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## The Impact of COVID-19 on Road Freight Transport Evidence from Poland

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**Abstract:**

**Purpose:** The main aim of this article is to investigate the impact of the COVID-19 pandemic on the Polish road freight transport industry. This paper seeks to understand the impacts on travel behavior and the transport system caused by the different actions and policies adopted by the governments and transport authorities to contain the COVID-19 spread.

**Design/Methodology/Approach:** Econometric and statistical methods were used, including analysis of primary data, predictive model of exponential smoothing.

**Findings:** Using primary data as part of the study, conclusions have been reached, stating that the imposition of the lock-down of the European economy had a negative impact on the short-term business of transport enterprises. On the other hand, once the number of infections was reduced, followed by a reduction in restrictions, the number of road kilometers covered by the enterprises under survey increased. This increase was higher than in the corresponding periods of previous years.

**Practical Implications:** The article analyses short-term effects on road freight transport of legal provisions aimed at limiting the virus's spread. Results can be helpful to draw some recommendations for transport systems derived and planning process by the enterprise. The researcher effect can also be helpful for national governments in terms of decision-making.

**Originality/Value:** The literature review shows that most of the authors have focused on analyzing the situation of the road transport branch in China, while the impact of the coronavirus on road transport in Europe has not been studied to a more significant extent so far. The study of the case involves Polish transport enterprises making up the second-largest carrier in the Community when the size of its rolling stock and transport tasks is compared to that of other states. The consequences of the pandemic on road cargo transport by Polish carriers indicate the impact of COVID-19 on the economic situation of similar enterprises from other European Union states.

**Keywords:** COVID-19, pandemic disease, Poland, road transport, economic restrictions, transport volume.

**JEL classification:** R40, R41.

**Paper Type:** Research article.

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## **1. Introduction**

From ancient times to the present day, all epidemics and pandemics have had a greater or lesser impact on people, the economy, and even politics (Bell and Lewis, 2004; Habicht, Pate, Varotto, and Galass, 2020; Huremović, 2019; Rudrajit and Jyotirmoy, 2020). Not to discuss epidemics, in 20th and 21st centuries, we witnessed outbreaks of three flu pandemics - the Spanish flu (1918-1920), the Asian flu (1956-1958), and the Hong Kong flu (1968-1970). In the following years, humanity experienced pandemics in dengue fever, swine flu (2009-2010), and Ebola hemorrhagic fever (2013-2016). The latest plagues of this type, or the COVID-19 pandemic, began marching around the world in late 2019 in China but quickly arrived in other states. In March 2020, the World Health Organization (WHO) announced the beginning of the global coronavirus pandemic.

The speed and manner of this pandemic spreading in the global economy considered its consequences for human health and life and the efficiency of health systems, the governments of many states decided to impose certain restrictions in social and economic life. Interpersonal contacts were limited, and social distance was ordered to be kept. Furthermore, it has become mandatory to wear mouth and nose protective masks when in the company of other people, both in buildings, public transport, and outdoors. Entrepreneurs in restaurants, hotels, fitness, recreation and entertainment were forced to close their businesses temporarily. Mobility within the state, but also between states, was restricted more or less stringently. Initially, the restrictions imposed were thought not to be necessary for a long time, and in their consequence, sufficient to help overcome the pandemic. However, now, after more than a year of existing with the COVID-19 virus, with recurring waves of disease, and successive periods of lockdown, we know that defeating it will not be easy or quick. The vaccination - expected to grant immunity to the populations of all states in the world, those less developed included, brings the hope of returning to everyday life.

