskie	41.50	20187.02	1 188 800	1055	1700070	39336492.89	24410.75956
Pomorskie	107.60	18310.34	2 307 710	1886	2417559	57051961.82	44507.70385
Śląskie	234.10	12333.09	4 570 849	4218	5132583	55500237.08	45610.56295
Świętokrzyskie	45.30	11710.50	1 257 179	626	670052	72364217.25	67606.69321
Warmińsko-mazurskie	50.90	24173.47	1 439 675	695	717084	73237410.07	70981.92123
Wielkopolskie	183.10	29826.50	3 475 323	4284	5838235	42740429.51	31362.2182
Zachodniopomorskie	71.70	22892.48	1 710 482	1427	1375353	50245269.80	52132.07082

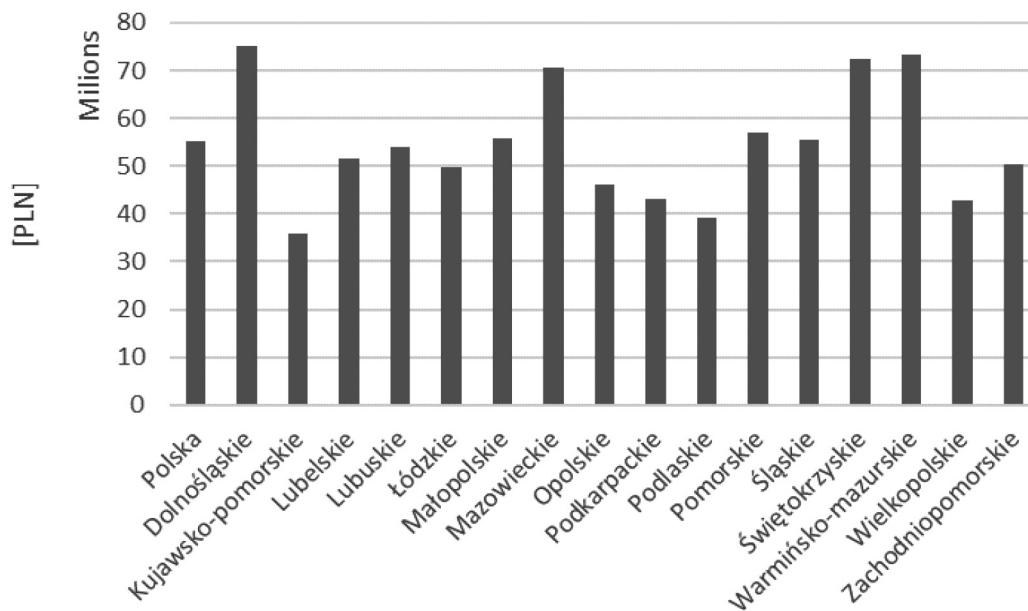
Source: Own calculations based on GUS Reports

voivodship and the number of warehouses or warehouse space.

The relationship between storage services implemented in the voivodship and their impact on the economy is best seen in the GDP graph for individual voivodships, which is shown in figure 6.

