THE IMPACT OF COVID-19 PANDEMIC ON TOURISM ACTIVITIES. A COUNTERFACTUAL ANALYSIS

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Abstract: We analysed the impact of the COVID-19 pandemic on tourism activities, during the first year of the crisis, for 32 European countries, by using monthly data concerning the occupancy rate of bed-places in hotels and similar accommodations. To assess the decrease in the use of touristic accommodation capacity, we used, as a counterfactual, the expected values under normal conditions, calculated using SARIMAX-type models. We estimated, for each country and each month, the decreases induced by the COVID-19 pandemic compared to normal developments. The analysis was detailed by types of establishment and comfort categories, using data from the Romanian tourism industry. As a structural analysis, we have shown that, in the first year of the crisis, the COVID-19 pandemic has pushed tourists towards lower comfort categories and smaller accommodation units, close to nature and with better possibilities of distancing people. We also calculated the severity of the impact, for each type of establishment and category of comfort.

Keywords: Tourism accommodation, Occupancy rate of bed-places, COVID-10 pandemic, Economic impact, Counterfactual analysis.

INTRODUCTION

The global spread of the new coronavirus-induced crisis (COVID-19) has severely affected national health insurance systems and had a strong negative impact on national and global economies.

The literature analyses the economic impact of COVID-19 pandemic on two levels: on the one hand, older models known in the literature are updated, and on the other hand, the effects of the current crisis are analysed based on economic theory and experience in mitigation of effects induced by previous crises [Ebola, A (H1N1) - H1N1 subtype of influenza A virus, SARS - severe acute respiratory syndrome, MERS-CoV – Middle East Respiratory Syndrome Coronavirus].[1]

It is considered that the starting point of studies through mathematical models of the spread of epidemics is a work of Daniel Bernoulli from 1766: *Essai d'une nouvelle analyse de la mortalité causée par la petite vérole (Mémoires de mathématique et de physique, présentés à l'Académie royale des sciences*, Paris 1766.[2] Among the works in the literature published before 2000, the study of Grassly & Fraser[3] is often cited, in which the authors construct a mathematical model of the transmission of infectious diseases. Meltzer, Cox & Fukuda[4] estimate the effect of a major epidemic on the US economy (by using a Monte Carlo simulation model for probability distributions of disease, recovery, and death rates, given the expansion of vaccination programs). Beutels et al.[5] assess the impact of SARS on China's economy (by analysing the daily and monthly time series related to SARS infection, correlated with the volume of transport services, tourism, and household consumption pattern).

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1 Baldwin, Weder di Mauro 2020b.
2 cf. Dietz, Heesterbeek 2002.
3 Grassly, Fraser 2008.
4 Meltzer, Cocs, Fukuda 1999.
5 Beutels et al. 2009.

The literature dedicated to the economic impact of the COVID-19 pandemic exploded after February 2020. We only mention the books of Baldwin & Weder di Mauro (eds.)[6], Malleret & Schwab[7], Gans[8]. An early review of the literature was carried out by Brodeur et al.[9]

The macroeconomic impact of COVID-19 pandemic was identified, theoretically, both in the reduction of supply (by declining production capacities and difficulties in supply channels) and in reducing and restructuring demand (due to declining revenues and changes in consumer behaviour). On the supply side, Stiglitz[10] identified, as economic damage of COVID-19, firstly, the bankruptcy, "which tends to be associated with a loss of human capital, organizational capital, and informational capital" and, secondly, the deterioration in corporate balance sheets, which "undermines the ability and willingness of corporations to make investments or even produce". Another negative supply shock has been created by deaths, workplace absenteeism, and global supply chain disruptions.[11]

On demand side, Stiglitz[12] discusses the hysteresis effect induced by the worsening of household balance sheets (decreases in income and wealth) and "the increase in uncertainty in imperfect risk markets", which has led to more precautionary savings and less spending on durables. On the same, Nikolopoulos et al.[13] analysed the panic buying, and[14] discussed the decrease in income and household finances. In an integrated approach, Bekaert, Engstrom & Ermolov[15] calculated, for the United States, that 2/3 of the GDP decline in 2020: Q1 was due to a negative shock in aggregate demand (-4.3% out of -6.6%), and 1/3 to the shock in aggregate supply, while in 2020: Q2, the ratio reversed: the greatest part of the decline in GDP (57%) was due to the reduction in aggregate supply.[16]

Sectoral, the crisis strongly affects certain segments of market services (tourism - hotels, restaurants, transportation, cultural services)[17] and through a contagion effect, industry,[18] construction,[19] energy,[20],[21],[22] and public services.[23] It has also had an impact on demographic phenomena (nuptiality, divortiality, and live-births rates, mortality rate, internal and international migration) and led to the emergence of conjunctural social effects (increased crime and social conflicts, etc.).[24]

For each country, the negative national impact of the COVID-19 pandemic is accentuated by the international synchronization of shocks, which has the effect of blocking supply channels, reverse migration, difficulties in entering foreign capital, or even reversing capital flows.[25]

Many articles in literature are also devoted to possible solutions to overcome the crisis. The solutions suggested referring, generally, to strengthening the role of the government and can be summed up in Stiglitz's words: "At least for a moment, we were all Keynesians".[26]

One of the most affected economic sectors, in the context of the Covid-19 crisis, was tourism.[27] An immediate explanation is that the COVID-19 pandemic hit hard, first and foremost, the activities that

[6] Baldwin, Weder di Mauro 2020a; 2020b.
[7] Malleret, Schwab 2020.
[8] Gans 2020.
[9] Brodeur et al. 2021.
[10] Stiglitz 2021a.
[11] Pak et al. 2020.
[12] Stiglitz 2021a, 4.
[13] Nikolopoulos et al. 2021.
[14] Pak et al. 2020.
[15] Bekaert, Engstrom, Ermolov 2020.
[16] Bekaert, Engstrom, Ermolov 2020, 28.
[17] Baldwin, Weder di Mauro 2020a.
[18] de Vet et al. 2021.
[19] International Labor Organization 2021
[20] Jula D.-M 2021.
[21] Bahmanyar, Estebsari, Ernst 2020.
[22] Zhong et al. 2020
[23] Krueger, Uhlig, & Xie 2020.
[24] Jula et al. 2021, 29, 51-53.
[25] Baldwin, Weder di Mauro 2020b; Sigala 2020.
[26] Stiglitz 2021b, 749.

require in-person contact (such as education, tourism, and other leisure activities, or the cultural and sporting activities, transportations, in-store shopping and the like) and less the remote transactions (such as out-of-store shopping, e-commerce, remote conferences, streaming services, and the like).[28]

Among the studies analysing the impact of major epidemics – before COVID-19 pandemic – on tourism, we mention Joo et al.[29] These studies try to determine the impact of MERS-CoV (the Middle East Respiratory Syndrome Coronavirus) on the tourism service sectors in the Republic of Korea, in 2015 (between May 20 - the date of confirmation of the first case of infection and December 23 - the date of the official announcement of the end of the epidemic). In Joo et al. the model used is SARIMA (Seasonal Autoregressive Integrated Moving Average).[30] The losses in the tourism sector were estimated by multiplying the average expenditure per tourist by the monthly differences between the expected number and the actual number of tourists arriving from abroad. These losses were then allocated to sectors (hotels, restaurants, transport ...). Joo et al.[31] estimate a 2.1 million reduction in the number of foreign tourists in South Korea in 2015, corresponding to a loss of 2.6 billion USD. In Joo et al.[32], the authors use a panel model to analyse the influence of factors on the monthly arrivals of tourists from abroad in the Republic of Korea. As for influencing factors, the degree to which SARS since 2003 affected the areas where tourists come from, the closure of certain areas, and the travel distance of foreign tourists were analysed. The authors tested hypotheses that tourists in areas affected by SARS in 2003 were less willing to travel during the MERS-CoV epidemic in South Korea, and people in more remote areas were less likely to cancel trips Joo et al.[33] calculated an average decrease in the number of tourists from abroad of 31.4% and 39.3% in the peak months of the epidemic (June-July), a moderate decrease in August-September (-10.7% and -1.3%, respectively).