The critical state of health affairs and the solutions introduced by governments to overcome it brought about the economic crisis and enormous problems for many branches of the economy in each country (among other things, the hotel industry, tourism, and recreation, transport, restaurants, health care, trade, automotive industry). Such phenomena manifested this as recession, the decline in GDP, reduction in consumption and investment projects, increase in unemployment, and poverty (Gern and Hauber, 2020; Sikder, Zhang, and Ahmod; 2020 Kufel, 2021). Growing economic uncertainty was followed by a decline in foreign trade turnover, a collapse in supply chains (Zhu, Chou, and Tsai, 2020), a growth in budget deficits in many states, and rising inflation (Balcilar, 2020, Mishra, 2020, Malliet, Reynés, Landa, Hamdi-Cherif, Saussay, 2020, Kuroda, 2020, Schwab and Zahidi, 2021). The experience of life for over a year in the pandemic along with subsequent phases of opening and lockdown of the economy which occurred in the European states together with difficulties in overcoming emerging virus mutations, cause further economists' concerns about the successive waves of recession (Colbourn, 2020; Prem, Yang,

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Russell, Kucharski, Eggo, and Davies, 2020; Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, and Jit and Klepac, 2020).

However, while concluding previous crises, governments try to counteract the demand recession through increased government spending (subsidies for companies to maintain jobs, material aid for citizens). At the same time, some positive economic phenomena can be noticed that could reduce the scale of the recession. Fortunately, some branches operate intensively during the pandemic, growing faster than before the COVID-19 virus appeared. They include, among other branches IT, e-commerce, food retail, biotechnology, and the pharmaceutical industry. This may reduce the GDP decline rate. However, in the current situation, it is difficult to precisely set out the adverse impact of the global pandemic on the world economy and individual states.

As indicated by Rodríguez-Caballero and Vera-Valdés (2020), the results of the pandemic for unemployment will be of long-term nature. They will force governments to find appropriate counter-cyclical policies to reduce the adverse impact of the recession on the economy. Cerra, Fatás and Saxena have a similar opinion (Cerra, Fatás, and Saxena, 2020). Some economists predict that global economic indices will not reach their pre-pandemic levels for a long time (Guerrieri *et al.*, 2020; McKibbin and Fernando, 2020; Grima *et al.*, 2020). UN experts also emphasize the need to introduce changes in the principles on which the global economy functions and the socio-economic policy of individual states (United Nations, 2021).

The transport, which involves the movement of all types of cargo and people, turned out to be a branch under a strong adverse impact which the pandemic had on the economy. This can be seen for all its types - road, rail, air, and sea transport. As the pandemic developed, various aspects of this phenomenon were studied in the context of changing demand for freight and passenger transport services due to government restrictions imposed in various states, supply chains being disrupted, production, consumption, and investment projects declining. The literature review shows that most of the authors have focused on analyzing the situation of the road transport branch in China, while the impact of the coronavirus on road transport in Europe has not been studied to a more significant extent so far (JuHo, Xing, Wu, and Lee, 2021). Some information on the impact of the COVID-19 pandemic on road freight transport in Europe can be found in the reports drawn up in 2020 by consulting bodies and economic intelligence agencies, such as IRU Intelligence (2020) or Transport Intelligence (2020).

The paper aimed to study the impact of the COVID-19 pandemic on the Polish road freight transport industry. The analysis of data on Polish road carriers gives exciting facts on the impact of this threat on the transport of goods in the European Union. The study of the case involves because Polish transport enterprises make up the second-largest carrier in the Community when the size of its rolling stock and transport tasks is compared to that of other states (Kozłak, 2018; Suproń, 2020; Łącka and Suproń, 2020). The consequences of the pandemic on road cargo transport by Polish carriers

indicate the impact of COVID-19 on the economic situation of similar enterprises from other European Union states.

The authors of this paper attempt to show how the restrictions imposed by the authorities of individual Member States to stop the spread of COVID-19 have affected the business of transport companies. The results of the empirical data analysis help to supplement the knowledge gap on the economic consequences of the pandemic for the road freight transport industry in Poland and other European Union Member States. Furthermore, the research results obtained allow conducting more detailed analyses referred to a more extended period. The facts noted may also be helpful for individual governments to decide to impose further restrictions aimed at slowing down the spread of the COVID-19 pandemic.

