

Significance of selected modes of transport used in services facilitating Polish foreign trade

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Abstract

The aim of this paper is to assess the utilization of selected transportation modes in services facilitating Polish foreign trade between 2010 and 2017. Poland's foreign trade in commodities is characterized generally herein. The contribution of individual transport modes (i.e. road, rail, inland waterways, sea, or air) to facilitating Polish exports and imports is analyzed in terms of quantity and value. As research material, data from the Customs Administration Analytical Centre are used. Simple statistical and graphic methods (e.g., structural and dynamics indicators) are applied. Polish foreign trade in commodities grew between 2010 and 2017. At the same time, the shares of individual transport modes in facilitating exports and imports shifted, with transport by road remaining the largest contributor. Quantitatively, the share of road transport increased, in both exports and imports; however, a reverse trend was observed for its value.

Introduction

The dynamic development of international trade is one of the most important processes characterizing the contemporary global economy. This development is justified by the benefits it brings, which may have an economic aspect, as well as a competitive/complementary, technological/technical, or simply resource/climate-related side to them (Bernaś, 2002). The development and effectiveness of international trade in commodities is determined by, among other things, logistics and transport processes. Transport has multiple functions, one of which to serve as an instrument of commodity and service exchange, which determines how traded goods are moved (Grzywacz & Burniewicz, 1989).

The objective of this paper is to analyze and assess the utilization of selected modes of transport in services facilitating Polish foreign trade in commodities. Moreover, the work describes the structure of exports and imports according to different transport modes. The following hypothesis is assumed for the

purposes of this paper: The dynamic development of Polish foreign trade in commodities is accompanied by transformations in the modes of transport used to facilitate exports and imports.

This publication discusses practical problems arising from statistical treatments of the Polish commodities trade. These issues focus on analyzing foreign commodity turnover and the significance of selected modes of transport in services that facilitate exports and imports. This analysis is complemented by assessing them in the context of current circumstances characterizing selected transport markets.

Literature review

Problems with international trade have been at the center of many researchers' interest as far back as the early modern period. The resulting international exchange theories have proven to be successful at explaining and assessing the development of international flows of commodities. The literature concerning this subject is rich and effective at describing

both traditional and contemporary international trade theories (Dixit & Norman, 1980; Krugman, 1994; Feenstra, 2015). Contemporary research on international exchange has mainly focused on the problems of globalization (Eaton et al., 2016), economic integration (Ohlin, 1935; Baier & Bergstrand, 2007), the development of international flows of services (Kimura & Lee, 2006; Jones & Kierzkowski, 2018; Malkowska, 2018), innovation (Grossman & Helpman, 1990; Santacreu, 2015), and their effects on the development of economies (Krugman, Obsfeld & Melitz, 2014).

The functioning and development of trade would not be possible without transport, which affects other sectors of the national economy, including trade. Transport plays a significant role in ensuring the functioning of the national economy (Hoyle, 1973; MacKinnon, Pirie & Gather, 2008). The relationship between transport and economic growth is not a direct one but is rather related to the influence it exerts on production and distribution structures and processes, the location and sizes of enterprises, and other production organization characteristics (Nistor & Popa, 2014).

In the literature focusing on transport and logistics problems, foreign trade analyses are typically the only complementary element studied (Grzelakowski, 2012; Pluciński, 2016; Mańkowska, 2019). There are no papers concerning how foreign trade tendencies affect the utilization of particular branches of transport that focus on foreign trade and only treat transport-related issues as a complementary element (Komornicki, 2000).

Various forms of transport are used in services facilitating foreign trade, and the basic modes of transport are sea, road, rail, inland waterways, or air. Each of these modes has its respective advantages, as well as its own limitations. Moreover, transport activity generates costs, both internal and external (Urbanyi-Popiołek, 2013). The latter type of costs, which are linked to negative consequences for the natural environment and human life, have been the subject of many literature analyses (Bickel & Friedrich, 2013; Kotowska & Kubowicz, 2019). This is related to the ongoing promotion of and frequent assistance provided (e.g. by the EU) to those branches of transport that are environmentally friendly.

