

## Impact of the COVID-19 pandemic on rail freight transport in selected EU countries

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**Keywords:** European Union, pandemic COVID-19, freight transport, rail transport, seasonality index method

**JEL Classification:** C32, C53, L92, N70, R41

### Abstract

The COVID-19 pandemic has affected all aspects of human life. Its negative effects have also hit the transport industry, largely as a result of staff contracting the virus and the restrictions imposed on human mobility. Therefore, the purpose of this study is to establish how the situation of rail freight transport in select EU countries has evolved in the post-pandemic era. The trend of rail freight transport is presented for the years 2015–2021, and forecasts are made for the years 2020–2021 using the method of seasonality indices. The study results show that most of the investigated countries show adverse differences in the actual and forecast quantity of freight handled, an effect clearly attributable to the pandemic.

### Introduction

The COVID-19 pandemic has had a negative impact on all areas of social and economic life worldwide (Fang, Wang & Yang, 2020; Arena & Aprea, 2021; Barczak, 2021; De Vet et al., 2021; Xuan et al., 2021). It has also taken its toll on transport (Barczak, 2021; Tianming et al., 2021). The lifting of part, or all, of the restrictions has not led to a recovery to pre-pandemic levels (Kolakowski et al., 2021; Barczak, 2021). On the contrary, many lines of transport are facing significantly reduced transport demand (Bagdatli & Ipek, 2022).

The impact of the COVID-19 pandemic on rail transport is indisputable. It has previously been investigated by a number of researchers and applies to different geographical locations and economic systems. For example, the impact of the pandemic on China's transport sectors has been researched in terms of demand and supply, which revealed heterogeneity in the impact of COVID-19 on individual

sectors. However, rail freight transport, rather than passenger transport, has been found to be less vulnerable to the negative impact of the pandemic (Cui et al., 2021). The literature also outlines the required steps needed for the rail sector to compete with other lines of transport in the event of future pandemic-like crises (Tardivo, Zanuy & Martín, 2021). The potential of the rail-road freight transport system has also been analyzed in international terms. Its potential to allow for new container-handling technological solutions has already been addressed. The authors argue that extending this solution to EU countries could result in a significant increase in the share of rail freight. Concurrently, the negative impact of the pandemic on supply chains would be mitigated (Vida, Illés & Bányainé Tóth, 2021).

From the brief literature review above, we can conclude that the COVID-19 pandemic has had a negative impact on rail transport worldwide. This is partly attributable to the rail freight transport being restricted in the early days of the pandemic

due to, in part, the challenges of inter-border shipments. Many countries would take case-by-case decisions to halt or severely restrict international traffic. However, after a few months, the international rail transport market situation improved, and transport volumes started to gradually increase. In Poland, as a result of the decrease in passenger services, the capacity of railway lines increased, positively influencing journey times and on-time performance of goods trains. With a high degree of confidence, we can presume that the situation was comparable in other countries.

The improved condition of rail freight transport operations has also been influenced by freight transport not having been subject to the same restrictions as passenger transport; some countries have even seen increases in traffic (e.g., Germany). National governments made it a priority to ensure continued freight exchange in the era of the pandemic in Europe. Alongside road transport, rail transport ensured the continuity of the supply of food and essentials and supported government efforts to deliver the tools to fight the pandemic, such as cleaning products, personal hygiene, and medicines and equipment (UTK, 2021). Concurrently, in a situation of restrictions on road freight, when trucks stood for hours at the borders, there was interest in rail transport for those goods that had not previously been transported by rail in Europe (Walków, 2020).

Notably, the (mainly financial) consequences, however, have been and continue to be paid by rail infrastructure managers and owners of service infrastructure centered around passenger rail transport. The COVID-19 outbreak has brought about a sharp drop in demand for rail transport services. This has had a serious impact on railway undertakings. The impact started to manifest itself as early as 1 March 2020, and it is likely to last until at least 31 December 2020. The circumstances linked to the COVID-19 outbreak are beyond the control of railway undertakings, which are facing considerable liquidity problems and major losses and in some cases the risk of insolvency (Regulation, 2020).