There are numerous studies on the impact of COVID-19 pandemic on tourism. We mention, among others, the 43 studies included in "Handbook of Research on the Impacts and Implications of COVID-19 on the Tourism Industry"[34] and the monograph "Counting the Cost of COVID-19 on the Global Tourism Industry".[35] In a recent literature review, Persson-Fischer & Liu identified six leading themes concerning the relationship between COVID-19 and tourism, in light of sustainability perspectives (government crisis management; tourist perception and decision-making; tourism service providers; new normal; tourism research; and inequality[36] and claim that "The challenges of sustainable tourism transformation after COVID-19 are irreversible".[37] Concerning the COVID-19 impact on tourism, Gössling, Scott, & Hall said that "The challenge is now to collectively learn from this global tragedy to accelerate the transformation of sustainable tourism".[38] There are also articles in the literature that focus on solutions regarding the recovery of the tourism industry. Three scenarios for the resumption (reopening) tourism activities, post COVID-19 pandemic, are analysed by Tsionas.[39] As for the economy as a whole, the solutions proposed for the tourism industry start - without stopping there only - from the role that the government can play in the recovery efforts.[40]

This paper, firstly, estimates the effects of the COVID-19 crisis on hotel accommodation activities in 2020, for 32 European countries, starting from the monthly data related to the net occupancy rate of bed-places in hotels and similar accommodation. Secondly, the analysis is extended, from Romania, to categories of receiving units (type of establishment) and to comfort category.

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27 Jula et al. 2021.
28 Taylor 2021.
29 Joo et al. 2019a; 2019b.
30 Joo et al. 2019a.
31 Joo et al. 2019a.
32 Joo et al. 2019b.
33 Joo et al. 2019b, 56, table 1.
34 Demir, Dalgıç, Ergen 2021.
35 Nhamo, Dube, Chikodzi 2020. We also note: Davahli et al. 2020; Sigala 2020; Hoqueet al. 2020; Škare, Soriano, Porada-Rochoń 2021; Kaushal, Srivastava 2021; Kang et al. 2021 and so on. Google Scholar Database reviews over one thousand studies in the field of "Tourism AND COVID-19", of which almost 700 in the first 8 months of 2021.
36 Persson-Fischer, Liu 2021, 5.
37 Persson-Fischer, Liu 2021, 24.
38 Gössling, Scott, Hall 2020, 15.
39 Tsionas 2020.
40 Assaf, Scuderi 2020.

DATA AND METHODOLOGY

The data used in the paper refer to the "net occupancy rate of bed-places in hotels and similar accommodation" for 32 European countries, between 1990-2021 (February). In accordance with Eurostat methodology "The occupancy rate of bed places in reference period is obtained by dividing the total number of overnight stays by the number of the bed places on offer (excluding extra beds) and the number of days when the bed places are actually available for use (net of seasonal closures and other temporary closures for decoration, by police order, etc.). The result is multiplied by 100 to express the occupancy rate as a percentage."[41] The number of bed-places "should not include units closed due to lockdown or for any other reason, units used as hospital rooms/bed-places, units used to accommodate sanitary personnel or workers".[42] *Eurostat* (the statistical office of the European Union) provides monthly data on that indicator for 38 European countries.[43]

In this paper, we analysed only the countries for which there are statistical monthly data including for the years 2020 and 2021 (January – February), even if the data series are, in some cases, incomplete. It resulted in a number of 32 countries: Austria, Belgium, Bulgaria, Cyprus, Czechia, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Croatia, Hungary, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia, Albania, Iceland, Liechtenstein, Norway, Switzerland, Serbia.

For the detailed analysis carried out in the case of Romania, we used data from the Romanian National Institute of Statistics (NIS), Tempo-Online section, regarding the "Index of a net using the touristic accommodation capacity in function by type of establishment and comfort category", monthly data, table TUR106C.[44] In accordance with NIS, the index is calculated as "the ratio between the total number of stays overnight and the tourist accommodation capacity in function during that period".

We considered that the major impact of the COVID-19 crisis on European economies has been registered since March 2020.[45]

There is a vast literature on causal inference.[46] The standard approach to assessing the effects of the crisis on an economic process is to compare the results recorded during the crisis with the values obtained through an ex-post forecast, calculated on the assumption that the process would have retained exactly the pre-crisis characteristics (naïve forecasting method, i.e., set all forecasts to be the value of the ante-crisis observations).[47] Such an approach is used by Qeadan et al. to forecast the Covid-19 outbreak in Utah (USA).[48] In a recent paper, Alasali et al. utilized a naïve as one of the benchmark methods for a rolling stochastic ARIMAX model used for electricity demand and load forecasting in COVID-19 pandemic time.[49] Chandelm, Kanga and Singh also use the naïve forecast to measure the monthly loss (April - December 2020) in India's tourism activity.[50] Römisch used the naïve forecast as a benchmark to analyse the massive drop in tourism nights spent in some Central European countries.[51]

For monthly data, naïve forecasting can be formulated as follows:

$$(y_t)^f = y_{t-12}$$

(1) where $(y_t)^f$ is the estimate (forecast) for *y* series on the month *t*, and y_{t-12} is the value of the last monthly observation (corresponding month on the previous year).

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41 https://ec.europa.eu/eurostat/cache/metadata/en/tour_occ_esms.htm
42 World Tourism Organisation 2021, 11.
43 https://ec.europa.eu/eurostat/web/main/data/database, table *tour_occ_mnor*.
44 http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table.
45 in fact, COVID-19 was declared as a pandemic by WHO, on March 12th, 2020.
46 As reference books, we mention: Pearl 2009; Morgan, Winship 2015; Huynh, Kreinovich, Sriboonchitta 2016; Peters, Janzing, Schölkopf 2017; Pearl, Mackenzie 2018; Hernán, Robins 2020. An overview can be found in Pearl 2009; Hill, Stuart 2015, and a literature survey in Winship, Morgan 1999; Guo et al. 2020 and Yao et al. 2020.
47 Hyndman, Athanasopoulos 2021, 5.2
48 Qeadan et al. 2020.
49 Alasali et al. 2021.
50 Chandelm, Kanga, Singh 2021, 230.
51 Römisch 2020,7-8, fig. 8.