Methodology

This article discusses Poland's foreign trade, which is treated here in a narrow sense by including only trade in commodities. The starting point

for the study is to create a general profile of Polish foreign trade in commodities, presented quantitatively (taking into account the volume of trade) and in terms of value (shown in USD). Categories such as the exports of commodities, the imports of commodities, and the balance of trade are discussed here. By way of addition, Poland's most important trade partners, commodity structure, and the ratio of the value of exports and imports to Poland's GDP are shown. Data from the Customs Administration's Analysis Center and from the public statistics database of the Chief Statistical Office are used.

Later on, the article analyzes the degree to which the five main branches of transport were used, i.e. sea, road, rail, air, and inland waterways, in services facilitating Polish exports and imports in the period of interest. These branches were chosen by the availability of cohesive statistical data. Exports and imports of commodities according to the individual types of transport from 2010–2017 are profiled in the paper. Also, commodities trade is examined from the point of view of its quantity and value. Additionally, the share of each type of transport in general exports and imports is shown. The indicators calculated for 2010 and 2017 are compared to observe and assess the changes that occurred over time.

The time scope of the study is from 2010 to 2017 and was selected due to the availability of homogeneous and current statistical data. To analyze Polish exports and imports of commodities and the shares of individual branches of transport in facilitating the country's foreign trade, the time series methodology was applied in order to depict the tendencies observed over a longer period. In some justified cases, the analysis is limited to a comparison between the base year 2010 and the target year 2017 to provide a more transparent analysis.

Polish and international literature sources that discuss this subject matter were used. Desk research, simple statistical methods (structural and dynamics indicators), and the descriptive method with elements of deduction were utilized. Drawings and a table were used to present the results.

A general profile of Poland's foreign trade in commodities between 2010 and 2017

Poland's foreign trade developed between 2010 and 2017, with exports of commodities growing by 44.6% from USD 157 bn in 2010 to USD 227.1 bn in 2017. The value of commodity imports grew by 31% from USD 170.3 bn in 2010 to USD 223.2 bn in 2017, indicating that the growth rate of foreign

sales was higher than that of foreign purchases. Consequently, the balance of trade became positive, and although it was negative between 2010 and 2014, it demonstrated a trade surplus since 2015. The balance grew more than four times, i.e. from USD –13.3 bn in 2010 to USD 3.9 bn in 2017 (Figure 1).

A value-based analysis of Poland's foreign trade is complemented by a quantitative examination. In 2010, the export of commodities amounted to 80.1 m tons and reached 109.3 m tons in 2017, representing an increase of 36.5%. Commodity imports grew from 120.8 m tons in 2010 to 144 m tons in 2017, i.e. by 19.2%. Notably, the balance of trade in commodities over the entire period was negative, and the largest deficit was observed in 2011 (–51.8 m tons) and the lowest in 2013 (–20.6 m tons) (Figure 2).

The ratio of the value of exports to the GDP is an indirect indicator of how export-oriented an economy is, and can illustrate the degree of the economy's

“openness”. For Poland, the ratio grew from 33.3% in 2010 to 39.8% in 2017, suggesting that the openness of the Polish economy improved. At the same time, the share of imports in the Polish GDP increased from 37.2% in 2010 to 39.1% in 2017, which indicated a continually growing dependence of the economy on the commodity imports.

Over the eight years of interest, Poland's five most important trade partners remained constant. For exports, in order of importance, they were Germany, the United Kingdom, the Czech Republic, France, and Italy. Among them, neighboring Germany had the largest share in Poland's international sale of its products (26.1% in 2010 and 27.5% in 2017). The share of each of the remaining countries did not exceed 6.5%. As for imports, Poland's most crucial importers in 2017 were Germany (23%), China (12%), Russia (6.4%), Italy (5.3%), and France (3.9%). Over the same period, the highest drop in its share in Poland's imports was observed for Russia