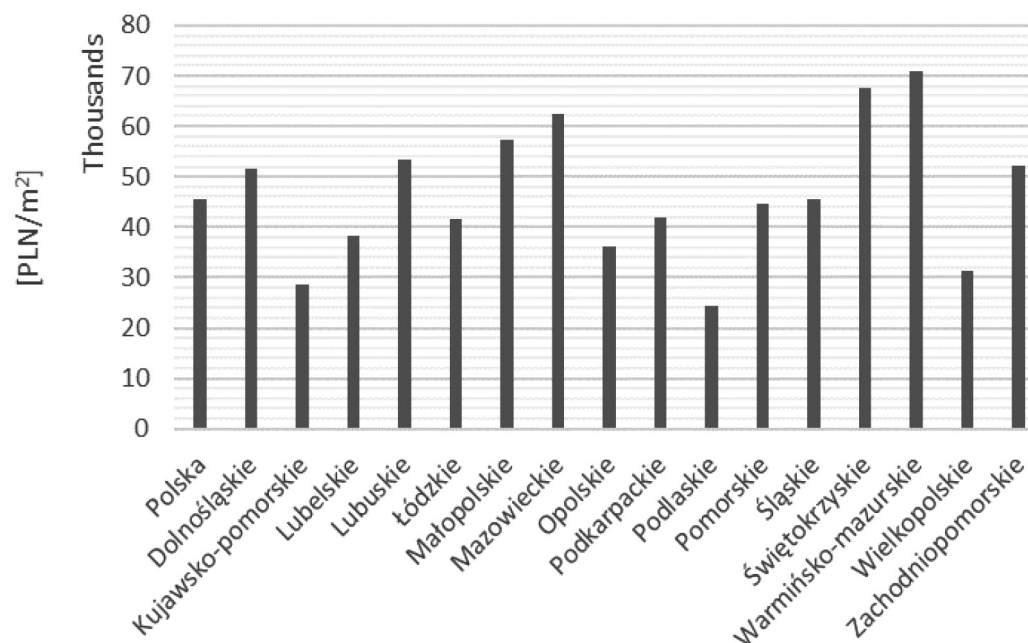
As shown in figure 6, GDP obtained for voivodships shows a correlation with the number and storage area in the voivodship. For the voivodships with the largest number of warehouses and the largest warehouse space (Mazowieckie, Śląskie and Wielkopolskie voivodships), the largest gross domestic product was obtained. This

Figure 4
The ratio of the province's GDP to the number of warehouses in the voivodship



Source: Own calculations based on data from Table 3

Figure 5
The ratio of the province's GDP to the storage area in the voivodship



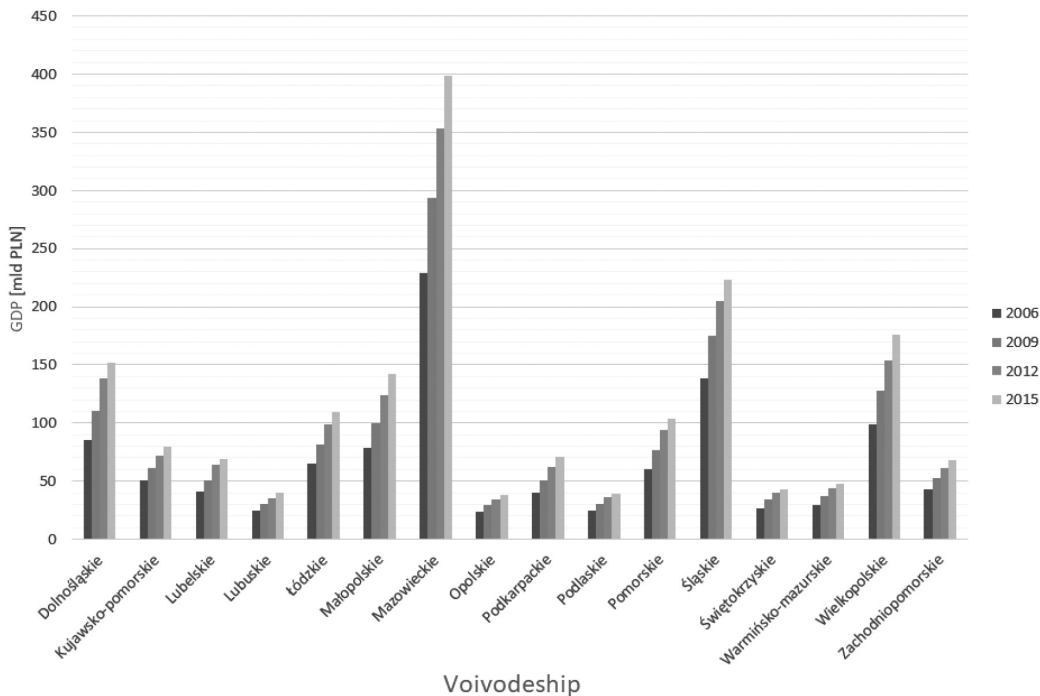
Source: Own calculations based on data from Table 3.

allows us to conclude that the provision of storage services on an adequate scale translates directly into the voivodship's GDP even though it is not directly visible in the indicators presented in figures 4 and 5.