The problems arising from the use of naïve forecasts are detailed in Taleb, Bar-Yam & Cirillo.[52] A naive forecast is a good solution when data follow a random walk. But, for our problem, the Variance Ratio Test strongly rejects the null of a random walk, for all the time series analysed (32 European countries).[53] In these circumstances, we have sought a more appropriate method for the sake of forecasting seasonal time series.

Other studies build the benchmark values (counterfactual) through more complex methods. For example, Chudik et al. used for counterfactual analysis the differences between June 2020 and January 2020 International Monetary Fund (IMF) World Economic Outlook (WEO) GDP growth forecasts (IMF-WEO forecast revisions).[54] These calculations start from the hypothesis that the Covid-19 pandemic was the "dominant" reason that led to the revision of the IMF (WEO) forecasts. In addition, the authors discuss other models for analysing the economic impact of COVID-19. Specifically, they build a threshold-augmented Global Vector Autoregressive (TGVAR) type model. Škare, Soriano & Porada-Rochoń used Panel Structural Vector Auto-Regression (PSVAR) model for 185 countries to estimate the impact of the COVID-19 pandemic on the tourism industry in India.[55] Zhang & Lu used Autoregressive Distributed Lag (ARDL) Error Correction to model forecast hotel room demand for Hong Kong.[56] Kovačević employed linear regression to assess the impact of the nights spent by tourists on GDP growth in Croatia.[57] Song et al. used the Quantile Autoregressive Distributed Lag (QARDL) model to analyse the impact of the COVID-19 pandemic on China's tourism industry.[58]

As a methodology, in this paper, we compared the dynamics of series concerning the tourism activity (dynamics recorded between March 2020 and February 2021) with a counterfactual data. The counterfactuals (the anticipated levels under normal conditions) are built through SARIMAX models. The SARIMA models have been used in the analysis of tourism activities because they "provide outstanding forecasts".[59] Recently, Qiu et al., by analysing the occupancy rate of five hotel classes in Hong Kong, found that "SARIMAX model generally provides the best forecasts of occupancy rates of all classes and all forecast horizons".[60]

If we assume that the model achieves an acceptable quality for the fitting of the data, so that the SARIMAX model captures the overall effect of the factors having an impact under normal conditions, then we can use the data predicted by the SARIMAX model as the counterfactual with which are compared the monthly evolutions recorded statistically between March 2020 and February 2021. We consider that the differences between the monthly statistical values registered from variables concerning tourist activities (ex. "net occupancy rates of bed-places in hotels and similar accommodation") and their counterfactual values are mainly due to specific conditions that occur between March-2020 and February-2021, once with COVID-19 pandemic.

Like a technical discussion, we mention that, before building econometric models, we tested the stationarity of time series. For this purpose, we used the ADF[61] and KPSS tests.[62] For the ADF test, the null hypothesis is non-stationarity, while for and KPSS test the null hypothesis is the stationarity of the analysed times series. For the sake of robustness, we also applied the seasonal unit roots tests, namely HEGY tests.[63] The null hypothesis for the HEGY test is the presence of unit root at zero frequency and/or the existence of seasonal unit roots (non-stationarity at different frequencies). To calculate anticipated levels under normal conditions (the counterfactuals), we estimated a SARIMAX (p, d, q) $(P, Q)_{s=12}$ model for each country separately, like:

52 Taleb, Bar-Yam, Cirillo 2020.
53 Lo, MacKinlay 1988.
54 Chudik et al. 2020.
55 Škare, Soriano, Porada-Rochoń 2021.
56 Zhang, Lu 2021.
57 Kovačević 2020.
58 Song et al. 2021.
59 Song, Qiu, Park 2019, 349-350.
60 Qiu et al. 2021, 2052.
61 Dickey, Fuller 1979.
62 Kwiatkowski et al. 1992.
63 Hylleberg et al. 1990.

$$\mathbf{ln(y_t) = a_0 + \sum_i a_i \cdot month_i + e_t}$$

$$\mathbf{\Phi(L)\ (1 - L)^d(1 - \phi L^{12})e_t = \Theta(L)\ (1- \theta L^{12})\varepsilon_t}$$

(2) where $ln(y_t)$ means logarithm transformation of the analysed series y_t (series y_t is, for example, "net occupancy rate of bed-places in hotels and similar accommodation", or "index of a net using the touristic accommodation capacity in function, by type of establishment and comfort category") for month = t, where t = Jan-1990, …, Feb-2020, and the 12 dummies months are for January, …, December. The transformation of the series by logarithm was the specification selected through the automatic ARIMA forecasting method for most of the analysed data series. We used this transformation for all times series to ensure a unified approach. In the error variable e_t equation, we have introduced a SARIMA (p, d, q) $(P, Q)_{s = 12}$ terms to capture the remaining seasonal effect, and to control for non-stationarity and for autocorrelation. In equation (2), L is the lag operator, with the usual definition, $Ly_t = y_{t-1}$, $\Phi(L)$ is a polynomial function of order p (the autoregressive part of the model), $\Theta(L)$ is a polynomial function of order q (the moving average part), d is the order of integration (degree of differencing involved), ϕ and θ are the parameters of the seasonal autoregressive (SAR) and seasonal moving average (SMA) parts, respectively.[64]

RESULTS

Impact of the COVID-19 pandemic on the of the net occupancy rate of bed-places in hotels and similar accommodation

We analysed the impact of COVID-19 pandemic on the of the "monthly net occupancy rate of bed-places in hotels and similar accommodation", for 32 European countries, between March 2020 and February 2021 (one year). Like a technical discussion concerning stationarity of times series, by countries, for 1990-2020(Feb.), the Augmented Dickey-Fuller – ADF unit root tests,[65] the KPSS unit root tests[66] and HEGY seasonal unit roots test[67] found no evidence to support the null hypothesis (presence of unit roots) for ten countries: Cyprus, Estonia, Spain, Finland, France, Portugal, Slovenia, Albania, Liechtenstein, and Norway. For the other 22 countries, as a rule, the mentioned tests do not reject the unit root hypothesis. When ADF and/or KPPS unit root tests reject the null hypothesis (unit root) and the HEGY test do not reject a non-seasonal root (unit root at zero frequency), we accept that the series is non-stationary because, according to Giles,[68] unlike ADF and KPSS, "when the HEGY procedure is used to test for a unit root at the zero frequency, it is done in a context that allows for the possibility of seasonal unit roots". The results are shown in the fourth column of Table 1.

These outcomes can be considered as pieces of evidence for the robustness of specifying equations through SARIMAX methods, in that the automatic SARIMAX (p, d, q) $(P, Q)_{s=12}$ forecasting methods (for the models with monthly dummies as exogenous variables) selected d = 0 for the first group of countries and d = 1 for the second group.

We also specify that, for all the times series, the HEGY tests reject the null hypothesis of unit roots at all seasonal frequencies (any of the individual or harmonic pair frequencies and joint tests of all seasonal frequencies), in the models with seasonal (monthly) dummy variables.