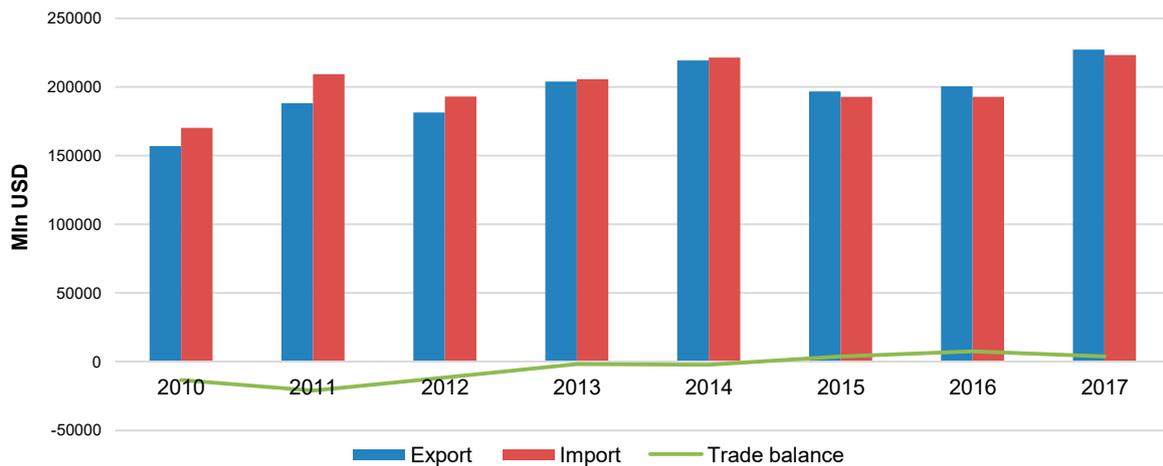


Figure 1. Poland's foreign trade in commodities between 2010 and 2017 in millions of USD (based on data from the Customs Administration's Analysis Center, 2011–2018)



Figure 2. Poland's foreign trade in commodities between 2010 and 2017 in thousands of tons (based on data from the Customs Administration's Analysis Center, 2011–2018)

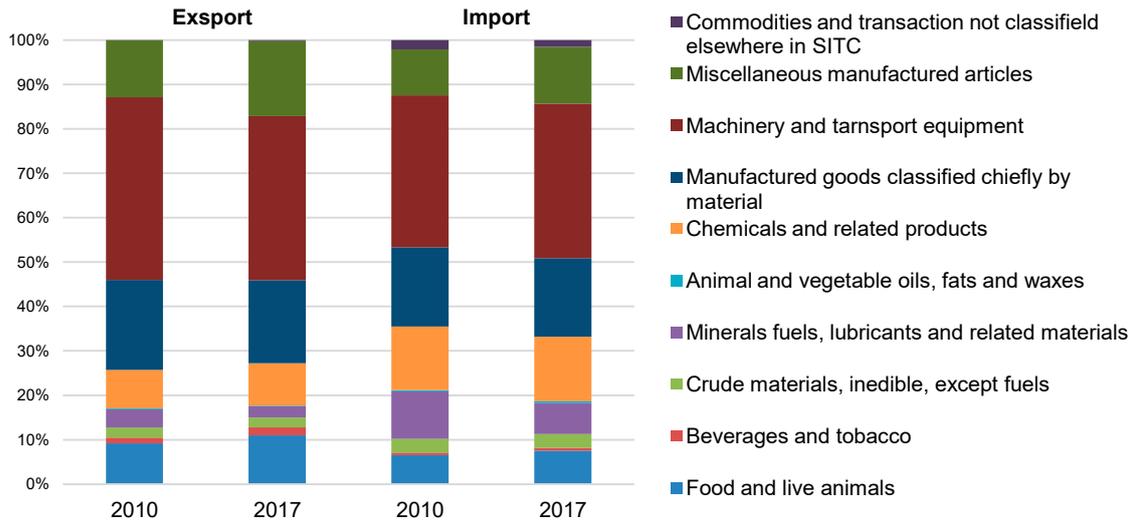


Figure 3. Commodity structure of Poland’s exports and imports in 2010 and 2017 by sectors, according to the SITC Nomenclature (based on Statistic Poland, 2011; 2018)

(10.2% in 2010) and China (9.2% in 2010). Between 2010 and 2017, there were also changes to the commodity structure of Poland’s foreign trade, as shown in Figure 3.

As for exports, the largest share increase was observed for the “Miscellaneous manufactured articles” (by 4.1 p.p.) and “Food and live animals” (by 1.8 p.p.) groups of commodities. The most notable drop was observed for the “Machinery and transport equipment” (by 4.1 p.p.), “Minerals fuels, lubricants, and related materials” and “Manufactured goods classified chiefly by material” (by 1.6 p.p.) categories. As for imports, the largest share increase was observed for the “Miscellaneous manufactured articles” (by 2.5 p.p.) and “Food and live animals” (by 1 p.p.) groups, with the most remarkable decrease observed for the “Minerals fuels, lubricants and related materials” (by 3.7 p.p.) group.