In view of the above, the purpose of this study is to investigate how the rail freight situation in select EU countries has evolved post-pandemic. However, the study excluded a distinction between national and international transport. Furthermore, freight volume forecasts for the period 2020–2021 were constructed on the basis of quarterly Eurostat data for the period 2015–2021, which are used to determine the scale of deviations that impacted rail freight traffic as a result of the COVID-19 pandemic.

## Sample and methodology

The countries with the highest volume of freight transported by rail in 2019, i.e., countries with volumes exceeding 364,120 thousand tons, were selected for analysis (Figure 1). This group included Germany (364,120 thousand tons), Poland (233,744 thousand tons), Austria (102,575 thousand tons), the Czech Republic (98,804 thousand tons), and Italy (94,295 thousand tons).

With data for the years 2015–2019, we made forecasts of transported freight volumes in each quarter of 2020 and 2021 for the selected countries. As rail freight traffic in all analyzed countries is characteristic of additive seasonality, the method of seasonality indices was used to make forecasts. This method is generally well-known and widely reported in the literature (e.g., Sobczyk, 2006, pp. 231–232; Barczak et al., 2022). Therefore, the paper focuses on the result analysis without providing a detailed description of the method. Of note, however, due to the forecasting method not being based on a formal model, it is not possible to determine the forecast error (Jóźwiak & Podgórski, 2009, pp. 441–442).

## Results

The portrayal of changes in the volume of transported freight (Figure 2) suggests a plausible hypothesis that the COVID-19 pandemic had a temporary negative impact on this line of transport. In Germany, 5.99% less freight was transported in 2020 but there has been 4.99% more in 2021 vs. 2019. Compared to 2019, it was 6.71% and 2.83% less freight in Poland, 4.94% and 0.73% less in Austria, and 7.63% and 1.31% less in the Czech Republic. In Italy, compared to 2019, there was a decrease of 5.68% in freight volumes in 2020 and an increase of 4.58% in 2021.

The following presents the results of the forecasts. For cargo in each of the countries analyzed, empirical data charts with a quarterly breakdown were created. On this basis, it was possible to make conclusions about the course of seasonal fluctuations. For all countries, the analysis showed that these are series with periodic fluctuations. The real-world data show a development trend with seasonality; therefore, the trend functions for each country were estimated (Table 1). The parameters of all the models set out in the Table are statistically significant at  $\alpha = 0.05$ .

Based on the above seasonality indices, Table 2 presents the freight traffic forecasts for the individual

