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Maritime passenger transport in Poland – development trends

Agnieszka Barczak

https://orcid.org/0000-0001-7584-7183

West Pomeranian University of Technology in Szczecin
Department of Management and Marketing
47 Żołnierska St., 71-210 Szczecin, Poland
e-mail: agnieszka-barczak@zut.edu.pl

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Abstract

The COVID-19 pandemic is undoubtedly a global crisis that has forced the world economy to a standstill. Subsequent lockdowns have caused downtime in all industries and all transportation sectors. The removal of the restrictions has made it possible to begin a slow return to pre-pandemic conditions, but research indicates that this will be a long process. Therefore, an indication of the development trends of passenger maritime transport in Poland, considering the impact of the COVID-19 pandemic, is the purpose of the article. Two specific objectives are identified: (1) To visualize the impact of the COVID-19 pandemic on passenger maritime transport in Poland; (2) To make long-term forecasts of passenger maritime traffic in Poland. The analyses showed that the COVID-19 pandemic had a very negative impact on passenger streams. It may take several more years to recover from the pre-pandemic state.

Introduction

The COVID-19 pandemic has brought the modern world to a "standstill". In order to prevent its spread, the mobility of people locally, nationally, and internationally was restricted. Passenger traffic was halted in most modes of transport, causing financial and social losses that are difficult to estimate. As noted in the Commission Guidelines on the progressive restoration of transport services and connectivity – COVID-19 (2020/C 169/02): "The COVID-19 outbreak is having a major impact on transport and connectivity in the EU. Measures to contain the outbreak have resulted in a dramatic reduction in transport activity, especially in passenger transport. Freight flows have been less affected, in part thanks to collective EU efforts to ensure that freight continues to move. However, there has been a reduction due to declining economic activity and disruption of supply chains" (European Commission, 2020).

After the outbreak of the pandemic, a number of passenger ships were stopped at Polish ports and later began to impose restrictions on the number of passengers on board, among other things. The effect of these measures was to reduce the risk of passengers becoming infected and, thus, spreading the pandemic.

The withdrawal of restrictions has not resulted in a quick return to pre-pandemic status. On the contrary, many branches will still be rebuilding their position for years to come. Researchers are analyzing the impact of the pandemic on various branches of transportation; the results are converging. It is likely to take many years for passenger transport to begin to grow, with more than just a catch-up (e.g., Poliński & Ochociński, 2021; Barczak et al., 2022; Łukasiewicz, 2022).

In view of the above, the purpose of the article is to indicate the development trends of passenger maritime transport in Poland, considering the impact

of the COVID-19 pandemic. In this connection, two specific objectives are distinguished. The first is to illustrate the impact of the COVID-19 pandemic on this branch of transportation. The second specific objective is to make long-term forecasts of passenger traffic.

Material and methods

Single-basis absolute and relative increments were used to analyze passenger maritime transport in Poland. To build combined forecasts (Bates & Granger, 1969; Dickinson, 1973, 1975; Newbold & Granger, 1974; Bunn, 1978; Winkler & Makridakis, 1983; Bodo & Signorini, 1987; Clement, 1989; Mancuso & Werner, 2013) such procedures as the method of seasonality indicators (Cieślak, 1997; Jóźwiak & Podgórski, 2009), one-period trend method (Zeliaś, Pawełek & Wanat, 2003; Kukuła, 2004), model with seasonal fluctuations (Pawłowski, 1966; Dittmann, 2003; Zawadzki, 2003; Barczak, 2018), exponential smoothing method with additive seasonal component (Brown & Meyer, 1961; Montgomery, Gardiner & Johnson, 1978; Billah et al., 2006; Ostertagova & Ostertag, 2011, 2012; Üyesi & Orkun Oralpp, 2019; Kovačević, Rebić & Kurušić, 2021), and the method of harmonic analysis (Cieślak, 1970; Zeliaś, Pawełek & Wanat, 2003; Barczak, 2016) were used. It should be noted that the combined forecast was built based on the weighted average method, with weights inversely proportional to the ex-post MAPE error. Since the methods used in the study are generally known and widely discussed in the literature, the article is limited to presenting the results obtained using them.