Utilization of individual branches of transport in services facilitating Poland’s foreign trade

Commodity exports

From 2010–2017, the utilization of individual transport branches tended to change. The largest volume of exported commodities was carried by road, and the least by air. From 2010 to 2017, the volume of goods transported by road, rail, and sea increased (by 51.8%, 9.5%, and 0.05%, respectively), while at the same time, a decrease was observed for transport by inland waterways (by 49%) and air (by 69%) (Figure 4). In terms of the value of Polish exports of commodities, transport by road was dominant, with inland waterways transport coming in last. The value of exported goods grew for transport by air

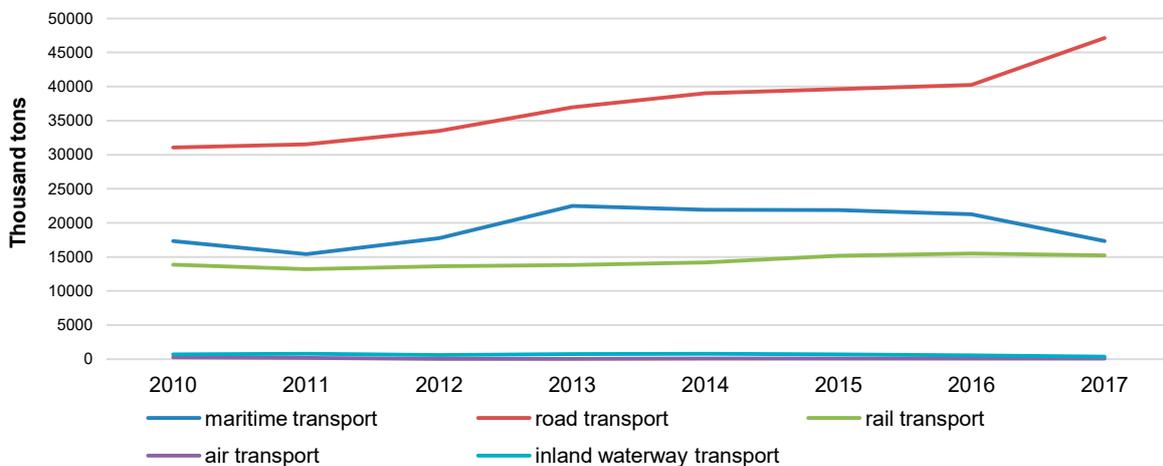


Figure 4. Poland’s commodities exports by branch of transport between 2010 and 2017 in thousand tons (based on data from the Customs Administration’s Analysis Center, 2011–2018)

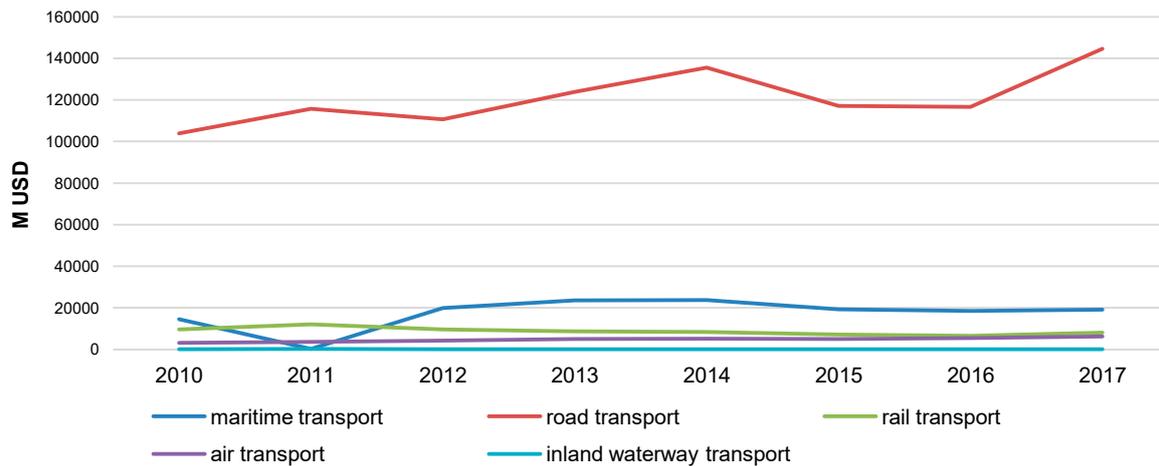


Figure 5. Poland's exports of commodities by branch of transport between 2010 and 2017 in millions of USD (based on data from the Customs Administration's Analysis Center, 2011–2018)

(by 98.4%), road (by 39.1%), and sea (by 31.7%) and decreased for transport by rail (by 15.9%) and air (by 70.5%) (Figure 5).