We compared the statistical data registered between March 2020 and February 2021 (one year) with the counterfactuals data. As counterfactuals, we calculated the anticipated level of series "net occupancy rate of bed-places" under normal conditions for 32 European Countries. Specifically, they estimated a SARIMAX (p, d, q) $(P, Q)_{s = 12}$ model for each country separately, like:

$$\mathbf{ln(NOR)_t = a_0 + \sum_i a_i \cdot month_i + e_t}$$

$$\mathbf{\Phi(L)\ (1 - L)^d\ (1 - \phi L^{12})\ et = \Theta(L)\ (1- \theta L^{12})\ \varepsilon_t}$$

[64] Jula, Jula, 2019, 198-215.
[65] Dickey, Fuller 1979.
[66] Kwiatkowski et al. 1992.
[67] Hylleberg et al. 1990.
[68] Giles 2016.

(3) where $\ln(NOR)_t$ means logarithm transformation of "net occupancy rate of bed-places in hotels and similar accommodation" for month = t, t = Jan-1990, …, Feb-2020, and the 12 dummies months are for January, …, December. As we mentioned above, we used that transformation of the series by logarithm for all countries, to ensure a unified approach. In the error variable e_t equation, we have introduced a SARIMA (p, d, q) $(P, Q)_{s=12}$ terms to capture the remaining seasonal effect, and to control for non-stationarity and for autocorrelation. In equation (3), the symbols used are identical to those described for equation (2).

The specification of the models was automatically selected through Akaike Information Criterion. The intervals for non-negative integer parameters are defined as follows: $d \leq 1$, $p \leq 11$, $q \leq 11$, $P \leq 1$, and $Q \leq 1$. In models, for estimating the coefficients, we used monthly data between 1990 and February 2020. For some countries, the range is shorter. We encountered a special situation for the Mew Member States of the European Union, for which data are only available after 2000. The range of available data, the results of unit root tests, and the SARIMA models used to construct the counterfactuals for net occupancy rate of bed-places in COVID-19 pandemic are in Table 1.

Table 1. Models used for the counterfactual's construction[69]

Country	Data	ADF / KPSS / HEGY	SARIMA (p,d,q)(P,Q) model specification
Austria	1995 - 2020 (Feb)	1 / 1 / 1	SARIMA (1,1,2) (1,1)
Belgium	1990 - 2020 (Feb)	1 / 1 / 1	SARIMA (4,1,0) (1,1)
Bulgaria	2002 - 2020 (Feb)	1 / $0^{0.01}$ / 1	SARIMA (3,1,0) (1,1)
Cyprus	1990 - 2020 (Feb)	0 / 0 / 0	SARIMA (1,0,0) (1,1)
Czechia	2002 - 2020 (Feb)	1 / 1 / 1	SARIMA (3,1,2) (1,0)
Germany	1990 - 2020 (Feb)	1 / 1 / 1	SARIMA (2,1,2) (1,1)
Denmark	1996 - 2020 (Feb)	1 / $0^{0.01}$ / 1	SARIMA (0,1,1) (1,1)
Estonia	2003 - 2020 (Feb)	$0^{0.10}$ / 0 / 0	SARIMA (4,0,2) (1,0)
Greece	1994 - 2020 (Feb)	1 / 0 / 1	SARIMA (3,1,2) (1,1)
Spain	1992 - 2020 (Feb)	0 / 0 / 0	SARIMA (3,0,2) (0,0)
Finland	1990 - 2020 (Feb)	0 / 0 / 0	SARIMA (4,0,2) (1,1)
France	2004 - 2020 (Feb)	1 / 0 / 0	SARIMA (3,0,0) (1,1)
Croatia	2004 - 2020 (Feb)	1 / 0 / 1	SARIMA (3,1,1) (1,0)
Hungary	2001 - 2020 (Feb)	1 / 1 / 1	SARIMA (1,1,1) (1,1)
Italia	1990 - 2020 (Feb)	1 / 0 / 1	SARIMA (2,0,1) (1,1)
Lithuania	2004 - 2020 (Feb)	1 / 1 / 1	SARIMA (3,1,2) (0,1)
Luxembourg	1997 - 2020 (Feb)	1 / 1 / 1	SARIMA (3,1,1) (1,0)
Latvia	2005 - 2020 (Feb)	1 / 1 / 1	SARIMA (0,1,1) (1,0)
Malta	2003 - 2020 (Feb)	1 / $0^{0.01}$ / 1	SARIMA (2,1,2) (0,0)
Netherlands	1990 - 2020 (Feb)	1 / 1 / 1	SARIMA (4,1,2) (0,1)
Poland	2003 - 2020 (Feb)	1 / 1 / 1	SARIMA (0,1,2) (1,0)
Portugal	1990 - 2020 (Feb)	1 / 0 / 0	SARIMA (4,0,2) (1,1)
Romania	2002 - 2020 (Feb)	1 / 0 / 1	SARIMA (2,0,2) (1,0)
Sweden	1990 - 2020 (Feb)	1 / 1 / 1	SARIMA (3,1,1) (1,1)
Slovenia	2003 - 2020 (Feb)	0 / 0 / 0	SARIMA (1,0,0) (0,0)
Slovakia	2003 - 2020 (Feb)	1 / $0^{0.01}$ / 1	SARIMA (2,1,0) (0,1)
Albania	2017 – 2020 (Feb)	0 / 0 / …	SARIMA (3,0 0) (1,0)
Iceland	1994 - 2020 (Feb)	1 / 1 / 1	SARIMA (1,1,1) (1,1)
Liechtenstein	1995 - 2020 (Feb)	0 / 0 / 0	SARIMA (4,0,1) (1,1)
Norway	1990 - 2020 (Feb)	0 / 0 / 0	SARIMA (1,0,1) (1,1)
Switzerland	1990 - 2020 (Feb)	1 / $0^{0.01}$ / 1	SARIMA (4,1,2) (1,0)
Serbia	2012 - 2020 (Feb)	1 / 1 / 1	SARIMA (0,1,1) (1,0)

[69] *Legend*: "ADF / KPSS" mean Augmented Dickey-Fuller (Dickey, Fuller 1979) and Kwiatkowski-Phillips-Schmidt-Shin (Kwiatkowski *et al.* 1992) unit root tests, respectively. "HEGY" is a seasonal unit roots test (Hylleberg *et al.* 1990). For ADF and KPSS the models contain the constant as an exogenous variable. We presented the results of HEGY tests for the hypothesis of unit root at zero frequency in models with intercept as non-seasonal deterministic exogenous variable and with monthly dummies variables. For all the tests, "0" without exponent means "stationarity" at least 0.05 level of significance, in other words, the series are I(0), while "1" means "non-stationary" in level and stationary in first difference, that is the series are I(1). The exponent specifies the level of significance (for the ADF test the null hypothesis is non-stationarity while for and KPSS test the null hypothesis is the stationarity). For Albania, the HEGY test cannot be applied due to insufficient data. *Source*: Own calculation based on Eurostat data: *Net occupancy rate of bed-places and bedrooms in hotels and similar accommodation* (NACE Rev. 2, I, 55.1) - monthly data, 1990 – 2021: May [table: tour_occ_mnor], https://ec.europa.eu/eurostat/web/main/data/database (extracted on 30.06.2022).