All the analyses indicated were based on quarterly data for 2013–2022 from the Eurostat database. In the next stage of the analysis, annual long-term forecasts up to 2026 were built based on three assumptions: (1) the number of passengers will follow the trend determined using combined forecasts; (2) the number of passengers will show the same development trend as in 2013–2021 (average percentage increase or decrease); (3) the number of passengers will increase by 10% each year.

Results

The analysis of passenger maritime transport in Poland has been divided into two stages. The first stage includes an analysis of the dynamics of changes in the number of passengers transported [in thousands of people], while the second stage deals with the modeling and forecasting of the analyzed volumes. Since the analyzed series is characterized by seasonality of an additive nature, appropriate forecasting methods were adjusted at the second stage.

Table 1 shows the values of the absolute single-basis increments, and the values of the relative single-basis increments of the number of maritime passengers, using the corresponding quarters of 2019 as the base period.

Table 1. Single-subject absolute and relative increases in the number of passengers

Period	Absolute growth [in thousands of people]	Relative increases [in %]
I Q 2020/I Q 2019	–52	–13.72
II Q 2020/II Q 2019	–274	–45.97
III Q 2020/III Q 2019	–237	–26.30
IV Q 2020/IV Q 2019	–54	–13.40
I Q 2021/I Q 2019	–61	–16.09
II Q 2021/II Q 2019	–176	–29.53
III Q 2021/III Q 2019	–118	–13.10
IV Q 2021/IV Q 2019	1	0.25

In all quarters of 2020 and 2021, there were declines in the number of maritime passengers compared to the corresponding quarters of 2019. The exception here is the fourth quarter of 2021, in which the number of passengers increased by one thousand people compared to the corresponding quarter of 2019, an increase of 0.25%. The largest decline occurred in the second quarter of 2020, with 274,000 people, a decrease of 45.97% compared to the second quarter of 2019. In the third quarter of 2020 and the second quarter of 2021, passenger declines exceeded 20% compared to the corresponding quarters of 2019. In the third quarter of 2020, it decreased by 26.30%, which accounted for 237,000 passengers, while in the second quarter of 2021, there was a decrease of 29.53%, or 176,000 passengers (Table 1). “In 2020, 17.6 thousand ships (compared to 20.8 thousand vessels in 2019) with a gross tonnage (GT) of 231.1 million (down 7.4% from the previous year) and deadweight tonnage (DWT) of 172.1 million tons (down 3.9%) will call at Polish ports” (Statistics Poland, 2021). While, in 2021, Polish ports “will see 19.5 thousand vessels (...) with a gross tonnage (GT) of 246.5 million (6.7% higher than the previous year) and deadweight tonnage (DWT) of 179.7 million tons (4.4% higher)” (Statistics Poland, 2022).

The next step is to carry out forecasting of the analyzed volumes in order to compare the size of

