THE IMPACT OF THE COVID-19 PANDEMIC ON THE DEVELOPMENT OF SELECTED REGIONS OF UE COUNTRIES

Andrzej WÓJCIK

University of Economics in Katowice; andrzej.wojcik@ue.katowice.pl, ORCID: 0000-0003-3803-8840

Purpose: The purpose of the considerations presented in the paper was to examine the changes that occurred in both population and GDP size and in selected economic sectors as a result of the outbreak of the COVID-19 pandemic in the highlighted EU regions.

Design/methodology/approach: The paper examined the impact of the COVID-19 pandemic on the population of selected EU regions, GDP in those regions, and the impact of the pandemic on the unemployment rate, the number of people at risk of poverty or social exclusion, the number of nights spent in overnight accommodations, the number of passengers traveling by air, the number of people who ordered goods or services online in the past year, and employment in high-tech sectors. The impact was examined by analyzing development trend models for selected variables and verifying the hypothesis of constancy of model parameters with the Chow test. Predictions of selected variables were also counted if there had been no pandemic and compared to actual values from the COVID-19 pandemic period.

Findings: Not all regions were equally affected by the effects of the pandemic. This was undoubtedly influenced by the authorities' struggle with the effects of the pandemic, but also by the entrepreneurial spirit of the residents of the regions studied. Also in different spheres of economic life, the effects of the pandemic varied from negative to positive.

Research limitations/implications: Further research should also include the other EU regions and more economic sectors, allowing us to group regions according to similarities in coping with the pandemic and calculate spatial correlations. A problem we may encounter is the lack of sufficient data, which may result in the exclusion of some regions and economic sectors from the study.

Social implications: Through the research, we can highlight regions that are coping better with the effects of a pandemic, and this can inspire regions that are coping less well. In the future, regions can look up to the actions carried out by authorities in other regions to offset the effects of pandemics (or other disasters with global effects) and transfer them to their own region.

Originality/value: The article compares regions within the boundaries of which are national capitals. It was shown which region did best in combating the effects of the pandemic and which did less well. The article also shows what the impact of the pandemic was on the various branches of the economy.

Keywords: COVID-19 pandemic, trend models, Chow test.

1. Introduction

The COVID 19 pandemic had a major impact on both social and economic life around the world, this has been addressed in many scientific articles (Ambroziak, 2020; Czajkowska, 2020; Długosz, 2021). This article examines the impact of the pandemic on the development of selected regions of the EU. Undoubtedly, the impact of the pandemic varied across countries and even across different regions of these countries. The study aims to identify which areas of the economy (among those studied) where most affected by the pandemic, and whether it had a stimulating or destimulating effect on the development of the area and economic life in the analyzed regions. While the literature offers a study of the impact of the pandemic on specific industries (Bukowski, 2023; Hasić, 2023; Nguyen et al., 2021) in terms of the economy of the country as a whole, the following paper examines the impact of the pandemic on specific regions.

In addition to the main objective of examining the changes that occurred as a result of the COVID-19 pandemic in selected economic sectors in the highlighted regions of EU pastures, a research hypothesis was also put forward stating that the effects of the pandemic were not felt in the same way in all regions. Also, in different spheres of economic life, the effects of the pandemic varied.

In addition to the changes in population and GDP of selected regions, the analysis included 6 areas of the economy:

- unemployment rate,
- people at risk of poverty or social exclusion,
- nights spent in tourist accommodations,
- air transport of passengers,
- people who ordered goods, or services over the past year on the Internet,
- employment in high-tech sectors.

All analyses were conducted in 22 EU regions. They are regions in which the capital cities of the selected countries are located: Région de Bruxelles-Capitale, Praha, Hovedstaden, Berlin, Attiki, Comunidad de Madrid, Île de France, Grad Zagreb, Lazio, Latvija, Luxembourg, Budapest, Malta, Noord-Holland, Wien, Warsaw Capital, Área Metropolitana de Lisboa, Bucuresti - Ilfov, Zahodna Slovenija, Bratislavský kraj, Helsinki-Uusimaa, Stockholm.

Using data from Eurostat (Eurostat, 2023), a trend function was estimated for each region and each variable, and then verified

In the next step, the increments of the variables in 2020 and 2021 compared to the previous year were calculated. The trend models were also estimated again using data up to 2019, and forecasts for 2020 and 2021 were calculated. Finally, the relative increments of the actual values to the forecast values were counted. The forecasts can tell us what the values of the variables would be if the pandemic had not occurred.

2. Methodology

Using time series data on individual economic sectors for selected regions, trend functions were estimated using the Least Squares Method. Polynomial trends of the first, second and third degree were used in the modeling.

$$y_t = \alpha_0 + \alpha_1 t + \xi_t \tag{1}$$

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \xi_t \tag{2}$$

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t^3 + \xi_t \tag{3}$$

Model verification included checking whether the random component of the model has a normal distribution with the Jarqua-Berry test, examining the autocorrelation of the residuals with the Durbin-Watson test and the Lagrange multiplier test, as well as verifying the hypothesis of heteroskedasticity of the random component with the White test. Unfortunately, it was not always possible to estimate the parameters of the model that passed the verification process. This was mainly due to the lack of data. Models that passed the verification process correctly were subjected to the Chow test to examine the stability of the models' parameters. The lack of stability of the models' parameters unambiguously meant a significant change in the trend of a given variable, and therefore a significant impact of the COVID-19 pandemic on a given variable in the study region. The absence of grounds for rejecting the null hypothesis of parameter stability does not mean that there has been no change in the values of the variables, but only that the expected value of the forecast error is zero, i.e., the forecast is unbiased. All tests are widely described in the econometric literature (Biolik, 2018; Maddala, 2006; Osińska, 2007).