An analysis of Poland's commodity exports by individual transport branches shows a clear dominance of transport by road, both in terms of volume and value. Examining the dynamics of the year-by-year figures shows an annual growth in the transported volume. In 2010, foreign sales using road transport amounted to almost 31.1 m tons and reached over 47.1 m tons in 2017, which was a growth of more than half (Figure 4). The value of commodities transported by road increased by 39.1%, i.e. from USD 103.9 bn in 2010 to USD 144.6 bn in 2017 (Figure 5). For road transport, the performance of the exports of commodities was higher in terms of volume than it was in terms of value.

Polish commodity exports via maritime transport grew between 2010 and 2017, despite fluctuations in some of the years. The volume of goods grew only slightly, i.e. by 0.05%, and was approx. 173.1 m tons both in 2010 and 2017. The largest volume transported by sea was observed in 2013 with almost 22.5 m tons and the smallest in 2011 with 15.4 m tons (Figure 4). A much greater increase in the value of Poland's commodity exports via maritime transport was observed. In 2010, the value of goods sold internationally was almost USD 14.7 bn and reached USD 19.2 bn in 2017, which constituted an impressive growth of 37.7% (Figure 5). Thus, the value of exports was much higher than the volume. It should be noted that although nearly identical volumes of goods were transported by sea in both the base year and the target year, the value of the goods grew significantly. This could be explained by the sale of more expensive or more processed products than before.

There were also fluctuations in commodity exports via rail, as well as a growth in the volume of goods by 9.5% (Figure 4), accompanied by a decrease in their value by 15.9% (Figure 5). In 2010, Poland exported 13.9 m tons of commodities worth over USD 9.6 bn by rail. In 2017, this figure rose to 15.2 m tons worth USD 8.1 bn.

An opposite situation was observed for air transport, in which the volume of exported commodities decreased from 247 k tons in 2010 to almost 77 k tons in 2017, which constituted a drop of 69.0% (Figure 4). Despite this, the value of commodities exported using this mode of transport grew by as much as 98.4%, i.e. from USD 3.2 bn in 2010 to USD 6.3 bn in 2017. Notably, in this case, the value of exports grew systematically year-by-year, except for 2015 (Figure 5).

The largest decreases in Poland's commodity exports were seen in the case of transport by inland waterways, both in terms of volume and value. Poland's commodity exports using this transport mode amounted to 678.3 k tons in 2010 and merely 345.9 k tons in 2017, which was a 49% decrease (Figure 4). The value of international sales of goods decreased by 70.5% from USD 136 m to USD 40 m (Figure 5). The commodity exports by inland waterways continued to systematically decrease both in terms of the volume of goods (since 2014) and their value (since 2013).

The imports of commodities

Substantial changes were observed when analyzing Poland's commodity imports by taking into account the main branches of transport. Between 2010 and 2017, imports by all transport modes,