## **2. Literature Review**

The impact of the COVID-19 virus spread on human mobility has been recognized by scientists from different fields - from medical, natural sciences to technical and social sciences already at the early stages of epidemic development (e.g., Donthu and Gustafsson, 2020; Sigala, 2020; Roboison and Lhermie, 2020). In the beginning, the researchers' attention was focused, first of all, on trying to find a link between population's mobility and the faster spread of the virus (Chinazzi *et al.*, 2020).

Another aspect on which they focused their attention was the impact of restrictions imposed in many states on population's mobility (Huang *et al.*, 2020). Subsequently, the research was centered on the impact of the pandemic on the generally understood topic of transport, particularly in the context of urban logistics, which was the subject of analyses by Gutiérrez, Miravet, and Domènech (2020) and Wielechowski, Czech, and Grzęda (2020). Some scientists focused their attention also on the impact of the COVID-19 epidemic on the air transport industry, which was one of the first types of transport to be under the adverse impact of the restrictions imposed (Abu-Rayash, 2020; Nižetić, 2020; Huang *et al.*, 2020).

In subsequent studies, scientists dealt with issues related to cargo transport. Ivanov was one of the first researchers to draw attention to disruptions in global supply chains, if any, as an effect of the spread of the SARS COV-2 epidemic, at the same time, underlining that the extent of disturbance shall be influenced by the period of the epidemic and the scale of its spread (Ivanov, 2020).

Furthermore, in individual regions of the world, analyses were carried out on the impact of the epidemic on supply chains, first of all, related to agricultural and food products (JuHo *et al.*, 2021; Coluccia *et al.*, 2021; Singh *et al.*, 2020; Gray, 2020). This problem was also analyzed by Chowdhury *et al.* (2021).

Following the progress of data being gathered, more and more aspects have been addressed concerning the epidemic impact analysis on the road freight transport

industry. This has been involved by demand and supply shocks in the economy. They have followed the growing scale of new disease cases and restrictions imposed in individual states (JuHo *et al.*, 2021; Baqae and Farhi, 2020). In the beginning, industrial production was limited in China (He *et al.*, 2020), which also contributed to a reduction of the volume of cargo transported by sea (Millefiori *et al.*, 2021; Gray, 2020), and thus reduced road transport as part of a combined carriage (Botha and Dednam, 2020). Subsequently, restrictions also affected the production and trade industry in Europe (Statista, 2020). These factors had an adverse impact on road freight transport (Arellana, Márquez, and Cantillo, 2020; Loske, 2020) as the transport demand is a secondary demand dependent on industrial production (Hesse and Rodrigue, 2004).

On the other hand, changes in shopping habits and preferences have become an opportunity for the development of transport enterprises in connection with the increased interest in the e-commerce industry (Alaimo, Fiore, and Galati, 2020; Chang and Meyerhoefer, 2020) and the decline in fuel prices on global markets (Sansa, 2020; Ghazanfari, 2020; European Commission, 2020; Kozicki, Górnikiewicz and Walkowiak, 2020).

### 3. Research Methodology

The study paper was drawn up based on data from 177 enterprises registered in Poland, which between 2019 and 2020 provided road freight transport services in the European Union states, using 6,895 vehicles. The data gathered covered information on daily and monthly mileage. Research data were obtained based on records from telematics systems, including drivers' cards and digital tachographs. The following assumptions were made for the study:

- lower demand for transport is linked to a smaller number of kilometres
- that vehicles cover while transporting loads in particular periods,
- the owner of the transport enterprise that pays the fixed costs in the form of driver's remuneration, depreciation, or fees for the lease of the vehicle tries to maximize the use of its vehicle,
- transport enterprises earn revenues based on the rate per one km and the number of kilometres covered and try to achieve a maximum of the vehicles being used in each working season.