3. Population

The COVID-19 pandemic has undoubtedly had a significant impact on socio-economic life worldwide. The first case of SARS-CoV-2 coronavirus infection was detected in November 2019 in Wuhan of China's Hubei Province, a city of 12 million people. In March 2020, the coronavirus pandemic spread to Europe and North America, among others. According to UN data, more than 6.9 million people worldwide had died from COVID-19 by May 2023 (Termedia, 2023).

Authorities in no EU region have protected their citizens from coronavirus infections. Studying the population from 2010 to 2021 in the studied regions, it was not possible to estimate the trend function for 2 regions due to the lack of data. For the remaining regions, the Chow test was performed after estimating the model parameters. For 7 regions (35%), the Chow test did not detect structural changes in the analyzed models.

On average, in the 20 regions analyzed, the population fell by about 0.01% in 2020 compared to 2019, so the decrease was insignificant. It should be remembered that in addition to births and deaths, the population is affected by migration. Since the analysis covered the regions in which the capital cities are located, we can expect that the migration balance in these regions is positive. In the next step, population projections for 2020 and 2021 were calculated on the basis of data from 2010-2019. Finally, the average share of the actual population to the projected population was calculated (Table 1).

Table 1.
Average share of actual population to projected population in 2020 and 2021

Year	Share
2020	99.31%
2021	99.25%

Table 1 shows that the average decrease in the actual population compared to the projected population was almost 1%, and this is a significant difference. It can be stated that the COVID-19 pandemic slowed down the development of the studied regions. The largest decrease in population in 2020 compared to 2019 was in Prague (4.9%), and the largest increase was in Luxembourg (1.3%) (Figure 1).
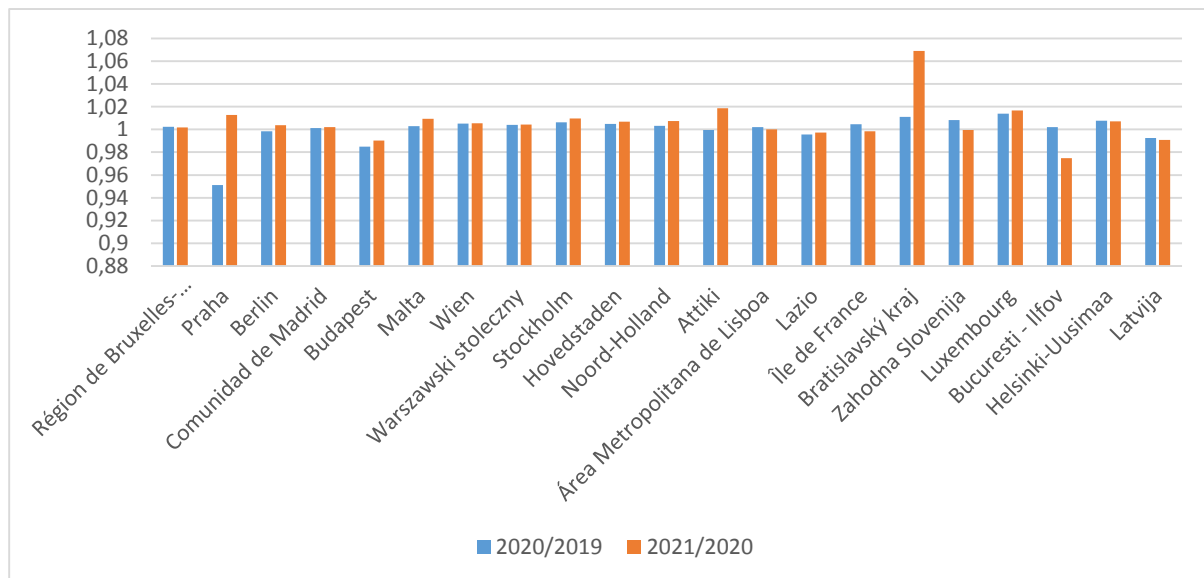

Figure 1. Relative population growth in 2020 and 2021 compared to the previous year.

In 2021, compared to 2020, such large population declines are no longer observed, although in the Bucuresti - Ilfov region the decrease was about 2.5%. On the other hand, the Bratislavský kraj region saw a population increase of as much as 6.9 percent.

4. Regional gross domestic product

A slowdown in regional development is associated with a slowdown in GDP growth. Again for 2 regions the trend function could not be estimated, because the models did not pass the verification process. This time, in 6 cases out of 20 (30%), the Chow test failed to detect significant structural changes in the models. Thus, it can be argued that in the vast majority of regions there was a significant change in GDP as a result of the COVID-19 pandemic.

Among the regions for which the trend models could be developed, the average decrease in GDP was 3.7%, and among all 22 regions it was 3.8%. Only 3 regions saw an increase in GDP in 2020 compared to 2019 - in the Hovedstaden, Luxembourg and Stockholm regions, where the increase was between 1.3 and 3.9 percent. The largest decrease in GDP was in the Comunidad de Madrid - 9.8 percent.