In order to obtain a better illustration of the correlation between GDP and storage services in the voivodship, the index of storage efficiency of the voivodship (warehouse efficiency index) was proposed

Figure 6

GDP for individual voivodeships for the 2006–2015 years



Source: Own calculations based on data from Table 3 and other data from GUS Reports

The warehouse efficiency index

The warehouse efficiency index is presented below as equation (1):

$$w_{magwoj} = \frac{Pow_{mag} * PKB_{woj} \text{ [mld PLN]}}{Pow_{woj}} \quad (1)$$

where:

Pow_{mag} — size of warehouse space (area) in the voivodeship [m^2]

Pow_{woj} — Voivodeship area [m^2]

PKB_{woj} — Gross Domestic Product in a given voivodeship [mld PLN]

w_{magwoj} — warehouse efficiency index [mld PLN]

The obtained values of the proposed indicator are presented in tabular form in table 4.

The results of calculations in the form of the Voivodeship's warehouse efficiency index for the period 2006–2015 are also presented in graphical form in figure 7.

Figure 8 shows the change in the warehouse efficiency index in 2006–2015 for Poland.

As shown in Figure 8, the warehouse efficiency index shows the overall development of warehouse

management in Poland. In contrast, figure 7 allows comparison of the effectiveness of storage services in individual voivodeships and over the years. Figure 7 clearly shows a deterioration in the efficiency of warehouse management in the Mazowieckie voivodeship.

Summary

Logistics services, including warehouse services, are one of the most important elements of the modern economy of each country. As presented in the article, one of the most important elements affecting the development of the country and its GDP are services, including storage services. On the basis of the obtained and presented calculations, the dependence between the size of storage areas in the region and its GDP was clearly observed.

Obtained results and measures clearly indicate improvement of the Polish economy in recent years, which allows to conclude that further the development of logistics and warehousing services in Poland will contribute to the further development of the Polish economy and the growing importance of storage services in Poland for the benefit of the entire European economy.

■ Table 4

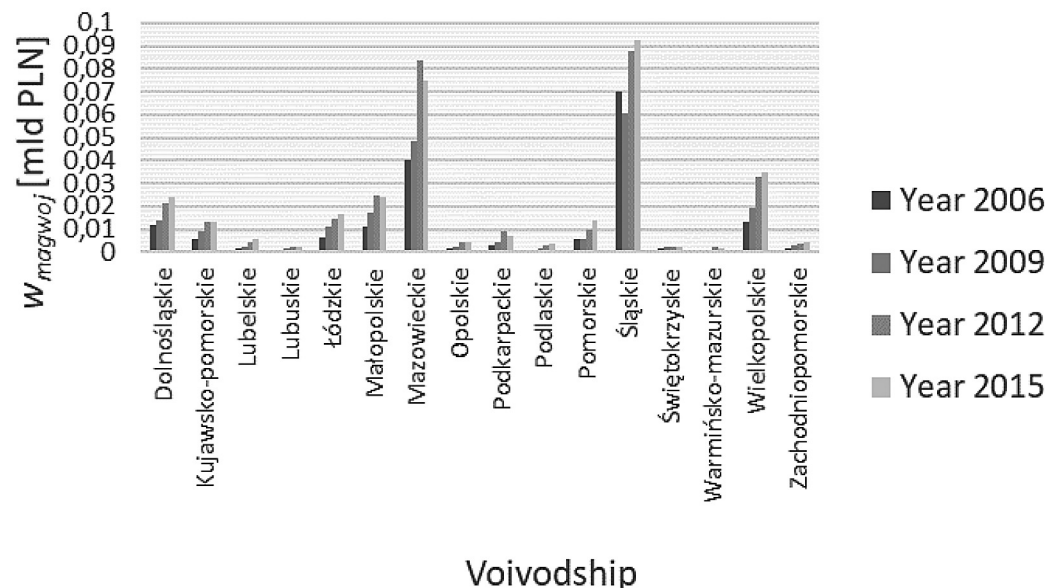
Data on the GDP of individual voivodships and warehouses and storage areas together with the calculated w_{magwoj} index for 2015