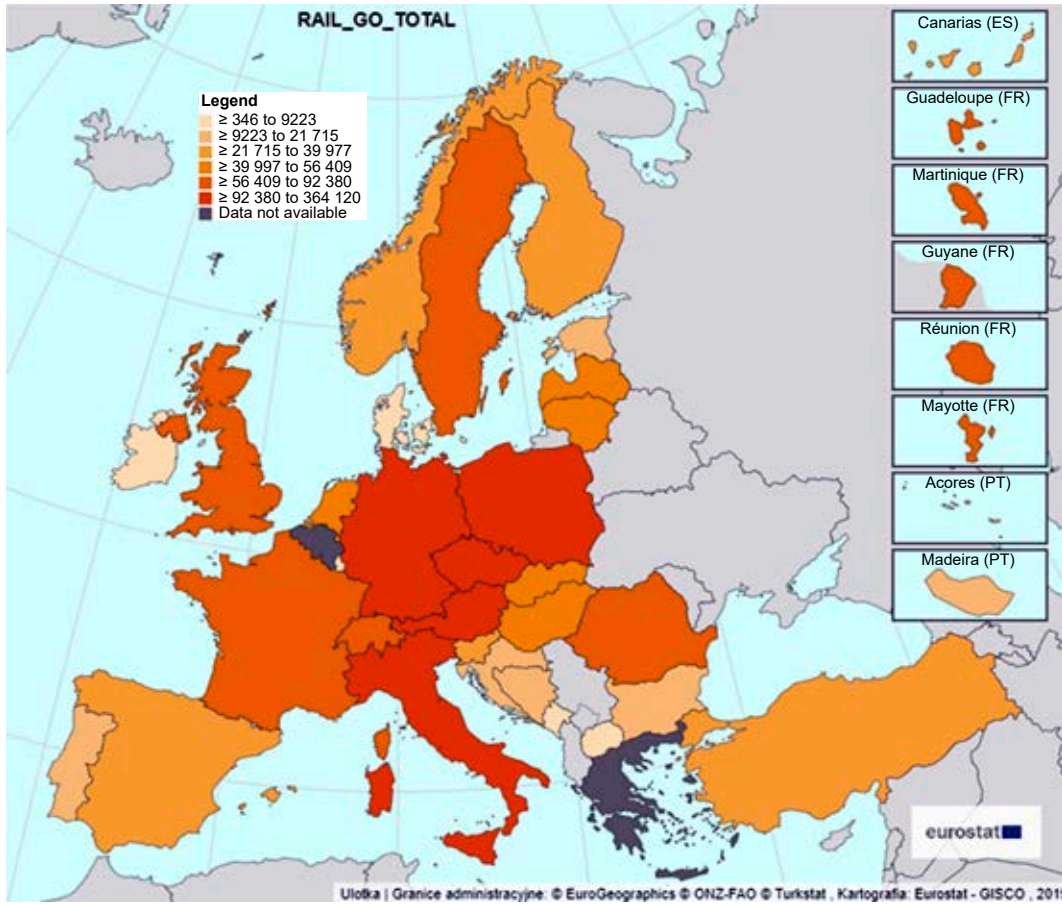


Figure 1. The volume of freight transported by rail in EU countries, 2019

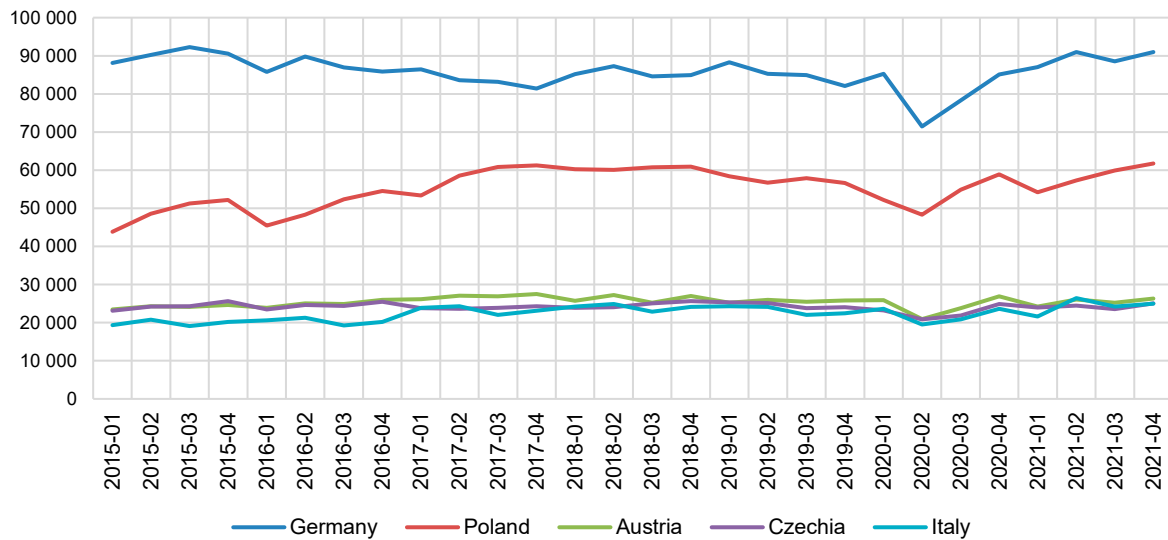


Figure 2. The volume of freight transported by rail in selected EU countries by quarter, data for 2015 to 2021

Table 1. Estimated functions of trends

Country	Trend function
Germany	$y_t = -309.9459 t + 89590.5316$
Poland	$y_t = 718.4481 t + 47561.1947$
Austria	$y_t = 118.2218 t + 24344.7211$
Czechia	$y_t = 28.5429 t + 24092.9000$
Italy	$y_t = 239.5496 t + 19637.1789$

quarters of 2020 and 2021. The forecast results are rounded to whole numbers.

Figures 3 to 7 show a comparison of the volumes of freight actually transported against the forecast values. The red line indicates the differences between the forecast values and the actual freight volumes in each country.