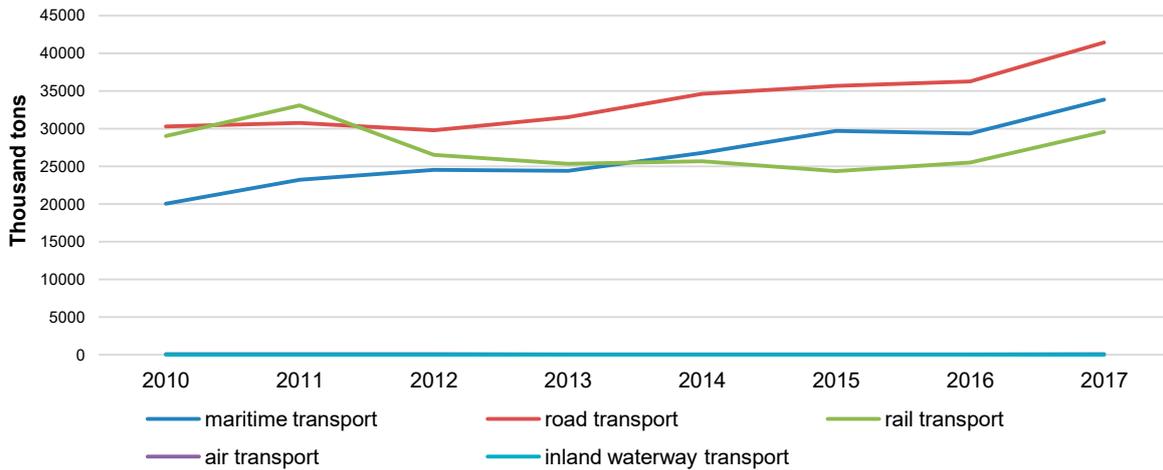


Figure 6. Poland's commodity imports by branch of transport between 2010 and 2017 in thousands of tons (based on data from the Customs Administration's Analysis Center, 2011–2018)

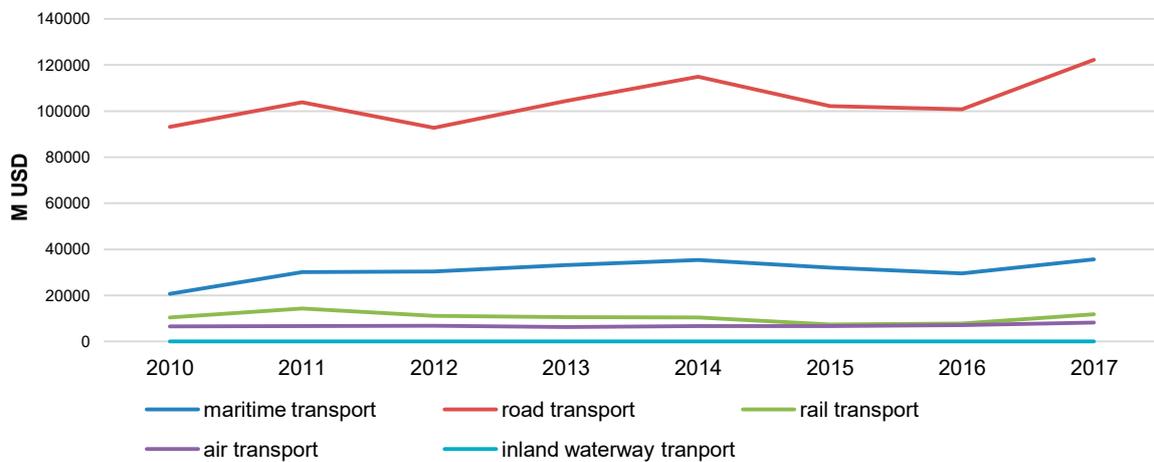


Figure 7. Poland's commodity imports by branch of transport between 2010 and 2017 in millions of USD (based on data from the Customs Administration's Analysis Center, 2011–2018)

except for inland waterways, grew. The largest increase in commodity imports was observed for transport by sea, both in terms of quantity (Figure 6) and value (Figure 7).

Poland's import activity is mostly based on transport by road. In 2010, this mode of transport was used to import 30.3 m tons and reached 41.4 m tons in 2017, an increase of 36.7% (Figure 6). The value of imported commodities increased here by 31.3%, with USD 93.1 bn in the base year and USD 122.3 bn in the target year. The latter figure was simultaneously the highest value reached during the period of interest (Figure 7).

Transport by sea came second in terms of the volume of imported commodities. This figure grew systematically, except for 2013 and 2016 which displayed small decreases. Maritime transport was used to import over 20 m tons in 2010 and 33.8 m tons in 2017, which amounted to an impressive 68.8% increase (Figure 6). A similar tendency was observed

in terms of value, where the growth was even larger and amounted to 71.9%. The value of Poland's imported commodities by sea rose from USD 20.7 bn in 2010 to USD 35.6 bn in 2017.