For all the countries, the SARIMX model explains more than 95% of the variance in the dependent variable (net occupancy rate of bed-places in hotels and similar accommodations), i.e., $R^2 > 0.95$, and most coefficients are significant at the 1% level. Table 2 summarizes the results of the calculations related to the decrease of the net occupancy rate of bed-places in hotel accommodations, starting with March-2020, by countries and by months, decrease generated by the special conditions appeared in the field of tourism. For all the countries, the largest decreases were recorded at the beginning of the pandemic (March-2020, but especially April and May-2020). In March-2020, the largest decreases of net occupancy rate of bed-places in hotels and similar accommodation were recorded in Italy (-76%, compared to normal values). Then, in April-2020, the decrease was about 90%, in most European countries analysed. In the peak months for tourism (July, August), the net occupancy rate of bed-places decreased from normal values by more than 1/3, with significant variations between countries. Another wave of COVID-19 pandemic impact was recorded in the winter of 2020-2021 (December - February), when the decreases returned to more than -60%. The largest decreases were recorded in Austria (-96%).

Table 2. COVID-19 impact on net occupancy rate of bed-places in hotels and similar accommodation.[70]

		2020										2021	
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Austria	data	20.8	0.9	2.7	17.9	46.3	54.1	39.3	18.2	4.1	2.2	2.2	2.9
	c.fact.	55.9	34.3	35.6	46.0	59.8	68.4	48.4	35.9	28.6	43.4	58.9	72.9
	Δ%	-63%	-97%	-92%	-61%	-23%	-21%	-19%	-49%	-86%	-95%	-96%	-96%
Belgium	data	17.3	4.96	7.02	17.04	34.2	30.4	26.29	17.71	10.28	12.67	...	19.22
	c.fact.	41.0	48.3	48.8	50.0	54.1	55.3	50.9	49.5	45.6	46.1	33.4	38.9
	Δ%	-58%	-90%	-86%	-66%	-37%	-45%	-48%	-64%	-77%	-73%	...	-51%
Bulgaria	data	13.9	5.8	6.6	10.7	30.9	46.8	29.1	...	12.1	10.2	16.9	24.8
	c.fact.	31.1	28.7	26.2	55.7	74.0	79.5	46.4	27.1	30.4	31.6	38.2	41.5
	Δ%	-55%	-80%	-75%	-81%	-58%	-41%	-37%	...	-60%	-68%	-56%	-40%
Cyprus	data	36	15.1	23	14.6	27.1	41.4	28.5	34.4	8.2	9.7	31.3	...
	c.fact.	46.2	55.2	70.5	81.7	88.2	93.6	83.3	73.4	46.8	30.5	30.2	38.0
	Δ%	-22%	-73%	-67%	-82%	-69%	-56%	-66%	-53%	-82%	-68%	4%	...
Czechia	data	25.0	5.0	12.0	20.0	38.1	41.1	26.0	12.0	8.0	8.0	6.0	7.0
	c.fact.	39.6	43.3	45.5	44.7	53.7	57.7	47.0	45.2	37.5	36.1	30.8	36.3
	Δ%	-37%	-88%	-74%	-55%	-29%	-29%	-45%	-73%	-79%	-78%	-81%	-81%
Germany	data	19.9	7.9	13.3	27.0	39.2	43.3	41.6	32.0	12.0	8.9	8.7	10.6
	c.fact.	40.5	44.4	48.8	51.9	54.6	55.0	54.3	50.0	42.2	39.8	33.7	38.4
	Δ%	-51%	-82%	-73%	-48%	-28%	-21%	-23%	-36%	-72%	-78%	-74%	-72%
Denmark	data	14.0	3.0	7.0	18.0	49.0	36.0	29.0	26.0	18.0	11.0	7.0	...
	c.fact.	38.6	43.2	50.1	55.6	70.4	62.4	51.0	46.1	42.8	34.2	30.7	34.0
	Δ%	-64%	-93%	-86%	-68%	-30%	-42%	-43%	-44%	-58%	-68%	-77%	...
Estonia	data	14.0	2.0	5.0	22.0	48.0	39.0	23.0	24.0	20.0	18.0	16.0	18.0
	c.fact.	39.8	46.7	52.1	58.8	74.7	66.2	47.7	47.8	43.5	43.8	35.1	39.0
	Δ%	-65%	-96%	-90%	-63%	-36%	-41%	-52%	-50%	-54%	-59%	-54%	-54%
Greece	data	11.3	15.5	26.1	12.2	...	52.0	37.5	36.9	8.3	7.1	7.9	8.8
	c.fact.	29.7	33.7	56.7	75.0	83.4	85.2	70.3	40.0	19.6	21.4	24.6	27.2
	Δ%	-62%	-54%	-54%	-84%	...	-39%	-47%	-8%	-58%	-67%	-68%	-68%
Spain	data	29.4	0.0	12.3	18.8	36.2	45.1	26.8	20.9	15.8	17.8	14.4	16.5
	c.fact.	55.1	60.3	60.7	66.6	73.6	82.2	70.4	58.5	49.6	43.7	42.4	48.5
	Δ%	-47%	-100%	-80%	-72%	-51%	-45%	-62%	-64%	-68%	-59%	-66%	-66%
Finland	data	25.1	6.9	10.3	25.8	48.9	32.4	25.9	25.6	20.2	18.6	16.8	23.0
	c.fact.	48.9	54.1	60.9	69.8	73.4	64.4	53.3	42.9	33.9	40.8	28.4	26.5
	Δ%	-49%	-87%	-83%	-63%	-33%	-50%	-51%	-40%	-40%	-54%	-41%	-13%

[70] *Legend*: "data" = Eurostat monthly statistical data on *Net occupancy rate of bed-places in hotels and similar accommodation*;
"c.fact." = value of counterfactual estimated through SARIMAX model.
$\Delta_{\%}$ = [(data – counterfactual)/counterfactual] ·100
... = missing data
Source: Own calculation based on Eurostat data: *Net occupancy rate of bed-places and bedrooms in hotels and similar accommodation* (NACE Rev. 2, I, 55.1) - monthly data, 1990 – 2021: May [table: *tour_occ_mnor*], https://ec.europa.eu/eurostat/web/main/data/database (extracted on 30.06.2022).