**Table 2. Forecasts for individual quarters of the years 2020 and 2021**

Country	Forecasts 2020			
	Quarter I	Quarter II	Quarter III	Quarter IV
Germany	83 043	83 497	82 666	81 245
Poland	60 896	63 037	65 237	65 720
Austria	26 321	27 346	26 744	27 607
Czechia	24 271	24 685	24 612	25 357
Italy	25 337	25 947	23 931	24 878

Country	Forecasts 2021			
	Quarter I	Quarter II	Quarter III	Quarter IV
Germany	81 802	82 257	81 426	80 005
Poland	63 769	65 911	68 110	68 594
Austria	26 794	27 819	27 217	28 080
Czechia	24 385	24 799	24 726	25 471
Italy	26 295	26 905	24 889	25 836

In Germany, in the first and fourth quarters of 2020, the actual freight volumes exceeded the forecast by 2258 thousand tons and 3831 thousand tons, respectively. Throughout 2021, the forecast volumes are lower than the actual freight volumes. The

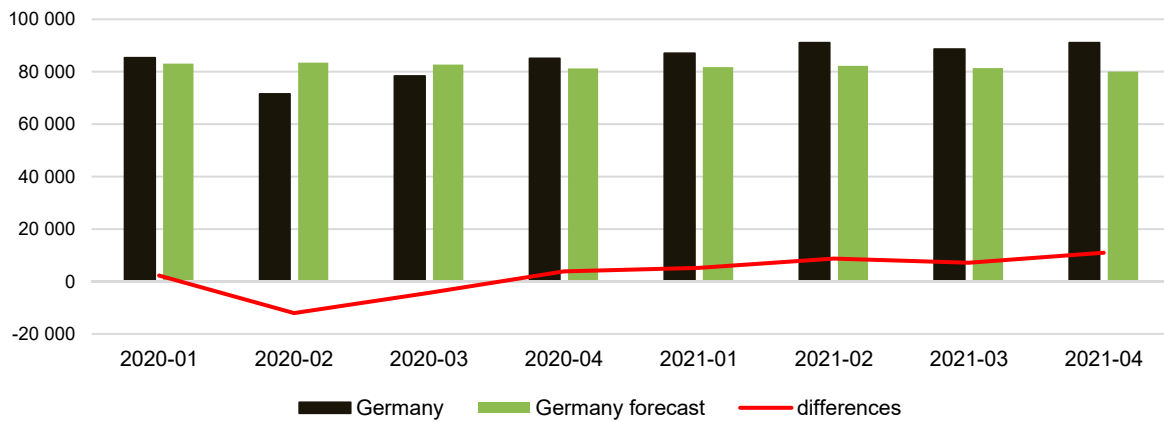
differences are as follows: 5223 thousand tons, 8755 thousand tons, 7124 thousand tons, and 10,971 thousand tons (Figure 3).

In Poland, all the actual values were lower than forecast. The largest differences were recorded in the second and third quarters of 2020, i.e., 14,718 thousand tons and 10,371 thousand tons, respectively (Figure 4).

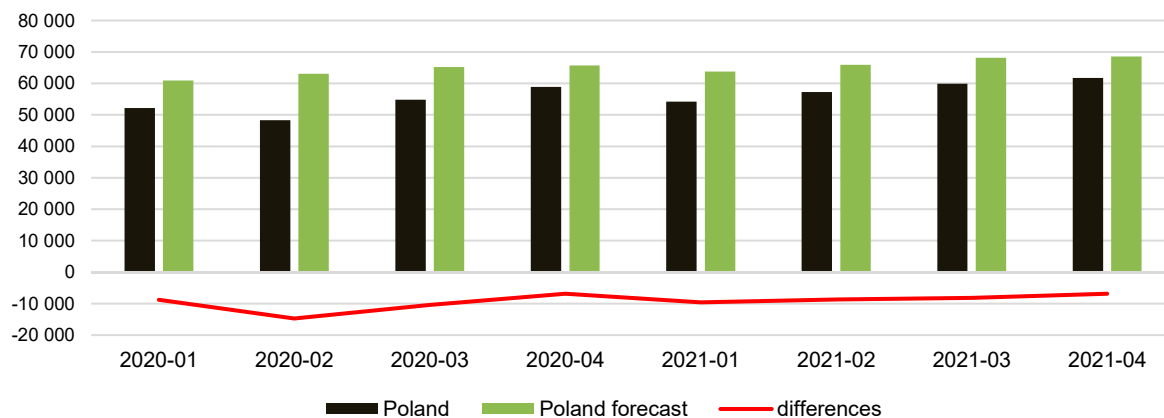
As in other countries, the volume of transported freight in the second and third quarters of 2020 decreased significantly in Austria. Compared to the forecast values, these were decreases of 6412 thousand tons and 2972 thousand tons, respectively. In the other periods, the volumes of transported freight were slightly lower than forecast (Figure 5).