An average GDP decline of 3.7% is a very high decline, but given that these regions are still developing, the potential GDP decline could have been even larger. Table 2 shows the average share of actual GDP values in their projections calculated on the basis of new trend functions.

Table 2.
Average share of GDP value in the forecast GDP value in 2020 and 2021

Year	Participation
2020	92.19%
2021	95.65%

Table 2 shows that the gap between actual GDP and what could have been reached is even greater. The COVID-19 pandemic certainly had a significant impact on slowdown in economic growth. The exception is Luxembourg, where the share of GDP to projected GDP in 2020 was more than 101.7%.

It can also be seen from Table 2 that in 2021 the situation began to improve rapidly, and on average the GDP share was lower than the forecast by about 4.35%.

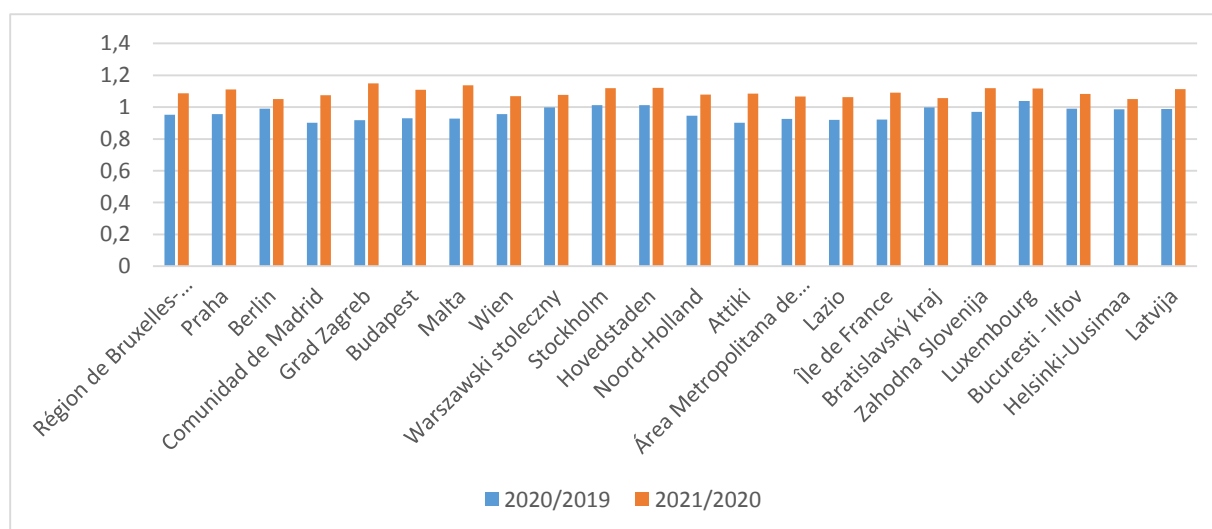The relative GDP growth by region is shown in Figure 2.

Figure 2. Relative GDP growth in 2020 and 2021 in the examined EU regions.

Figure 2 shows that the recession resulting from the COVID-19 pandemic in the studied regions did not last long, and in 2021 there was an increase in GDP in all regions. The highest GDP growth was recorded in Zagreb (15%), and the lowest in the Helsinki-Uusimaa region (5%).

5. Unemployment rate and people at risk of poverty or social exclusion

On the one hand, in 2020, on average, the population of the studied regions decreased, and on the other hand, the value of GDP also decreased. What impact did both of them have on the change in the unemployment rate?

For 17 regions it was possible to estimate a trend model. In 10 out of these 17 models, the Chow test did not give grounds to reject the hypothesis of no structural change in the models. In most cases (59%), there was no significant structural change in the trend models. If we look at the change in the unemployment rate in 2020 compared to 2019, it can be noticed that only 3 regions out of 22 saw a decrease, which means that in 19 regions (86%) the unemployment rate increased (Figure 3). In 2021, the unemployment rate increased in 7 regions and decreased in 13.
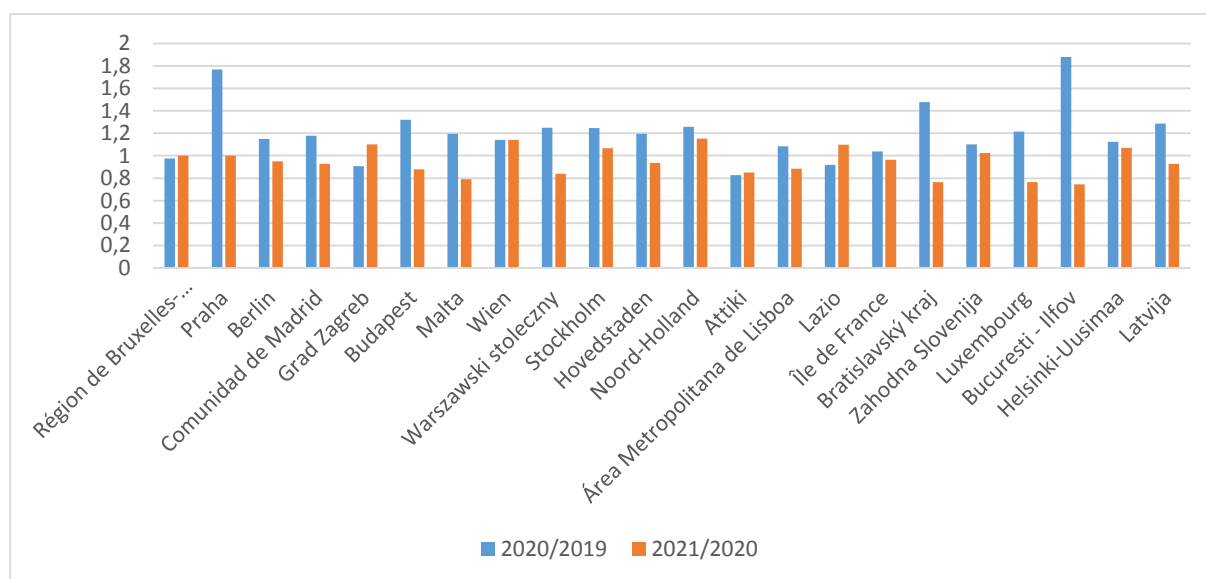