		2020										2021	
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
France	data	20.0	10.0	13.0	25.0	45.0	56.0	34.0	27.0	16.0	21.0	21.0	...
	c.fact.	39.8	46.7	52.1	58.8	74.7	66.2	47.7	47.8	43.5	43.8	35.1	39.0
	$\Delta_{\%}$	-65%	-96%	-90%	-63%	-36%	-41%	-52%	-50%	-54%	-59%	-54%	-54%
Croatia	data	12.8	2.6	3.9	21.2	47.0	58.9	20.3	12.6	8.6	6.2	11.7	14.2
	c.fact.	29.5	43.4	54.9	80.5	104.5	110.7	79.0	45.7	25.6	23.3	19.5	26.7
	$\Delta_{\%}$	-57%	-94%	-93%	-74%	-55%	-47%	-74%	-72%	-66%	-73%	-40%	-47%
Hungary	data	15.6	2.7	6.1	16.5	38.2	45.5	20.4	20.2	8.8	5.7	6.6	7.5
	c.fact.	39.2	43.7	44.7	46.1	55.9	60.6	46.4	45.1	38.2	34.5	29.4	32.9
	$\Delta_{\%}$	-60%	-94%	-86%	-64%	-32%	-25%	-56%	-55%	-77%	-83%	-78%	-77%
Italia	data	10.7	3.9	6.1	16.7	40.2	61.9	37.1	22.6	11.2	10.0	11.7	15.8
	c.fact.	44.0	44.7	44.8	58.1	73.7	81.9	57.1	49.4	34.3	36.0	39.2	43.4
	$\Delta_{\%}$	-76%	-91%	-86%	-71%	-45%	-24%	-35%	-54%	-67%	-72%	-70%	-64%
Lithuania	data	17.1	4.7	8.9	23.9	38.6	40.3	29.4	26.3	13.5	8.6	7.2	9.2
	c.fact.	37.5	42.9	52.5	59.9	67.6	68.8	53.0	45.7	40.4	38.7	35.3	36.6
	$\Delta_{\%}$	-54%	-89%	-83%	-60%	-43%	-41%	-45%	-42%	-67%	-78%	-80%	-75%
Luxembourg	data	13.4	1.1	1.6	11.0	17.5	21.8	20.4	20.1	18.3	16.3	15.7	18.1
	c.fact.	30.0	30.1	32.1	35.2	33.8	35.7	35.1	33.5	30.9	26.6	26.8	27.8
	$\Delta_{\%}$	-55%	-96%	-95%	-69%	-48%	-39%	-42%	-40%	-41%	-39%	-41%	-35%
Latvia	data	...	6.9	10.0	22.5	44.3	45.5	20.9	18.9	13.6	11.7	11.6	13.0
	c.fact.	35.5	42.7	50.3	57.7	70.6	68.5	50.1	43.9	38.1	37.4	34.2	34.2
	$\Delta_{\%}$	...	-84%	-80%	-61%	-37%	-34%	-58%	-57%	-64%	-69%	-66%	-62%
Malta	data	24.1	4.6	4.8	7.9	25.8	40.6	24.1	19.2	9.4	11.0	9.7	13.4
	c.fact.	54.8	67.0	71.0	80.2	94.7	98.1	81.6	72.7	52.0	40.3	39.1	48.9
	$\Delta_{\%}$	-56%	-93%	-93%	-90%	-73%	-59%	-70%	-74%	-82%	-73%	-75%	-73%
Netherlands	data	18.6	6.0	10.3	24.7	42.8	46.6	35.4	20.9	15.6	12.8	8.9	10.9
	c.fact.	47.4	58.8	57.6	56.1	58.2	63.2	55.8	53.1	47.3	42.5	38.7	44.4
	$\Delta_{\%}$	-61%	-90%	-82%	-56%	-27%	-26%	-37%	-61%	-67%	-70%	-77%	-75%
Poland	data	17.3	6.8	8.4	19.9	36.0	42.9	32.2	21.4	11.2	10.1	8.5	16.9
	c.fact.	36.4	39.3	45.9	49.3	52.6	56.1	48.2	42.9	38.4	34.4	35.0	39.3
	$\Delta_{\%}$	-52%	-83%	-82%	-60%	-32%	-24%	-33%	-50%	-71%	-71%	-76%	-57%
Portugal	data	18.1	6.0	8.3	14.4	25.1	44.5	32.3	21.3	8.6	12.6	9.3	8.2
	c.fact.	45.0	52.6	54.5	59.7	66.1	79.1	66.1	54.1	38.0	32.4	30.4	37.2
	$\Delta_{\%}$	-60%	-89%	-85%	-76%	-62%	-44%	-51%	-61%	-77%	-61%	-69%	-78%
Romania	data	...	7.9	6.9	14.4	31.2	42.4	29.0	19.6	14.2	12.6	18.6	21.8
	c.fact.	29.3	32.3	36.1	41.7	53.1	60.1	43.8	40.5	36.9	28.5	26.8	30.0
	$\Delta_{\%}$	…	-76%	-81%	-65%	-41%	-29%	-34%	-52%	-62%	-56%	-31%	-27%
Sweden	data	20.0	10.0	14.0	20.0	48.0	35.0	29.0	32.0	16.0	16.0	16.0	21.0
	c.fact.	39.8	39.7	45.9	49.9	67.2	56.4	46.4	43.7	42.3	35.5	33.7	39.0
	$\Delta_{\%}$	-50%	-75%	-70%	-60%	-29%	-38%	-37%	-27%	-62%	-55%	-52%	-46%
Slovenia	data	...	0.3	1.6	20.3	50.3	61.0	44.7	24.9	7.4	5.8	5.6	7.6
	c.fact.	34.2	38.0	40.8	47.4	57.0	66.0	49.4	41.1	33.9	32.8	35.9	39.0
	$\Delta_{\%}$	...	-99%	-96%	-57%	-12%	-7%	-10%	-39%	-78%	-82%	-84%	-81%
Slovakia	data	...	16.4	10.6	18.0	41.0	47.6	29.6	14.0	10.2	9.3	6.6	7.6
	c.fact.	31.3	30.0	35.0	37.9	44.5	48.3	38.9	35.4	30.3	26.7	29.7	36.5
	$\Delta_{\%}$	...	-45%	-70%	-52%	-8%	-1%	-24%	-60%	-66%	-65%	-78%	-79%
Albania	data	4.1	0	2.9	6	16.3	26.6	10.8	4.6	4.7	4.5	4.1	4.8
	c.fact.	11.0	18.7	16.6	18.6	45.6	39.2	17.5	14.7	13.6	6.5	7.9	8.9
	$\Delta_{\%}$	-63%	-100%	-82%	-68%	-64%	-32%	-38%	-69%	-65%	-31%	-48%	-46%
Iceland	data	23.6	2.7	7.6	17.9	43.0	32.9	12.4	7.8	5.7	5.2	7.0	9.6
	c.fact.	48.0	38.5	43.5	57.1	69.3	68.6	57.4	51.0	41.8	36.7	34.4	44.3
	$\Delta_{\%}$	-51%	-93%	-83%	-69%	-38%	-52%	-78%	-85%	-86%	-86%	-80%	-78%
Liechtenstein	data	18.2	3.4	9.3	16.4	34.3	34.3	28.3	23.0	12.1	16.3	15.5	29.0
	c.fact.	32.9	25.8	27.4	32.0	32.6	35.7	29.6	26.9	23.1	25.5	29.6	37.0
	$\Delta_{\%}$	-45%	-87%	-66%	-49%	5%	-4%	-4%	-14%	-48%	-36%	-48%	-22%
Norway	data	17.4	8.6	14.6	25.9	59.3	33.1	23.2	22.2	14.2	15.2	12.2	15.8
	c.fact.	36.4	32.7	34.2	47.6	56.1	50.3	38.0	33.1	33.0	27.0	29.3	36.1
	$\Delta_{\%}$	-52%	-74%	-57%	-46%	6%	-34%	-39%	-33%	-57%	-44%	-58%	-56%
Switzerland	data	18.7	5.9	13.7	22.1	48.4	46.8	42.2	35.2	16.1	21.8	19.0	...
	c.fact.	44.8	40.1	46.6	52.2	56.3	54.5	47.9	43.2	36.1	44.0	40.6	46.6
	$\Delta_{\%}$	-58%	-85%	-71%	-58%	-14%	-14%	-12%	-19%	-55%	-50%	-53%	...
Serbia	data	18.0	7.6	8.3	21.2	22.6	33.3	24.0	21.3	15.5	13.0	21.3	24.9