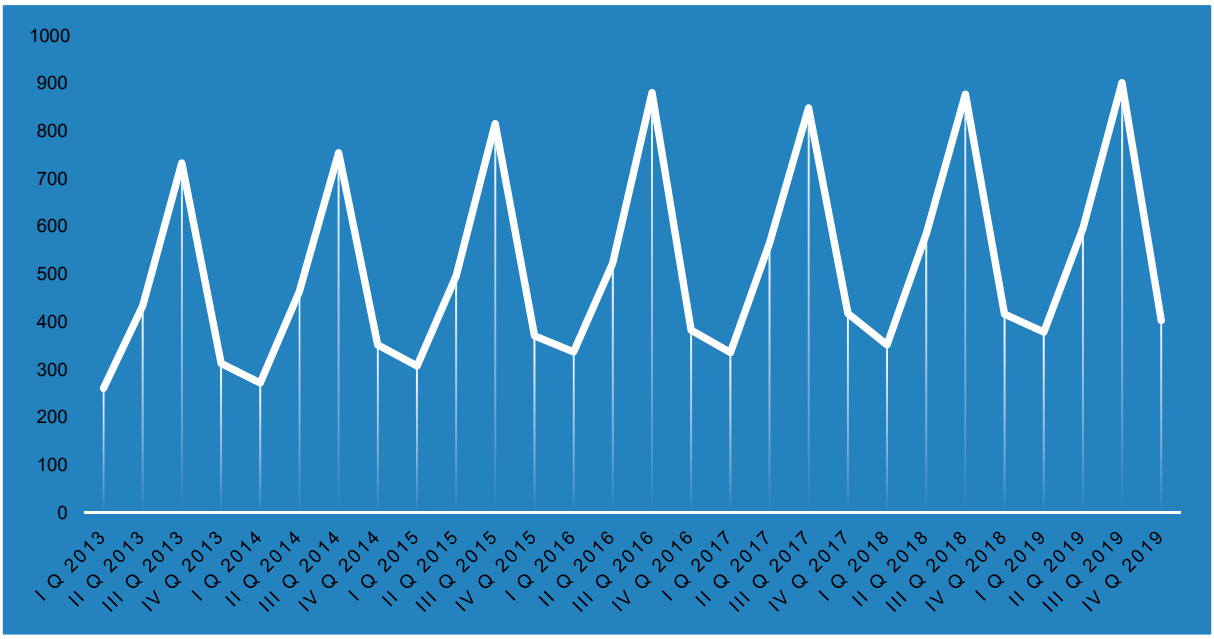

Figure 1. Number of passengers by quarter in 2013–2019 [in thousands]

the differences between the forecast values based on historical data and the actual realization of the variables. Figure 1 shows the development of the number of passengers in maritime transport in 2013–2019. As mentioned earlier, the analysis of statistical material indicates the presence of additive seasonal fluctuations.

The first method used for forecasting is the seasonality index method, which resulted in cleaned seasonality indexes. They indicate that only as a result of seasonality in the first and fourth quarters was the number of passengers lower by 182,712 and 143,645 thousand passengers, respectively, with respect to the trend line. In the second and third quarters, on the other hand, the number of passengers was higher with respect to the trend line by 13,168 and 313,190 thousand, respectively.

Another method used is the univariate period trend method. The functions that fit real data estimated for each quarter are shown in Table 2.

Table 2. Trend functions with fits to real data

Period	Model	R^2	*Vs*
I quarter	$y_t = 19.357t + 243.286$	0.9559	3.07%
II quarter	$y_t = 28.536t + 409.000$	0.9833	1.68%
III quarter	$y_t = 27.964t + 717.857$	0.8592	3.23%
IV quarter	$y_t = 15.893t + 315.857$	0.8195	4.65%

Next, a model with seasonal fluctuations was estimated (Table 3) and an exponential smoothing method with an additive seasonal component was applied (Figure 2).

Table 3. Seasonal fluctuation model with fit to real data

Model	R^2	*Vs*
$y_t = 287.679 + 5.734t - 41.511Q_1 + 155.183Q_2 + 456.020Q_3 - 569.692Q_4$	0.9919	3.93%

The model shown in Table 4 was obtained using a harmonic analysis. It explains 95.48% of the variance in the forecast variable.

Table 4. Harmonic analysis – the result of modeling

Model	% of variance
$y_t = 6.549t + 418.286 + 78.406 \sin[(2\pi/28)\cdot 7t] - 247.951 \cos[(2\pi/28)\cdot 7t]$	95.48%

Based on the results presented above, passenger forecasts were made for each quarter of 2020–2021 (Table 5).

Based on the forecast values in Table 5, combined forecasts were constructed for each quarter. It should be noted that since the use of a model with seasonal fluctuations generated negative forecast values (the fourth quarter of 2020 and 2021), this method was not included in the construction of the combined forecast. The forecasts are presented in Table 6, supplemented by the differences between the forecast and actual values in thousands of passengers and using the relative error of the ex-post forecast.

Based on the combined forecasts and the assumptions indicated earlier, three long-term forecasts were built. They are shown in Figure 3.