Figure 3. Relative increases in the unemployment rate in 2020 and 2021 in the examined EU regions.

When comparing the actual unemployment rates in 2020 and 2021 with the forecasts for those years, it can be found that in both 2020 and 2021, only 1 region (out of 19) had an actual unemployment rate lower than the forecast[1]. This was the Área Metropolitana de Lisboa region.

---

[1] In the case of the unemployment rate, no average relative changes are provided because the forecast values of the unemployment rate are sometimes small (close to 0) and the relative differences between the actual unemployment rate and the forecasts are huge (in the case of the Zahodna Slovenija region it is 4500%), which has a very large influence on the average.

This can lead to the conclusion that the outbreak of the pandemic had an impact on the unemployment rate in the studied regions.

The number of people at risk of poverty is associated with growing unemployment. For this variable, Eurostat has a very poor database, so trends were not estimated for individual regions, and only the relative changes for 2019-2020 and 2020-2021 were calculated (Figure 4). Of the 14 regions for which data were available, in 2021, 8 observed a reduction in the share of people at risk of poverty in the total population, and in 1 region the rate remained unchanged. This means that in 5 regions the share of people at risk of poverty increased. In the studied regions, the average decrease in this share in 2020 was 5%.
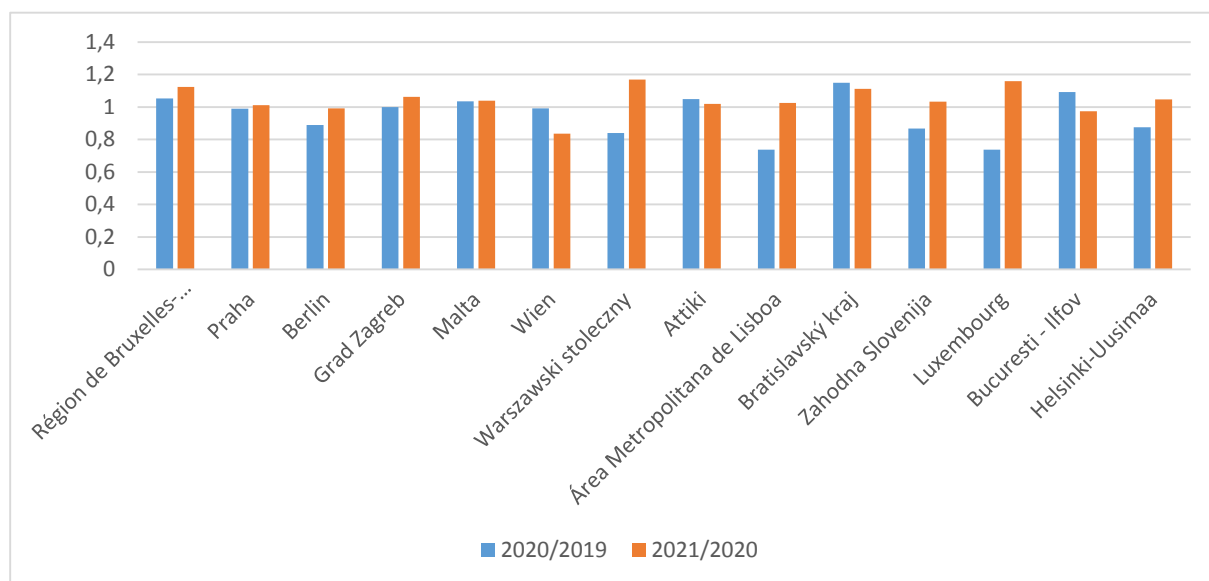

Figure 4. Relative increases in the number of people at risk of poverty in 2020 and 2021 in the surveyed EU regions

In 2021, the situation worsened the average increase in the share of people at risk of poverty for the surveyed regions was more than 4%. In as many as 11 regions, the share increased, and only in 3 it decreased.

Overall, the worst situation was in the Bratislavský kraj region because in 2020 the number of people at risk of poverty, compared to 2019, increased by about 15%, and in the following year by another 11%. In 2021, the largest relative increase in the analyzed variable was observed in the Warsaw Capital Region - an increase of 17%.