Therefore, by the assumptions adopted, the number of kilometers covered daily, weekly and monthly shall illustrate the demand for transport services. Assessing the COVID-19 epidemic's impact on the business of Polish transport enterprises, it became necessary to estimate the fundamental values related to the number of kilometers covered before the epidemic intensified, during its period, and when the restrictions were eased. The study included the data from the daily increase in the number of infected people in the European Union to compare the epidemiological

situation with transport dynamics in the enterprises under survey. This assumption relied on the research of the restrictions in most states related to the spread of the pandemic, which was made more stringent with the increase in the daily number of those struck with the disease, and eased after this indicator was reduced.

Within this study, an attempt was also undertaken to analyze the consequences of a no-pandemic situation, if any, and thus no lockdown of individual economies. For this purpose, the exponential smoothing model was applied - Brown's model for an additive time series. The model was used, the following premises were taken into consideration (Billah *et al.*, 2006):

- too few observations in the time series that could allow to apply more complex methods like Census, ARIMA and artificial neural networks,
- the time series tested does not show a strong trend,
- slight seasonal fluctuations can be noticed in the phenomenon observed.

The exponential smoothing model consists of one predictive equation (Brown and Meyer, 1961):

$$y_t^* = F_{t-1} = \alpha y_{t-1} + (1 - \alpha) y_{t-1}^* \quad (1)$$

where:

$\alpha$  - is the smoothening index i  $0 < \alpha < 1$ ,

$y_t^*$  - prediction of variable Y determined for the moment or t period,

$y_t$  - value of variable predicted for the moment or t period.

#### 4. Results and Discussions

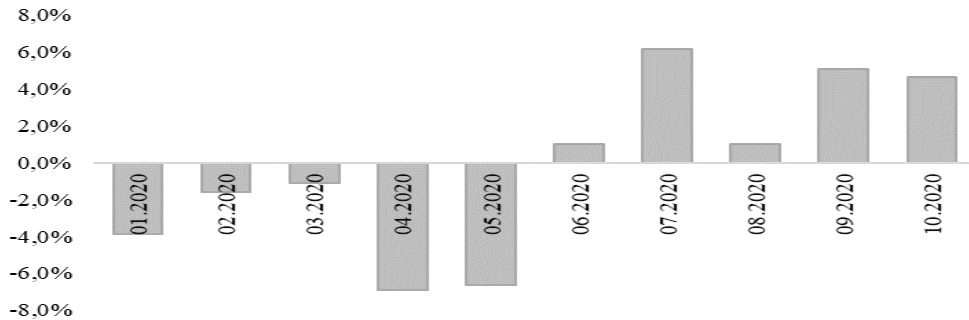
The daily number of kilometres covered by one vehicle was adopted as the basic value to assess the activity of vehicles operated in the enterprises under survey. It was necessary to adopt this daily value in order to normalize the data in consequence of different distribution of holidays and days off in individual months of the period under survey. The number of kilometres covered by a vehicle for one day being estimated, it allowed to eliminate the disturbances indicated and ensure the comparability of data in individual years under survey.

The data analysis regarding average daily vehicles mileage in individual months of 2019 and 2020 shows that in January 2020 vehicles covered 3.9% fewer kilometres than in the corresponding period of 2019. In the following months, this figure began to come closer to the mileage recorded in February and March 2019 and showed an insignificant decline. On the other hand, since April 2020, when most European Union States decided to lockdown economies, a significant reduction in the average number of kilometres covered was clear compared to the corresponding period of 2019. This decline continued until May 2020. In subsequent months, a growth occurred in the daily mileage made by vehicles in the transport enterprises under survey. In the period



from June 2020 to October 2020, these values were higher than in the corresponding periods of 2019 (Figure 1).