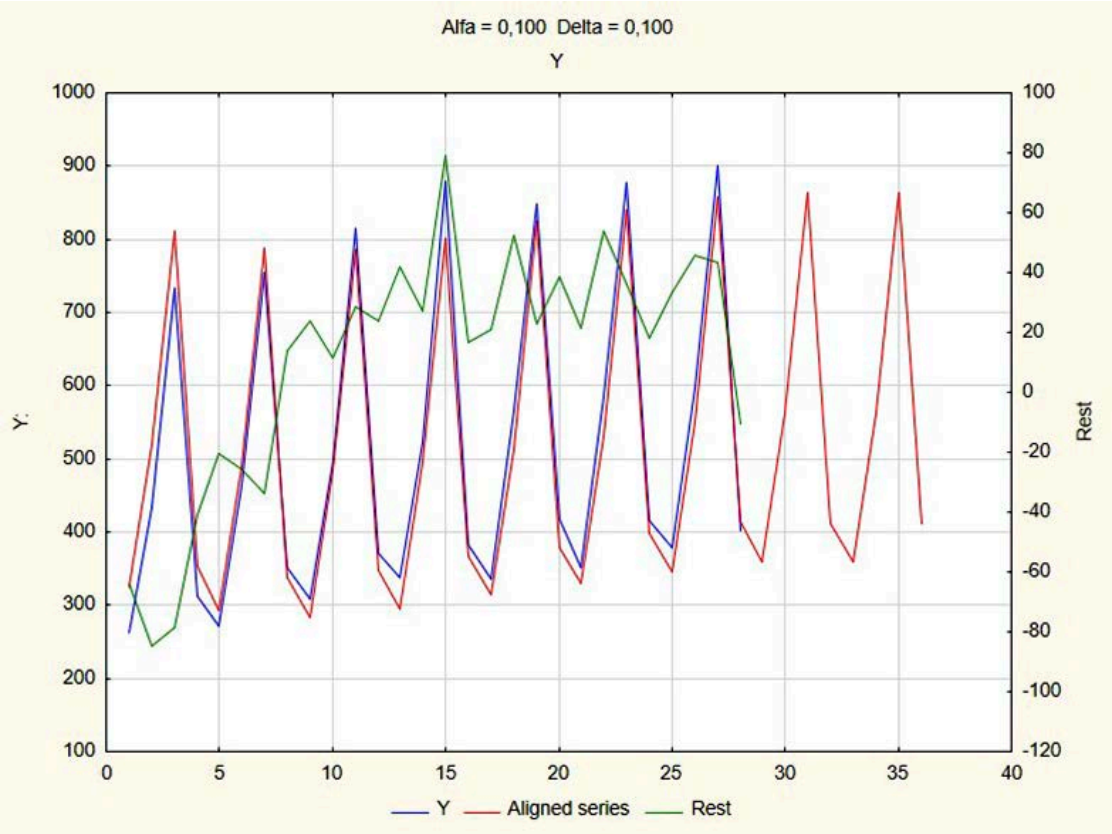

Figure 2. Exponential equalization model with additive seasonal fluctuations

Table 5. Passenger forecast for 2020–2021 [in thousands of passengers]

Method	Year	I quarter	II quarter	III quarter	IV quarter	MAPE
Seasonality indicators	2020	425.504	627.932	934.504	484.218	0.5449
	2021	634.413	640.962	647.511	654.061	
One-name period trends	2020	398.143	637.286	941.572	443.000	0.3945
	2021	417.500	665.821	969.536	458.893	
Model with seasonal fluctuations	2020	412.465	614.894	921.465	−98.513	0.6403
	2021	435.403	637.831	944.403	−75.575	
Exponential smoothing method	2020	359.726	562.092	864.678	411.525	0.2399
	2021	359.726	562.092	864.678	411.525	
Harmonic analysis	2020	686.648	862.707	542.879	379.922	0.7108
	2021	712.849	888.903	569.073	406.120	

Table 6. Combined forecast of the number of passengers

Period	Forecast	Difference	Relative ex-post forecast error
I quarter 2020	417.099	–90.099	–21.60%
II quarter 2020	627.879	–305.879	–48.72%
III quarter 2020	869.531	–205.531	–23.64%
IV quarter 2020	432.346	–83.346	–19.28%
I quarter 2021	467.308	–149.308	–31.95%
II quarter 2021	641.666	–221.666	–34.55%
III quarter 2021	823.141	–40.141	–4.88%
IV quarter 2021	473.702	–69.702	–14.71%

The above results clearly indicate an increasing trend in passenger numbers. The blue line (data with forecast) is a forecast based on the number of passengers that would have been served had there been no travel restrictions related to the pandemic. The current rate of growth in the number of maritime passengers (annual growth of 2.35%) indicates that the number of passengers served will not return to its pre-COVID-19 state until 2026. Only an annual increase of 10% in the number of passengers will make the branch recover in 2025.