6. Nights spent at tourist accommodation establishments and air transport of passengers

During the COVID-19 pandemic, various countries introduced several restrictive regulations to counteract the spread of the pandemic. This undoubtedly had a significant impact on the tourism industry. Of the trend models for the 14 regions that could be estimated,

the Chowa test detected significant structural changes in all of them. The average decrease in occupied beds in 2020 compared to 2019 in all 22 regions was 64% (Figure 5), which meant disaster for the tourism industry. The following year saw an increase in occupied beds, reaching an average of 34%.
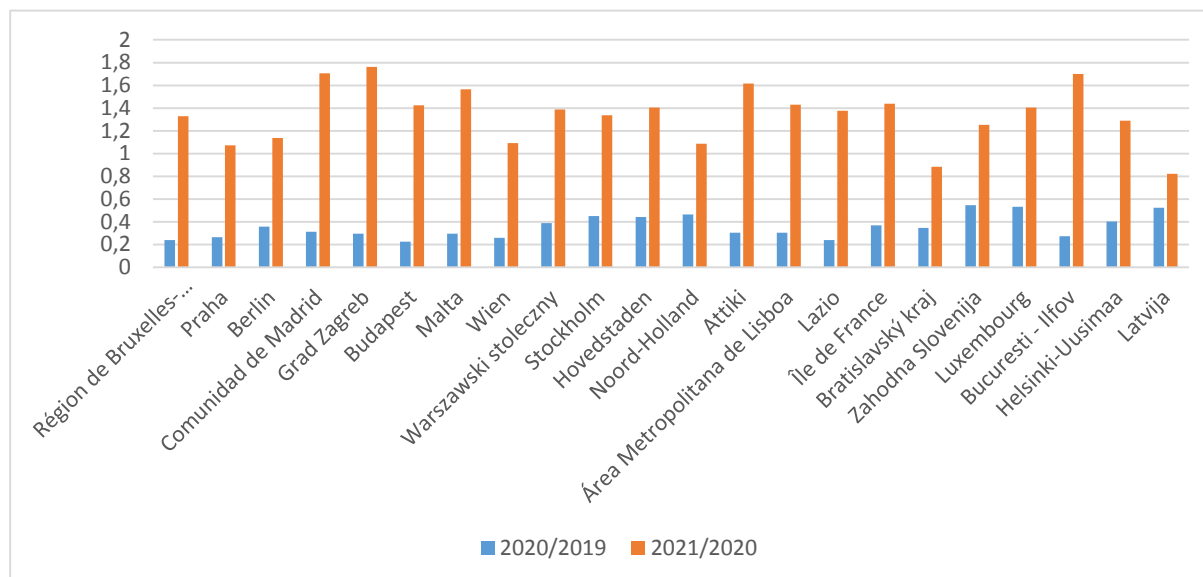

Figure 5. Relative increase in the number of occupied bed places in 2020 and 2021 in the surveyed EU regions.

In 2020, the worst situation was in Budapest, where the number of occupied beds decreased by 78% compared to the previous year, and the best situation was in the regions: Zahodna Slovenija, Luxemburg and Latvija. In 2021, a decrease in occupied beds was only observed in 2 regions, i.e., in Bratislavský kraj and Latvija. Three regions saw an increase of more than 70%, with the largest increase in the Grad Zagreb region (76%).

For 15 regions the forecasts for 2020 and 2021 could be calculated. Certainly, not assuming the outbreak of the pandemic, the forecasted number of occupied beds was much higher than the actual number of occupied beds, as confirmed in Table 3.

Table 3.
Average share of nights spent in tourist accommodation facilities in the forecast of nights spent in tourist accommodation facilities in 2020 and 2021

Year	Participation
2020	35.06%
2021	43.07%

In 2021, the situation was much better, but it was still bad. The travel industry seems to have suffered the most from the pandemic. The number of travelers is also related to accommodation bookings. The study examined only passengers using air transport.

For this variable in all 17 estimated models the Chow test showed significant structural changes in the models. Thus, the outbreak of the pandemic affected not only the accommodation facilities, but also passenger transportation. The average decline in the number of passengers in

the 19 regions for which data were available reached 74% in 2020 compared to 2019 (Figure 6), which represents even greater decrease than for occupied accommodations. Comparing the number of airline passengers to their projections for 2020 proves to be even worse, with a drop of 77%. In 2021, the situation improved and there was a 23% increase in passengers served compared to 2020, but the situation was still very bad compared to the non-pandemic forecasts (the actual number of passengers was 71% less than the projected number of passengers). Such a tough situation in the airline market contributed to the collapse of 103 carriers, but interestingly, as many as 126 new airlines were established during the pandemic (Money, 2023).
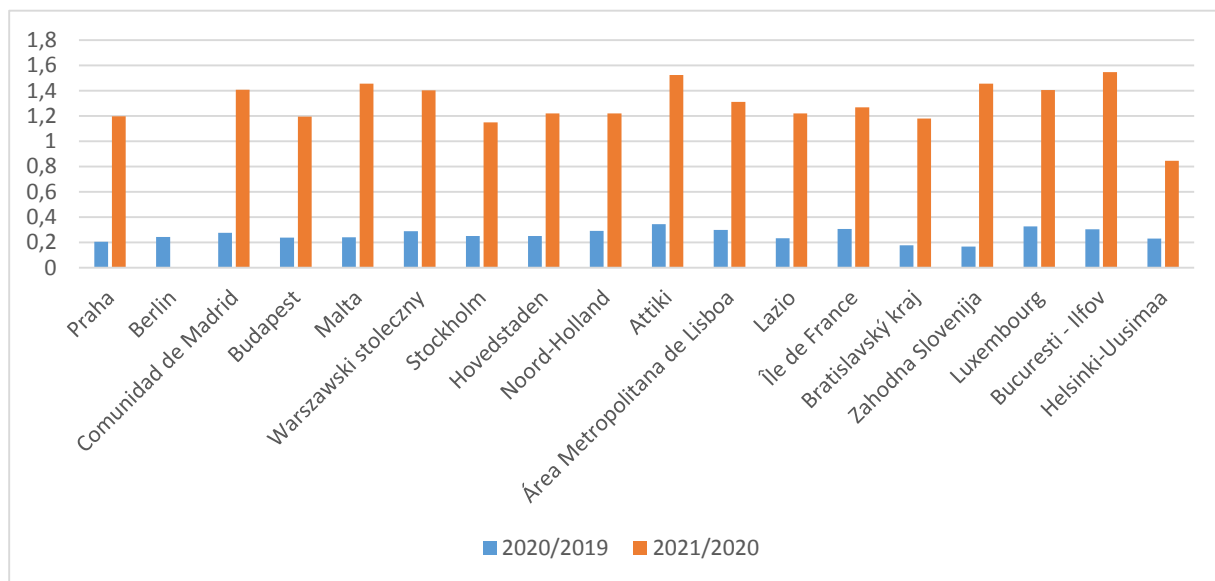