	2020										2021	
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
c.fact.	33.0	38.7	46.0	43.6	44.4	47.8	42.5	40.9	31.5	32.1	33.6	35.0
$\Delta_{\%}$	-45%	-80%	-82%	-51%	-49%	-30%	-44%	-48%	-51%	-60%	-37%	-29%

For the whole period (March-2020 – February-2021), were recorded only two positive values for the net occupancy rate of bed-places as compared with a long-run trend (counterfactuals), both in July 2020: Lichtenstein (+5.1%) and Norway (+5.6%).

Impact of COVID-19 pandemic on the index of net using the touristic accommodation capacity in function, by type of establishment

The estimated data based on the described models provide information and allow analysis only at the aggregate level of the tourism industry. Notwithstanding, the COVID-19 effects have been differentiated by the type of establishment and comfort category. In order to identify the differentiated effects, by types of accommodation and comfort category, we developed the analysis by studying the evolutions registered in the Romanian tourism industry, in the context of the COVID-19 pandemic. As a variable, we used "Index of net using the touristic accommodation capacity in function by type of establishment and comfort category, monthly", calculated as "the ratio between the total number of stays overnight and the tourist accommodation capacity in function during that period" (according to Romanian National Institute of Statistics, Tempo Online section, table TUR106C).

The types of the establishment of touristic reception refer to Hotels, Hostels, Motels, Inns, Touristic villas, Touristic chalets, Bungalows, Holiday villages, Campings, Touristic halting places, Houselet type unit, School and pre-school camps, Touristic boarding houses, Agritourism boarding houses, and Ships accommodation spaces.

As a technical discussion regarding stationarity, we mention that, for Hotels, Hostels, Touristic villas, Touristic chalets, Bungalows, Campings, Touristic halting places, Touristic boarding houses, Agrotouristic boarding houses, School and pre-school camps and Ships accommodation spaces, both ADF[71] and KPSS tests do not reject the null hypothesis of the unit root.[72] For the sake of robustness, we applied the seasonal unit roots tests. For the time series mentioned above, the HEGY test does not reject the hypothesis of unit root at zero frequency (at 0.01 significance level), in the models with intercept as non-seasonal deterministic exogenous variable and monthly dummies variables.[73] Instead, HEGY tests reject the null hypothesis of unit roots at all seasonal frequencies (any of the individual or harmonic pair frequencies and on joint tests of all seasonal frequencies). All the tests were carried out for the period 2010-2020 (Feb.).

For Motels (at 0.05 significance level), for Inns, Holiday villages, and Houselet type unit (at 0.10 significance level), the HEGY test does not found pieces of evidence for unit root at zero frequency and, as for the other countries, rejects the null hypothesis of unit roots at all seasonal frequencies. In order to identify the specific dynamics of monthly "index of net using the touristic accommodation capacity in function, by type of establishment", we calculated the anticipated levels under normal conditions (the counterfactuals). For this, we estimated a SARIMAX (p, d, q) $(P, Q)_{s=12}$ model for each type of establishment separately, like:

$$\ln (NUTAC)_t = a_0 + \sum_i a_i \cdot month_i + e_t$$

$$\Phi(L)\,(1 - L)^d\,(1 - \phi L^{12})\,e_t = \Theta(L)\,(1 - \theta L^{12})\,\varepsilon_t$$

(4) where $\ln (NUTAC)_t$ means logarithm transformation of "index of net using the touristic accommodation capacity in function, by type of establishment" for month = t, t = Jan-2010, …, Feb-2020, and the 12 dummies months are for January, …, December. The transformation of the series by logarithm was the variant selected in the automatic ARIMA forecasting method for most of the analysed types of establishments. We used that transformation for all types of establishments in order to ensure a unified approach. In the error variable e_t equation, we have introduced a SARIMA(p, d, q)$(P,Q)_{s=12}$ terms in order to capture the remaining seasonal effect and to control for non-stationarity and for autocorrelation. In equation

[71] Dickey, Fuller, 1979.
[72] Kwiatkowski et al. 1992.
[73] Hylleberg et al. 1990.

(4), as in equations (2) and (3), L is the lag operator, Φ(L) is a polynomial function of order *p* (the autoregressive part of the model), Θ(L) is a polynomial function of order *q* (the moving average part), *d* is the order of integration (degree of differencing involved), ϕ and θ are the parameters of the seasonal autoregressive (SAR) and seasonal moving average (SMA) parts, respectively. We defined the range of non-negative integers parameters as follows: $d \leq 1$, $p \leq 11$, $q \leq 11$, $P \leq 1$, and $Q \leq 1$. Table 3 shows the results of unit root tests and the specifications of SARIMA models used in order to build the counterfactual dynamics for Romanian "index of net using the touristic accommodation capacity in function". The specification of each model is selected via the automatic ARIMA forecasting method.

Table 3. Models used for the counterfactual's construction for Romanian index of net using the touristic accommodation capacity in function by type of establishment.[74]

Type of establishment	ADF / KPSS / HEGY	SARIMA(p,d,q)(P,Q) model specification
Total	1 / $0^{0.01}$ / 1	SARIMA (4,1,1) (0,1)
Hotels	1 / 1 / 1	SARIMA (1,1,1) (1,0)
Hostels	1 / 1 / 1	SARIMA (2,1,2) (0,0)
Motels	$0^{0.10}$ / 0 / 0	SARIMA (1,0,1) (1,0)
Inns	0 / 0 / $0^{0.10}$	SARIMA (3,0,0) (0,0)
Touristic villas	1 / 1 / 1	SARIMA (3,1,1) (1,0)
Touristic chalets	1 / 1 / 1	SARIMA (4,1,0) (1,0)
Bungalows	1 / 1 / 1	SARIMA (4,1,2) (1,1)
Holiday villages	1 / 0 / 0	SARIMA (2,0,0) (0,0)
Campings	1 / 0 / 0	SARIMA (2,0,2) (0,0)
Touristic halting places	1 / 1 / 1	SARIMA (2,1,2) (0,0)
Houselet type unit	1 / 0 / 0	SARIMA (3,0,2) (0,0)
School and pre-school camps	1 / 0 / *	SARIMA (1,0,3) (0,0)
Touristic boarding houses	1 / 1 / 1	SARIMA (1,1,1) (1,0)
Agroturistic boarding houses	1 / 1 / 1	SARIMA (1,1,1) (0,0)
Ships accommodation spaces	1 / 1 / *	SARIMA (2,1,0) (0,0)

The outcomes of the models are in Table 4. The maximum amplitude of the negative effects of the COVID-19 pandemic on net using the touristic accommodation capacity in function, by type of establishment was registered in the spring of 2020 and at the beginning of summer. In July-August-September, the average decreases were smaller in size but returned to high values in October-November and December.