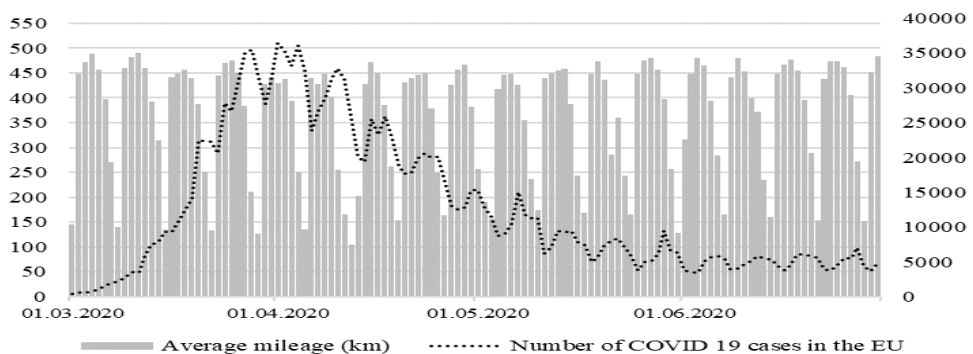
**Figure 1.** Difference between average mileages in individual months of 2020 and 2019 (2019 = 100%)



Source: Own study.

A more in-depth analysis indicates that the daily average mileages in the enterprises under survey were reduced from 27th March 2020 to 15th May 2020 (down to a level below 450 km per day). Afterward, the number of kilometers covered started to grow again on individual days. Data analysis about the disease cases caused by the epidemic indicates that in the last week of March 2020, the pandemic growing rate in Europe accelerated dramatically. The number of newly revealed cases kept increasing intensively to reach its maximum on 4th April 2020. At the same time, the rapid growth of the number of patients contributed to new restrictions being imposed on people in their social and economic contacts in most European Union states (Figure 2). It also forced the lockdown of the business of many branches and industries of the economy (among other things: air transport, tourism, hotels, catering, entertainment, hair and beauty, and fitness industries included).

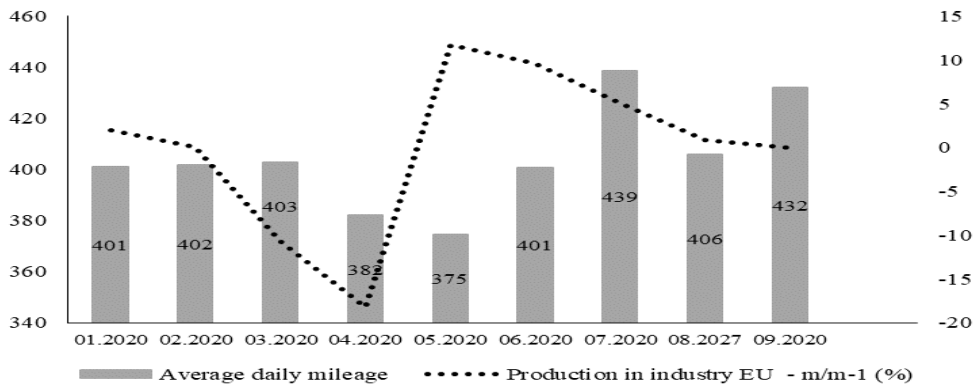
**Figure 2.** Comparison of average daily mileages of heavy load vehicles from 01.03.2020 to 30.06.2020 with the number of those struck with COVID-19 and registered in the European Union



Source: Own study.

The summary of the monthly data indicates that the average number of kilometers covered in a given month by vehicles of the enterprises under survey showed a time delay about changes in industrial production. The one-month shift is evident in the analyzed period. In March 2020, a rapid decline in industrial production occurred in the European Union, and the average daily mileage started to decline only in April 2020. However, the revival of industrial production after the lockdown in May 2020 resulted in a growth of the average number of kilometers covered by a vehicle only in June 2020 (Figure 3).

**Figure 3.** Comparison of average daily mileages of vehicles with the number of new COVID-19 cases in the European Union



**Source:** Own study.

The indicated relationship testifies to a close connection between the transport services of the enterprises under survey and the industrial production in the European Union states. In the analyzed period, fluctuations in the industrial production caused by the imposed economic restrictions directly impacted the demand for transport services, and by the same, on the use of the vehicle's stock belonging to the enterprises under survey.