For Czech rail freight transport, all volumes in 2020–2021 fall short of the forecast volumes. The highest differences were reported in the second and third quarters of 2020: 3816 thousand tons and 2716 thousand tons, respectively (Figure 6).

In Italy, the volumes of transported freight decreased significantly in the second and third quarters of 2020. Compared to the forecasts, these were decreases of 6396 thousand tons and 3042 thousand



**Figure 3. Comparison of actual and forecast freight volumes in Germany**



**Figure 4. Comparison of actual and forecast freight volumes in Polandes in the Czech Republic**

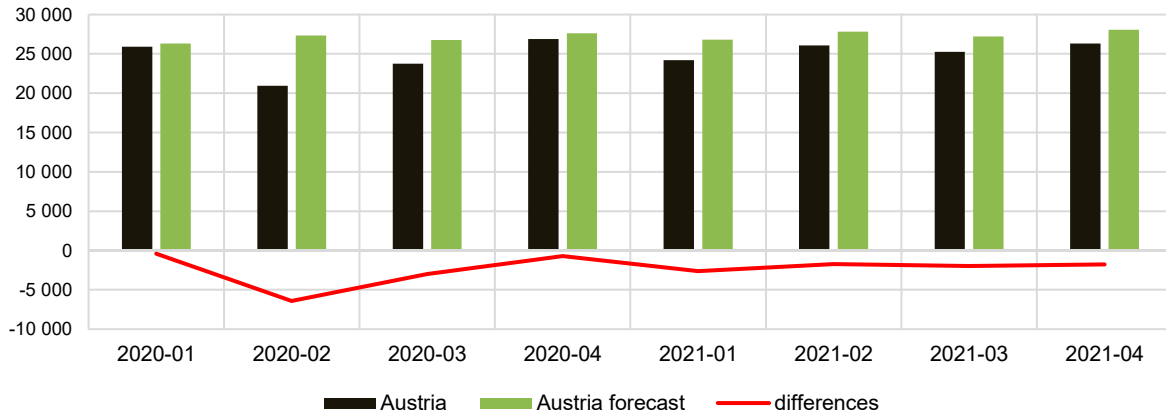


Figure 5. Comparison of actual and forecast freight volumes in Austria

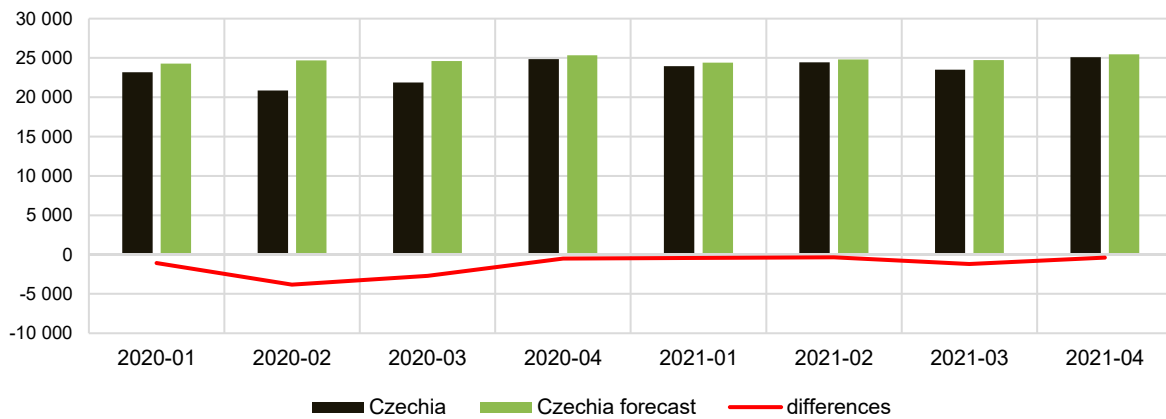


Figure 6. Comparison of actual and forecast volumes in the Czech Republic

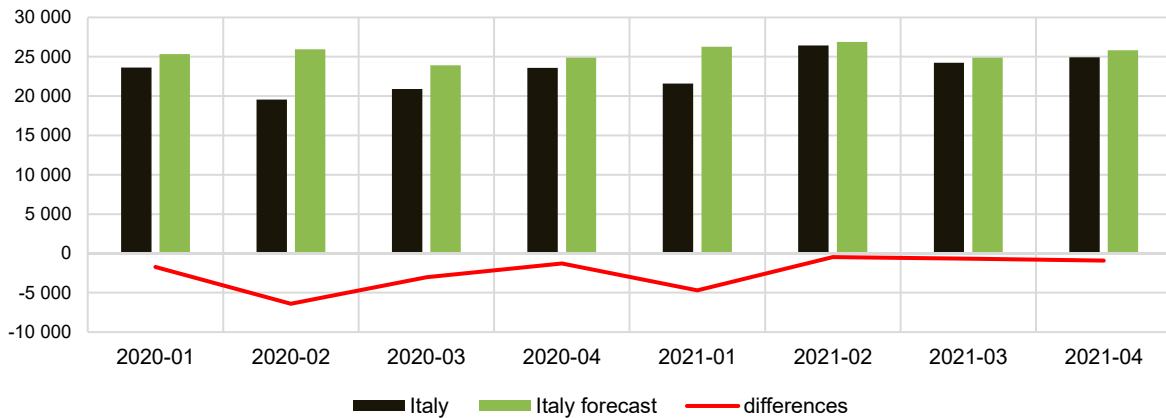


Figure 7. Comparison of actual and forecast freight volumes in Italy

tons, respectively. A major decrease, against the forecast values, was also recorded in the first quarter of 2021, at a value of 4696 thousand tons. Notably, all the actual freight volumes were lower than the forecast values (Figure 7).

### Conclusions

As the rail freight and passenger transport restrictions had a different “impact zone”, it is reasonable

to expect that rail freight volumes will recover after the initial shock due to the declaration of the state of pandemic threat. All the countries under review reported significant declines in freight volumes in the second and third quarters of 2020. However:

- In Germany, after the aforesaid decrease, there has been a significant increase exceeding the pre-pandemic level of transport. Compared to the estimated forecasts, it is reasonable to estimate that between 2020 and 2021 there was a surplus

of 21,764 thousand tons of freight transported in Germany;