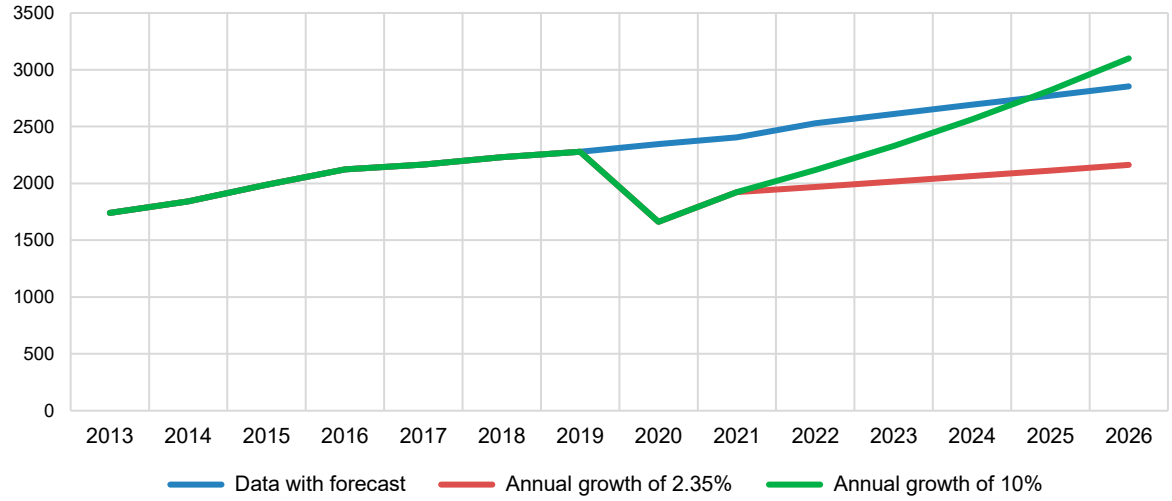

Figure 3. Long-term forecasts of the number of maritime passengers in Poland

Conclusions

Due to the fact that passenger maritime transport is nearly 80% international (according to the GUS, in 2019, it was 74.8% (92.0% is traffic between Poland and Sweden), in 2020, it was 81.5% (94.7% travel between Poland and Sweden), while in 2021 it was 76.2% of which 95.3% is maritime connections with Sweden), because of the pandemic state in force, passengers have reduced travel by sea transport to the minimum necessary. The demand for passenger transport has decreased significantly, which is mainly due to border closures and restrictions on population movement. Thus, the performed analysis clearly showed the negative impact of the COVID-19 pandemic on passenger maritime transport.

The long-term forecasts made indicate the need to support this mode of transportation. It seems necessary to provide logistical support for the development of port, road, and rail infrastructure. From the point of view of passenger transport, it is also important to provide catering facilities, accommodation facilities, etc., which is tantamount to developing the service offer and adapting it to market needs and the ever-increasing demands of passengers.

Taking care to increase demand for sea travel should also apply to those offering such services. Norwegian Cruise Line Holdings, which offers cruises, has chosen an interesting solution. The Holdings CEO warns against lowering cruise prices. In their opinion, a better strategy is to include additional services such as drinks on board, internet access, optional excursions, or a flight to the port and sell the package created in this way for a higher price. NCLH's CEO also believes that money, rather than discounts, is better spent on marketing, which his company is also doing for agents from travel agencies. They are one of the most important sales channels; unfortunately, they are also hard hit by the pandemic (German, 2022).

In summary, it should be noted that passenger maritime transport faces many challenges in terms of making up for financial losses and due to changes in people's mobility behavior. The industry needs both logistical and marketing support.

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