Figure 6. Relative increases in the number of air passengers in 2020 and 2021 in the examined EU regions.

The worst situation was in the Helsinki-Uusimaa region, which observed decline in the number of passengers both in 2020 and 2021. For 2 years, the number of passengers fell by more than 80 percent.

7. Individuals who ordered goods or services on the internet for private use in the last year

During the pandemic, many countries, including Poland, introduced restrictions on the free movement of people. Seeing the enormous number of the pandemic victims in the world, people avoided direct contact with other people. The situation created room for trade to flourish via the Internet.

Due to the lack of data, trend models were developed for only 11 regions, in 5 of which the Chow test indicated that there was a significant structural change in the models. We can therefore argue that in almost half of the surveyed regions for which the trend function was

estimated, the pandemic had a significant impact on the number of people ordering goods or services over the Internet. The surveyed regions saw an average increase of 26% in the number of people ordering online in 2020 compared to 2019. This is certainly a significant increase, but such a substantial increase was affected by the result of the Bucuresti-Ilfov region, where it amounted to almost 80%. In all 16 regions for which data was available, the average increase in the number of people ordering online was 14% (Figure 7). It should be noted here that during the period under study, the Lazio region saw an 11% decrease in the number of people ordering goods or services on the Internet. In the following year, the average increase was almost 5%.
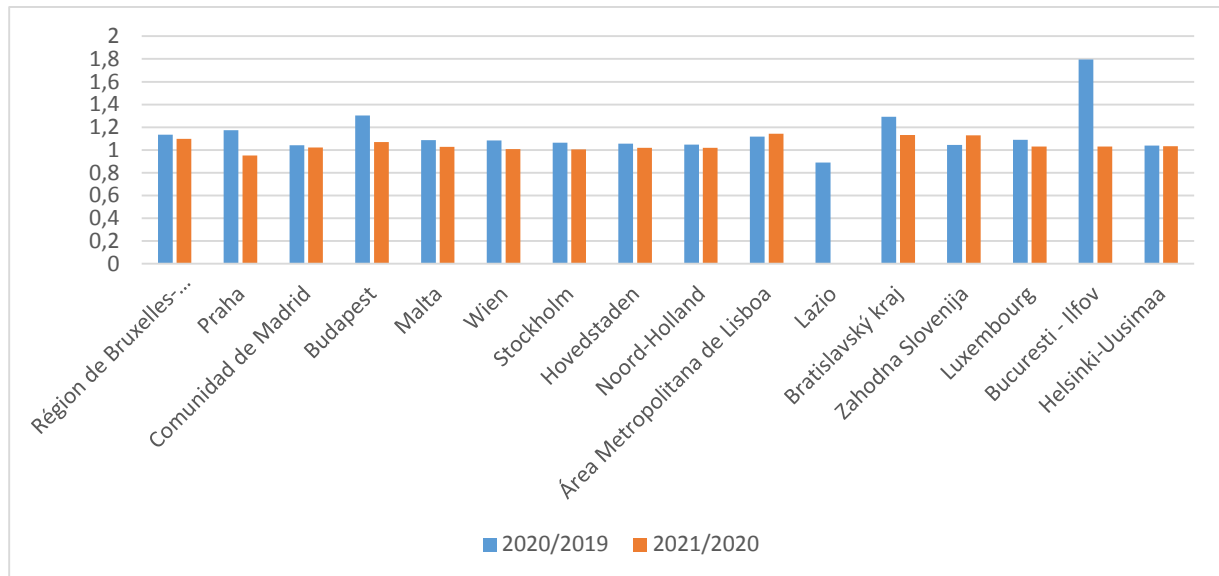

Figure 7. Relative increase in the number of people shopping online in 2020 and 2021 in the surveyed EU regions.

Growth of 14% in 2020 and 5% in 2021 should be considered significant, especially since it is 10 and 13 percentage points higher than forecast, respectively.