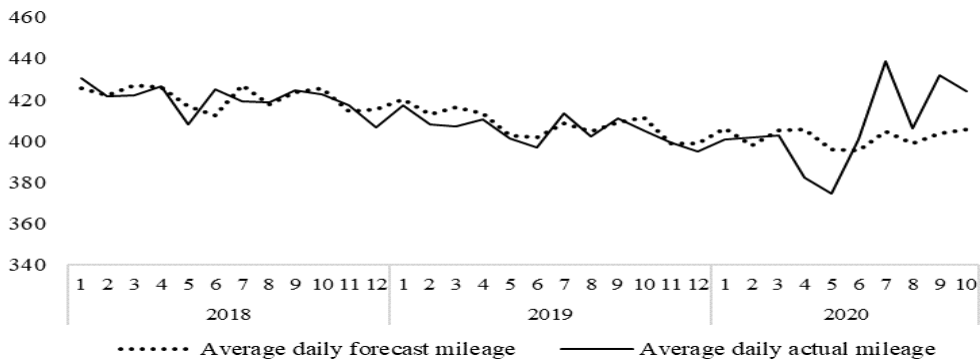
In order to set out the potential mileage losses of the vehicles used by the enterprises under survey, a prediction was made based on the data obtained for the years 2017-2019. The purpose of the model was to indicate the potential level of vehicle mileage in the enterprises under survey if there had not occurred the COVID-19 epidemic and the lockdown related to it, which was imposed in the European Union in April and May 2020.

For this purpose, a seasonal model of exponential smoothing was used, for which the parameter  $\alpha = 0.454$  was estimated. The comparison of ex-post data with the data obtained as a result of prediction with the model allowed us to ascertain that the model reflected well the phenomenon under study. The mean absolute prediction error (MAPE) for the data gathered was estimated at 1.16%, which allows us to claim that the prediction drawn up is acceptable. Afterward, the data obtained from the prediction



from April 2020 to September 2020 were compared with the ex-ante data gathered for the indicated months. The comparison of the predicted data and those obtained from the empirical study indicated that the difference between the average daily mileage in the months from April 2020 to September 2020 differed significantly. A deviation in April and May is also apparent (Figure 4).

**Figure 4.** Average daily predicted mileage and the actual one between 2018 and 2020



*Source: Own study.*

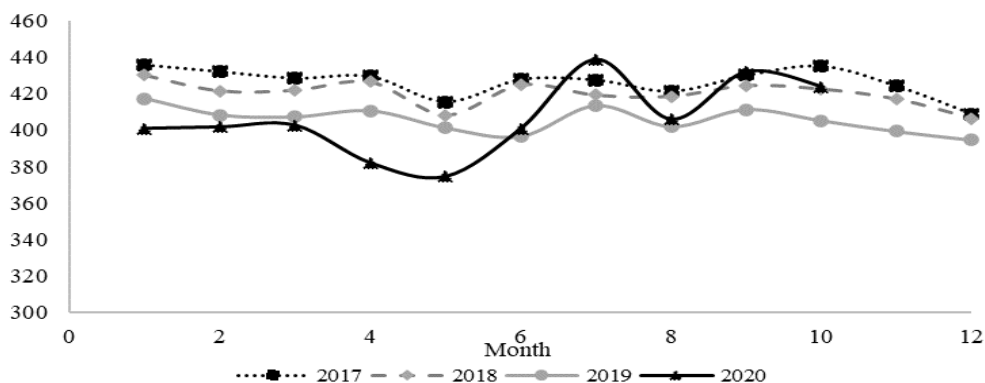
In April, the average daily mileage of vehicles in the enterprises under survey was lower by 23.2 km compared to the prediction, and in May, by 21.1 km. On a monthly scale, this meant that in April, the mileage was on average 489.0 km lower than predicted, while in May, it was lower by 420.3 km. Assuming the margin of error of the estimated prediction, the results obtained indicate that in consequence of the reduction in mileage, the enterprises under survey recorded a loss in the number of kilometers covered about the situation with no lockdown of European economies. Thus, the demand for transport services of the enterprises under survey can be assumed with great caution to have been lower in the initial period of the epidemic, and the vehicles covered shorter distances than those predicted.