In the same period, rail transport was used to import over 29.0 m tons of commodities in 2010 and 29.6 m tons in 2017, which was a growth of 1.9%. However, it should be noted that the highest value was observed in 2011, with 33.1 m tons (i.e. more than in the case of road transport in the same year), and the lowest in 2015, with 24.4 m tons (Figure 6). Generally, the value of commodities imported to Poland by rail declined, except for some larger increases in 2011 (USD 14.4 bn) and 2017 (USD 11.8 bn). Hence, an overall increase of 13.5% was achieved from 2010 to 2017 (Figure 7).

Poland's imported commodities by air amounted to 97.6 k tons in 2010 and 100.7 k tons in 2017, which constituted a 3.2% increase in terms of volume. It must be added here that the highest value

of imports by this mode of transport was observed in 2012 with 102.8 k tons and the lowest in 2014 with 69.8 k tons (Figure 6). The value of the imports of commodities by air amounted to USD 6.5 bn in 2010 and USD 8.2 bn in 2017, which was a 25.3% increase (Figure 7).

Inland waterway transport had a much smaller share in Poland's imported commodities than the other modes. In 2010, it was used to import 10.1 k tons of goods, with only 5.1 k tons imported in 2017, a decline of 49.2% (Figure 6); however, it should be noted that the lowest value (0.01 k tons) was observed in 2013. The value of goods imported by inland waterways amounted to USD 2.6 m in 2010 and USD 1.02 m in 2017, which was a decrease of 60.2%.

Assessing the significance of utilizing the main transport branches in services facilitating Poland's foreign trade

The significance of individual branches of transport in services which facilitate Polish foreign trade in commodities was diverse and continually changed from 2010-2017. In terms of quantity, the dominant transport mode was road, the share of which grew from 38.8% in 2010 to 43.1% in 2017. The share of the remaining transport branches decreased. For transport by sea, the drop amounted to 5.8 p.p. (from 21.6% in 2010 to 15.8% in 2017), and for transport by rail, it amounted to 3.4 p.p. (from 17.3% in 2010 to 13.9% in 2017). The share of the other branches was minimal and did their combined total not exceed 1.2% in 2010 and 0.4% in 2017. In terms of the value of exported goods, the share of all branches of transport, except for transport by air, declined. Here, the advantage of road transport over the other modes was even larger than in the case of the quantity of

exported goods. In 2017, it amounted to almost 63.7% (Table 1).

As for imported commodities, the share of transport by road and sea rose between 2010 and 2017, both in terms of quantity and value, while the remaining transport modes decreased (Table 1). Road transport was the dominant mode among all used in services facilitating Polish foreign trade. Its significance rose over the period of interest despite the fact that the national and provincial roads, which are the most important in the country's entire road system, account for less than 12%. The forecast for the coming years suggests that the road market will continue to develop; therefore, it appears likely that it will remain unrivaled, especially when it comes to services facilitating Polish foreign trade.

Maritime transport plays a significant role in Poland. Since joining the EU, Poland has carried out numerous strategic investments in its largest ports (e.g., in the Central Port in Gdańsk, or the construction of the external harbor in Gdynia, or the construction of the LNG terminal in Świnoujście). The growth in significance of maritime transport in services facilitating the Polish foreign trade was also assisted by investments planned for the years to come, e.g., the modernization of the Świnoujście-Szczecin fairway, or the construction of a new LNG redistribution station in Świnoujście.

Transport of freight by rail is an element of Poland's integrated transport system, although it does not play a dominant role in the carriage of goods by land. The main problems encountered by this branch of transport are the decreasing length of railway lines, the insufficient technical condition of railway lines, and the exceedingly slow process of rolling stock replacement, all of which limit any expansion. Recently, the carriage of freight by rail has been unstable due to growing competition

Table 1. The share of branches of transport in Poland's exports and imports of commodities in 2010 and 2017 expressed in % (based on data from the Customs Administration's Analysis Center, 2011–2018)

Year	Maritime transport		Road Transport		Rail transport		Air transport		Inland waterway transport	
	volume in thous. tons	value in millions of USD	volume in thous. tons	value in millions of USD	volume in thous. tons	value in millions of USD	volume in thous. tons	value in millions of USD	volume in thous. tons	value in millions of USD
Exports										
2010	21.614	9.282	38.801	66.207	17.330	6.146	0.309	2.017	0.847	0.087
2017	15.840	8.453	43.128	63.682	13.903	3.573	0.070	2.767	0.316	0.018
Imports										
2010	16.596	12.171	25.083	54.663	24.021	6.114	0.081	3.849	0.008	0.002
2017	23.502	15.967	28.777	54.780	20.531	5.298	0.070	3.681	0.004	0.000

from road transport (Fechner & Szyszka, 2018). An opportunity for improving rail transport, also in respect of facilitating foreign trade, has been seen in investments co-financed under EU funds from 2014–2020.