- In Poland, after the initial decline, transport volumes have been higher than in the previous years, but lower than forecast. It is, therefore, reasonable to estimate that Poland's 2020–2021 volume of transported freight fell 73,931 thousand tons short of the forecasts;
- In Austria, after two quarters of decline, the volume of transported freight evolved at a similar level as in the pre-pandemic period. However, the freight volumes were 18,591 thousand tons lower between 2020 and 2021, as compared to the forecasts;
- In the Czech Republic, after the aforesaid decrease, the freight volumes took on a profile similar to that of the pre-pandemic era. However, they were lower than forecast. Between 2020 and 2021, the difference stood at 10,455 thousand tons;
- In Italy, as in the other countries, the freight volumes started to gradually rebound to the pre-pandemic level following the reported decreases. Between 2020 and 2021, the actual freight volumes were lower than forecast. During the reference period, the difference stood at 19,151 thousand tons.

Although freight traffic has been diverted to rail, as far as possible, due to international traffic restrictions and travel requirements for truck drivers in some countries (e.g., Germany), the rate of growth in freight volumes has slightly slowed versus the previous years. Our findings clearly point to the major differences between the volume of transported freight and the forecast values. In view of their readings, the select countries only saw a fall of 133,437 thousand tons of freight transported by rail.

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**Cite as:** Barczak, A. (2022) Impact of the COVID-19 pandemic on rail freight transport in selected EU countries. *Scientific Journals of the Maritime University of Szczecin, Zeszyty Naukowe Akademii Morskiej w Szczecinie* 72 (144), 11–16.