Voivodship	Voivodship GDP [mld PLN]	Area of Voivodship [km ²]	Number of inhabitants	Number of Warehouses	Warehouses Area [m ²]	Warehouse Area/Voivodship Area [m ² /km ²]	warehouse efficiency index w_{magwoj} [mld PLN]
Polska(Country)	1888	312679.67	38 437 239	34284	41451162	132.5675	0.238541
Dolnośląskie	160.48	19946.74	2 904 207	2137	3112596	156.0453	0.023667
Kujawsko-pomorskie	83.1	17971.34	2 086 210	2309	2906127	161.709	0.012893
Lubelskie	73.6	25122.46	2 139 726	1424	1922340	76.51878	0.005260
Lubuskie	41.5	13987.89	1 018 075	770	779440	55.72249	0.002219
Łódzkie	115.1	18218.95	2 493 603	2316	2757070	151.3298	0.016548
Małopolskie	147.2	15182.79	3 372 618	2633	2567988	169.1381	0.024036
Mazowieckie	419.1	35558.47	5 349 114	5937	6698489	188.3796	0.075139
Opolskie	39.6	9411.87	996 011	857	1093538	116.1871	0.004389
Podkarpackie	73.6	17845.76	2 127 657	1710	1762638	98.77069	0.006971
Podlaskie	41.5	20187.02	1 188 800	1055	1700070	84.216	0.003335
Pomorskie	107.6	18310.34	2 307 710	1886	2417559	132.0324	0.013680
Śląskie	234.1	12333.09	4 570 849	4218	5132583	416.1636	0.092724
Świętokrzyskie	45.3	11710.5	1 257 179	626	670052	57.21805	0.002439
Warmińsko-mazurskie	50.9	24173.47	1 439 675	695	717084	29.66409	0.001420
Wielkopolskie	183.1	29826.5	3 475 323	4284	5838235	195.7399	0.034537
Zachodniopomorskie	71.7	22892.48	1 710 482	1427	1375353	60.07881	0.004074

Source" Own calculations based on table 2 and table 3

■ Figure 7

Voivodship's warehouse efficiency index for the period 2006–2015



Source: Own work based on own calculations

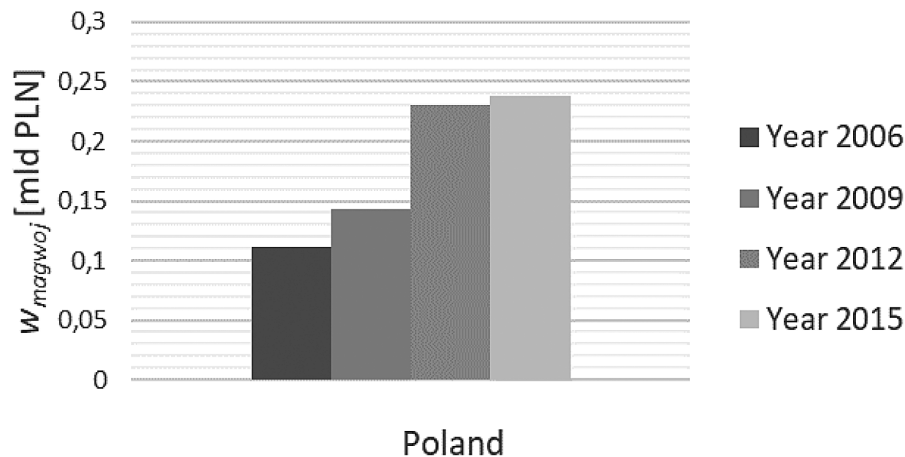
The proposed and calculated warehouse efficiency index also allows the observation and assessment of changes in the efficiency of warehouse management.

In connection with the above, intensive investment

activities in the area of warehouse infrastructure should be carried out all the time, because it can contribute to the development of not only these branches, but also the entire national economy.