Air transport is not important to Poland's international trade in commodities, and 90% of the Polish freight market is accounted for by two airports, one in Warsaw and one in Katowice. That lack of modern freight handling infrastructure is perceived as the major obstacle to the development of the freight market at Polish airports. Apart from this, there is enormous competition from German hubs, such as those in Frankfurt and Leipzig. It has been suggested that Poland is merely a freight supply region to be benefited from by other airports, and not a venue where carriage business is expected to develop.

The level of utilization of inland waterway transport in Poland is very poor, and thus this mode has the smallest significance in facilitating Polish foreign trade, primarily due to infrastructural limitations. Only 5.9% of domestic waterways meet the requirements of waterways of international importance. Moreover, Poland only has one port, in Gliwice, that is adapted to handle containers and is itself an element of a logistics center. It has been indicated that one of the inland waterway development priorities should be to modernize the Odra and Wisła waterways between Warsaw and Gdańsk (Fechner & Szyszka, 2018).

Individual main transport modes offer different means to facilitate Polish foreign trade, and their contribution may be subject to significant changes in the future. For example, (1) the EU transport policy indicates that by 2030, 30% of road freight transport over 300 km should shift to other means of transport, such as rail or waterways. By 2050, this rate should reach 50% (European Commission, 2011); (2) an increase or decrease in importance other than the main modes of transport, e.g., intermodal or multimodal transport. Studies suggest that the share of the main transport branches in facilitating Polish exports has decreased (from 78.9% to 73.3% in terms of quantity, and from 83.7% to 78.5% in terms of value), but their share in facilitating Polish imports has risen (from 65.8% to 72.9% in terms of quantity, and from 76.8% to 79.7% in terms of value); (3) changes with respect to the commodity structure and the destinations of the Polish foreign trade. As an example, EU Member States are the main recipients of Polish exports, but not all of them have access to sea waters, hence any increase in the share of maritime transport will be limited.

Conclusions

Between 2010 and 2017, the Polish foreign trade in commodities grew both in terms of value and quantity. Higher export and import value growth rates were observed than in terms of volume, possibly because more expensive and more processed or more technologically advanced products were being sold internationally. In terms of value, a trade surplus has been observed since 2015, while in terms of volume there was always a trade deficit.

Not all branches of transport experienced a growth in Polish export and import commodities. In the case of the exports, the largest growth was observed for road transport, and the smallest for air transport (in terms of volume) and inland waterway transport (in terms of value). In the case of imports, road transport was also the dominant mode, although the largest growth was enjoyed by maritime transport, both in terms of volume and value.

The changes within Poland's foreign trade were accompanied by changes to the structure of transport modes used to facilitate it. During the period of interest, changes with respect to its structure turned out to be unfavorable from the point of view of environmental protection and sustainable development. Moreover, research has shown that the share of the main transport branches in services facilitating exports fell, but their share in facilitating imports grew between 2010 and 2017. Hence, the role of intermodal/multimodal transport in services facilitating the Polish foreign trade is also changing.

Over the coming decade, the structures of the individual transport branches used to facilitate trade are expected to change. The share of transport by road should decrease in favor of more environmentally friendly modes, such as transport by rail or waterways. Any increase in the significance of rail transport in services facilitating Poland's foreign trade will largely depend on the results of investments using EU funds. As for inland waterway transport, any increase of its currently marginal share appears to be the biggest challenge due to the enormity of the required investments to modernize waterways and mostly, river harbor infrastructure; however, this calls for government-level commitment.

Nevertheless, it should be remembered that the choice of the means of transport for the carriage of commodities, including into foreign markets, is determined by multiple factors. In the case of international trade, of significance are issues such as the development directions of Polish exports and imports and the commodity structure of trade.

The specifics of foreign trade should be taken into account when planning the development of transport infrastructure.

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