8. Employment in high-tech sectors

The increase in ordering goods and services on the Internet and the more frequent introduction of remote work by employers is associated with an increase in high-tech employment. Such a significant increase in high-tech employment is not confirmed by the Chow test; only in 4 out of 18 cases it indicated a significant structural change in the models. In all 22 regions, the increase in 2020, compared to 2019, averaged 7% (Figure 8), with 5 regions experiencing a decrease in employment in the sector and 1 remaining unchanged. The largest increase in employment occurred in the Noord-Holland region reaching around 31%, while the largest decrease occurred in the Grad Zagreb reaching 22%.
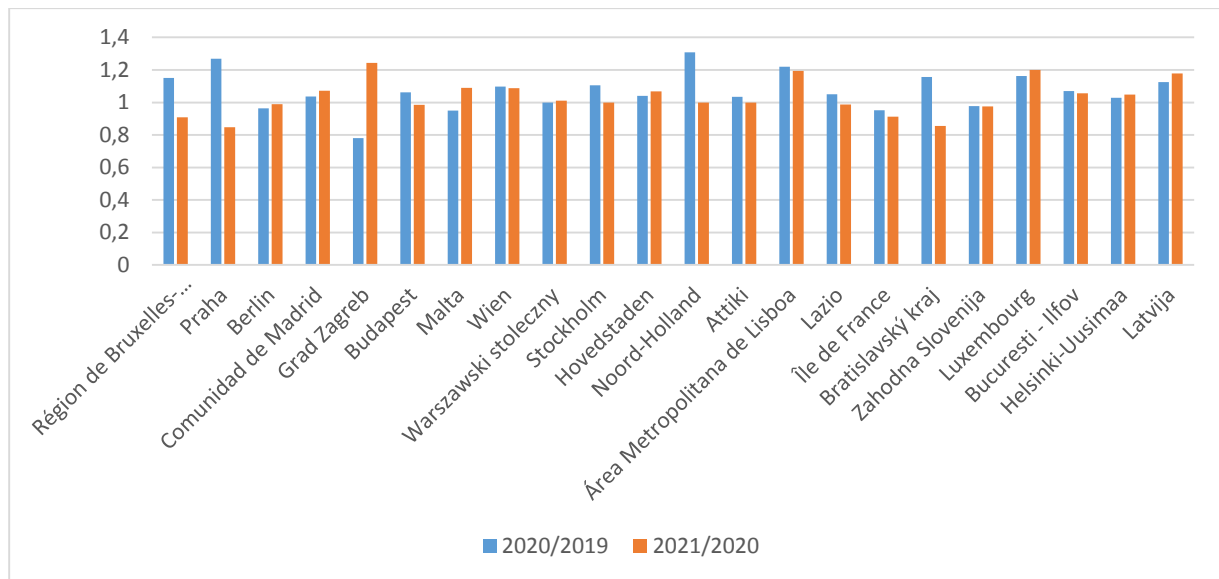
Figure 7. Relative increase in the number of people employed in the high technology sector in 2020 and 2021 in the surveyed EU regions.

In 2021, the average increase in employment in the surveyed regions was only 2.5%. The largest increase, i.e., almost 25% was observed in the Grad Zagreb region, where the largest decline had been reported before.

Comparing actual employment in the high-tech sector with forecasts that did not assume a pandemic would occur, it can be seen that in 2020 there was an increase in employment in this sector compared to forecasts (by an average of 5%), but in 2021 actual employment was at the forecast level (the average share of actual employment in forecast employment was 1). It can be concluded that the pandemic had a short-term impact on employment in the high-tech sector.

9. Conclusions

The COVID-19 pandemic undoubtedly had a major impact on the development of EU regions. There are capital cities in the studied regions, so they tend to be the fastest growing. In terms of population, the largest decline in 2020 was observed in Prague. The decrease was 4.5%, and if we look at the decrease in population relative to projections it is as high as 6.3% in Prague. Among the surveyed regions, there were also 4 in which the population in both 2020 and 2021 was higher than forecast. For 65% of the estimated trends, the Chow test indicated structural changes in the trend models, which means that the pandemic in these cases had a significant impact on the population.

The decline in population also had an impact on the decline in GDP. In 2021, there was not a single region where the population decreased, and GDP increased. The largest decline in GDP in 2020 was in the Comunidad de Madrid region. In this Spanish region, the decline in GDP

reached 10%. In 2021, the European economies began to rebound and none of the surveyed regions saw a decline in GDP. Special attention should be paid to 3 regions, i.e., Stockholm, Hovedstaden and Luxembourg. These regions saw GDP growth in both studied years, and it was significant. The ratio of GDP in 2021 to 2019 was between 13.4 and 15.9%. It can be concluded that the COVID-19 pandemic has a stimulating effect on GDP growth because in 2021 it was higher in these regions than projected on the basis of trends by 6.3 to 11.3 percent.

In other regions, the growth was not that impressive, and in 3 cases there was a decrease in GDP in 2021 compared to 2019 GDP (Attiki, Área Metropolitana de Lisboa, Lazio).

The pandemic also had an impact on the unemployment rate. The worst situation was in the eastern part of the EU, in the Bucuresti - Ilfov, Praha and Bratislavský kraj regions. The increase in the unemployment rate was 88%, 77% and 48%, respectively. While in the Bucuresti-Ilfov and Bratislavský kraj regions the unemployment rate fell sharply in the following year, it did not change in Prague. Significant increase was also seen in the Noord-Holland and Stockholm regions, both of which saw large growth in the unemployment rate in both years. In 2021, the unemployment rate was 45% and 33% higher in these regions than in 2019, respectively.