Figure 8

Warehouse efficiency index in 2006–2015 for Poland



Source: Own work based on own calculations

Bibliografia/References

- Bartosiewicz, S. (2018). Ocena procesów magazynowych wybranego przedsiębiorstwa produkcyjnego z wykorzystaniem metody wskaźnikowej. *Gospodarka Materiałowa i Logistyka*, (5), 71–84.
- Chamier-Gliszczyński, N. and Staniuk, W. and Staniuk, M. (2018). Problematyka wskaźnikowej oceny systemu logistycznego w aspekcie koncepcji audytu logistycznego 9A. *Prace Naukowe Politechniki Warszawskiej, Seria Transport*. Z.120/2018, Warszawa, 49–58.
- Coyle, J. and Bardi, E. and Langley C. (2010). *Zarządzanie logistyczne*. Warszawa: Polskie Wydawnictwo Ekonomiczne.
- Stępnicka, N. and Bąkowska, P. (2013). Zarządzanie logistyczne i gospodarka magazynowa w przedsiębiorstwach — wybrane aspekty teoretyczne. *Studia i Materiały. Miscellanea Oeconomicae*, 2, Wydział Zarządzania i Administracji Uniwersytetu Jana Kochanowskiego w Kielcach, Kielce, 297–309.
- Trzop, A. and Smoleń, K. (2018). Badania dotyczące dostosowania obiektów magazynowych do indywidualnych potrzeb biznesowych — inwestycja build-to-suit. *Zeszyty Naukowe Politechniki Poznańskiej, Seria Organizacja i Zarządzanie* 78. Poznań, 231–244.
- Twaróg, J. (2005). *Mierniki i wskaźniki logistyczne*. Poznań: Instytut Logistyki i Magazynowania.
- Eurostat (2018), *Udział wartości dodanej brutto w usługach w wartości dodanej brutto wytworzonej w gospodarce narodowej (ceny bieżące) Dane statystyczne Eurostat z 7.09.2017*, <http://ec.europa.eu/eurostat> (dostęp: 9.02.2020)
- Eurostat (2018), *Zmiana PKB w krajach UE w latach 2006–2017. Dane statystyczne Eurostat*, <http://ec.europa.eu/eurostat> (dostęp: 9.02.2020)
- GUS (2008), *Powierzchnia i ludność w przekroju terytorialnym w 2006 r. Opracowanie GUS*, Dokument elektroniczny <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2010), *Powierzchnia i ludność w przekroju terytorialnym w 2009 r.. Opracowanie GUS*, Dokument elektroniczny <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2013), *Powierzchnia i ludność w przekroju terytorialnym w 2012 r.. Opracowanie GUS*, Dokument elektroniczny <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2016), *Powierzchnia i ludność w przekroju terytorialnym w 2015 r.. Opracowanie GUS*, Dokument elektroniczny <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2007), *Rynek wewnętrzny w 2007. Opracowanie GUS*, Dokument elektroniczny <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2010), *Rynek wewnętrzny w 2010. Opracowanie GUS*, Dokument elektroniczny, <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2013), *Rynek wewnętrzny w 2013. Opracowanie GUS*, Dokument elektroniczny, <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2016), *Rynek wewnętrzny w 2016. Opracowanie GUS*, Dokument elektroniczny, <http://stat.gov.pl> (dostęp: 9.02.2020)
- GUS (2016), *Rynek wewnętrzny w 2017. Opracowanie GUS*, Dokument elektroniczny, <http://stat.gov.pl> (dostęp: 9.02.2020)

Dr inż. Paweł Sobczak

Adiunkt w Katedrze Transportu i Informatyki na Wydziale Nauk Stosowanych Akademia WSB w Dąbrowie Górniczej. W swojej działalności naukowej zajmuje się zagadnieniami analizy i usprawnienia transportu publicznego oraz magazynowania, specjalizuje się także w wykorzystaniu nowoczesnych technologii informatycznych w logistyce ze szczególnym uwzględnieniem procesów magazynowych.

Dr inż. Paweł Sobczak

Assistant Professor at WSB University, Faculty of Applied Sciences, Department of Transport and Computer Science. In his scientific activity he deals with the issues of analysis and improvement of public transport and warehousing, as well as specializes in the use of modern information technologies in logistics, with particular emphasis on warehouse processes.