It shall also be emphasized that a violent increase in mileage occurred from June 2020 to September 2020, which largely derogated from the data obtained as a result of the prediction. In the authors' opinion, the increase in the demand for transport services was the revived economies of the European Union states caused by the gradual reduction of restrictions in summer. The mileage values exceeding those predicted may have resulted from the accumulated demand for transport services due to production processes being resumed in many enterprises and trading businesses being re-activated. Thus, the analysis of data obtained as a result of prediction and those ex-ante allows claiming that the COVID-19 pandemic impacted the transport enterprises under survey. This negative impact of the pandemic on the operations of road transport companies in Poland in the first half of 2020 was also demonstrated by Głodkowska and Owczarek (Głodkowska and Owczarek, 2020).

However, it shall be underlined that in the case of road cargo transport, the decline of mileage was noticeable in the short term, followed by a rebound of business. This may testify to the fact that in cargo transport, the demand for transport in the event of a lockdown accumulates and in subsequent periods after the de-frosting of the economy, the number of carriages increases along with kilometers covered.

The conclusions discussed above are confirmed by analyzing data on average daily mileage in individual months in the period from 2017 to 2020 in the enterprises under survey. Compared to the previous years, a substantial decline in the discussed value can be noticed in April and May 2020. A general analysis of the data gathered shows that the number of kilometers covered by vehicles is liable to seasonal fluctuations, in which periods occur with more kilometers covered by the vehicles, along with periods in which this figure goes down. However, in April and May 2020, the most significant decline of this value was recorded in the enterprises under survey in the entire period from 2017 to 2020. At the same time, starting in June 2020, the average daily number of kilometers covered by the vehicles of the enterprises under survey increased again, and their situation was similar to that in 2019 (Figure 5).

**Figure 5.** Comparison of average daily mileage of the vehicles under survey in individual months between 2017 and 2020



Source: Own study.

## 5. Conclusion

The survey results depict the scale of economic losses resulting from the policies related to the lockdown of individual industries during the first wave of the COVID-19 epidemic. The analysis shows that the mobility of people is limited, sanitary restrictions imposed in many enterprises, and the ban on conducting business imposed on many industries that reported their demand for road transport directly impacted the volume of road transport carried out by Polish transport enterprises. This, in turn, brought about the bankruptcy of small businesses. “Additionally, the sanitary regime imposed several difficulties and reorganized the work of shippers. Many entrepreneurs, particularly the smallest ones, were not able to cope with the crisis and,

in consequence, were forced to close their enterprises” (Starzyk, 2021). In road cargo transport in Poland, the pandemic triggered some concentration processes. The research of Bisnode experts indicates that in 2021, the consequence of COVID-19 will be numerous mergers, acquisitions, and consolidations in this industry (Starzyk, 2021).

The empirical results also have several other implications. Primarily, after the period of the mileage decline in the enterprises under survey, there was an increase in the number of kilometers covered by vehicles on a larger scale than in previous years. This could depict a change in consumers’ behavior who reduced the consumption of their goods during the lockdown period. After the lockdown period, consumption grew more than under normal conditions, which may be due to consumption storage. This caused a response - an increase in industrial production, which affected the transport market with delay. Another factor that shall not be excluded, which contributed to the number of kilometers covered by vehicles, was the intensified interest in shipping goods and the intensive development of e-commerce in Europe (Ecommerce Europe, 2021).

Cargo transportation will be undoubtedly helpful to expand the database and create in-depth scientific studies on the impact of the COVID-19 epidemic on the road transport industry. Observations regarding this issue may also provide conclusions on other research areas, consumers’ behavior, and preferences during the national quarantine period. To determine the impact the policy of support to road haulage enterprises had in periods of economic lockdown on their ability to survive. It then resumed its operating in the post-pandemic economy could make an interesting topic for future research.

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