Although the unemployment rate increased the most in Prague, the number of people at risk of poverty did not change for the 2 analyzed years. The worst situation was in the Bratislavský kraj and Région de Bruxelles-Capitale. In 2020, the number of people at risk of poverty in Portugal's Área Metropolitana de Lisboa region dropped significantly, with a decrease of almost 25%.

Undoubtedly, the COVID-19 pandemic had the greatest impact on the tourism industry, as indicated by earlier analyses. For both occupied accommodation and passenger air transport, the Chow test indicated a structural change in the parameters in all estimated trend models. This means, statistical confirmation of the very large impact of the pandemic on the tourism industry. Even significant increase in occupied accommodations and air passenger transport did not compensate for the losses of 2020. Tourism-oriented regions were by far the worst affected. In the Île de France region, the number of occupied beds fell from more than 84.6 million to more than 31.2 million. In terms of absolute numbers, the Lazio region came in second, with a drop from 39 million to 9.3 million occupied beds. In the case of passenger air transport, the worst situation was observed in the Bratislavský kraj and Helsinki-Uusimaa regions, where the decline in passengers in 2021 compared to 2019 was about 80%.

The pandemic outbreak also provided an opportunity for other industries to flourish. Due to restrictions on movement and the proliferation of remote work in many areas, it seemed natural that online commerce and high-tech job growth would flourish. Indeed, in 2020 and 2021, there was an increase in online sales of goods and services much higher than predicted by the trend models despite the fact that the Chow test confirmed a significant change in trend for only almost half of the estimated models. The largest increase in customers ordering goods

and services online was noted in Bucharest, with an increase of almost 80% in 2020. Only the Lazio region saw a decrease in the number of online shoppers in 2020.

In terms of employment in the high-tech sector, a significant increase was observed in 2020, the rate of which fell in 2021. In that year, the average employment in the surveyed sector was at the level of forecasts, so it can be said that the pandemic had a very short-term impact on this industry.

In conclusion, it can be stated that the COVID-19 pandemic had an impact on all the studied regions, but its intensity was varied. Regions that are related to the tourism industry suffered the most.

Further study should cover other EU regions and a larger number of economic sectors, which will allow for grouping regions according to similarities in coping with the pandemic and calculating spatial correlations.

References

1. Ambroziak, Ł. (2020). Wpływ pandemii COVID-19 na handel rolno-spożywczy Polski: pierwsze doświadczenia. *Zeszyty Naukowe SGGW w Warszawie - Problemy Rolnictwa Światowego*, *Vol. 20, No. 4*, pp. 5-17, doi: 10.22630.
2. Biolik, J. (2018). *Podstawy ekonometrii z Excelem i Gretlem.* Katowice: Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.
3. Bukowski M. (2023). Wpływ pandemii na branżę turystyczną w Polsce, In: M. Bukowski, H. Gawroński, K. Olszewska, K. Sidorkiewicz, K. Starańczak (Eds.), *Globalne, europejskie i krajowe skutki pandemii Covid-19 dla gospodarki. Wybrane problemy* (pp.35-64). Elbląg: Wydawnictwo Akademii Nauk Stosowanych w Elblągu.
4. Czajkowska, A. (2020). pandemii COVID-19 na działania CSR podejmowane przez przedsiębiorstwa. *Zeszyty Naukowe UE w Krakowie - Problemy Rolnictwa Światowego*, *Vol. 3, No. 987*, pp. 45-62, doi: 10.15678.
5. Długosz, P. (2021). *Trauma pandemii COVID-19 w polskim społeczeństwie.* Warszawa: CeDeWu.
6. *Eurostat*. Retrieved from: https://ec.europa.eu/eurostat, 10.10.2023.
7. Hasić M. (2023). Wpływ pandemii Covid-19 na zachowania konsumenckie Polaków w handlu elektronicznym, In: M. Bukowski, H. Gawroński, K. Olszewska, K. Sidorkiewicz, K. Starańczak (Eds.), *Globalne, europejskie i krajowe skutki pandemii Covid-19 dla gospodarki. Wybrane problemy* (pp. 129-152). Elbląg: Wydawnictwo Akademii Nauk Stosowanych w Elblągu.

8. Klimczuk, A. (2021). Pandemia COVID-19 z perspektywy teorii ryzyka. In: A. Zybała, A. Bartoszewicz, A. Księżopolski A. (Eds.), *Polska... Unia Europejska... Świat... w pandemii COVID-19 – wybrane zagadnienia* (pp. 35-57). Warszawa: Elipsa.

9. Maddala, G.S. (2006). *Ekonometria.* Warszawa: PWN.

10. *Moneyt*. Retrieved from: https://www.money.pl, 16.10.2023.

11. Nguyen, V.K.L., Le, T.M.H., Tran, T.M.C., Le, T.T.H., Duong, T.N.M., Le, T.H., Nguyen, T.S., Vo, N.H. (2021). Exploring the Impact of Pandemic on Global Economy: Perspective from Literature Review. *Social Sciences And Humanities, 29(3),* pp. 2033-2087.

12. Osińska, M. (2007). *Ekonometria współczesna*. Toruń: Dom Organizatora.

13. *Termedia*. Retrieved from: https://www.termedia.pl, 15.10.2023.

14. *Worldbank*. Retrieved from: https://www.worldbank.org/en/publication/wdr2022/brief/chapter-1-introduction-the-economic-impacts-of-the-covid-19-crisis.