The data for "Campings" show significant differences between the values recorded in summer and those for the rest of the year (e.g., the monthly average was 23.5% in August and 20.3 in July, against 1.6 to 1.9% in January-April and October-December; in May and September, the values were 6.2%). Under these conditions, for "Campings", we built forecast models only for the "warm" months (May - September).

With a few exceptions (which refer in particular to certain coefficients of dummy variables attached to the winter months), the coefficients of the models are significantly different from zero at 0.01 level (according to t-tests). Furthermore, the Breusch-Pagan-Godfrey tests do not reject the null hypothesis of

[74] *Legend*: (*) For "School and pre-school camps" and "Ships accommodation spaces" the HEGY test cannot be applied due to insufficient data. For "Ships accommodation spaces", we were only able to apply the Dickey-Fuller test (DF, instead of ADF), due to an insufficient number of observations for lag length automatic selection. The DF test does not reject the null hypothesis of unit root. "ADF / KPSS" means Augmented Dickey-Fuller (Dickey, Fuller 1979) and Kwiatkowski-Phillips-Schmidt-Shin (Kwiatkowski *et al.* 1992) unit root tests, respectively. "HEGY" is a seasonal unit roots test (Hylleberg et al. 1990). For ADF and KPSS the models contain the constant as an exogenous variable. We presented the results of HEGY tests for the hypothesis of unit root at zero frequency in models with intercept as non-seasonal deterministic exogenous variable and with monthly dummies variables. For all the tests, "0" without exponent means "stationarity" at least 0.05 level of significance, in other words, the series are I(0), while "1" means "non-stationary" in level and stationary in first difference, that is the series are I(1). The exponent specifies the level of significance (for ADF and HEGY tests the null hypothesis is non-stationarity, while for the KPSS test the null hypothesis is the stationarity). *Source*: Own calculation based on Romanian National Institute of Statistics data: *Index of net using the touristic accommodation capacity in function by type of establishment and comfort category*, monthly data (table TUR106C), http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (extracted on 30.06.2022).

homoskedasticity for the residuals in the econometric models.[75] In addition, the coefficients of determination in regression equations are generally greater than 90-95%.

Table 4. Romania: COVID-19 impact on index of net using the touristic accommodation capacity in function, by type of establishment.[76]

		2020										2021	
		Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Total	data	14.3	8.3	6.9	13.8	28.8	39.1	26.3	17.5	12.8	12.2	17.2	19.8
	c.fact.	24.3	27.2	31.8	37.5	46.3	52.5	38.2	35.3	31.9	26.3	23.9	25.3
	Δ%	-41%	-69%	-78%	-63%	-38%	-26%	-31%	-50%	-60%	-54%	-28%	-22%
Hotels	data	16.5	6.9	6.7	14.9	32.9	44.6	30.4	21	14.9	12.9	19.5	23.1
	c.fact.	31.9	35.8	41.0	46.7	57.8	65.5	49.7	47.6	42.6	32.3	30.3	32.9
	Δ%	-48%	-81%	-84%	-68%	-43%	-32%	-39%	-56%	-65%	-60%	-36%	-30%
Hostels	data	14.9	15.6	7.2	10.4	20	25.9	17.5	12.1	9.9	10.2	12.2	13
	c.fact.	19.4	21.3	23.1	26.4	35.2	40.7	25.5	24.0	21.7	19.9	18.0	19.8
	Δ%	-23%	-27%	-69%	-61%	-43%	-36%	-31%	-49%	-54%	-49%	-32%	-34%
Motels	data	10.8	14.7	10.4	7.9	14.2	20.3	16.4	11.2	10.5	9.2	9.8	11.2
	c.fact.	13.2	14.2	16.1	17.8	20.1	23.0	18.2	16.8	15.5	13.1	11.6	13.4
	Δ%	-18%	4%	-36%	-56%	-29%	-12%	-10%	-34%	-32%	-30%	-15%	-16%
Inns	data	2.5	…	…	1.9	6.4	7.8	6.2	0.7	0.5	1.2	19.5	20.6
	c.fact.	20.7	19.2	18.0	21.7	18.7	20.4	16.4	13.9	14.0	12.0	9.2	8.8
	Δ%	-88%	…	…	-91%	-66%	-62%	-62%	-95%	-96%	-90%	112%	133%
Touristic villas	data	11.7	12.5	9.0	13.7	26.8	37.6	25.1	14.2	11.7	13.5	18.7	20.1
	c.fact.	15.4	18.6	23.4	27.6	41.8	50.0	30.4	23.8	21.1	21.5	20.4	19.4
	Δ%	-24%	-33%	-62%	-50%	-36%	-25%	-17%	-40%	-45%	-37%	-8%	4%
Touristic chalets	data	8.0	…	9.0	11.8	21.6	29.0	19.7	11.2	8.8	11.8	17.9	18.9
	c.fact.	10.9	11.9	13.4	16.2	25.2	32.7	19.0	12.9	12.3	17.9	17.1	16.6
	Δ%	-27%	…	-33%	-27%	-14%	-11%	3%	-13%	-28%	-34%	5%	14%
Bungalows	data	9.0	...	7.5	33.7	35.0	37.0	29.0	8.3	6.7	7.3	13.6	18.6
	c.fact.	13.9	18.6	17.6	21.1	33.1	45.5	19.9	14.8	14.2	17.9	17.8	19.5
	Δ%	-35%	…	-57%	60%	6%	-19%	46%	-44%	-53%	-59%	-23%	-4%
Holiday villages	data	0.3	...	0.9	4.9	17.4	15.7	21.5	7.5	9.9	5.5	4.0	9.1
	c.fact.	2.1	7.6	8.8	14.1	22.6	26.9	14.3	8.3	4.8	8.3	4.8	3.8
	Δ%	-86%	…	-90%	-65%	-23%	-42%	51%	-10%	105%	-34%	-17%	138%
Campings	data	...	...	...	15.4	27.4	31.3	16.4	...	...	...	...	...
	c.fact.	...	...	…	13.8	29.1	37.6	6.7	...	...	...	...	...
	Δ%	…	…	…	12%	-6%	-17%	146%	…	…	…	…	…
Touristic Halting places	data	4.5	...	2.7	7.0	24.6	32.9	26.5	11.0	11.2	24.4	11.7	10.6
	c.fact.	7.1	12.2	16.8	23.9	45.8	56.3	19.7	7.5	8.5	10.8	7.3	5.7
	Δ%	-37%	…	-84%	-71%	-46%	-42%	34%	48%	31%	126%	61%	86%
Houselet type unit	data	1.7	…	1.5	12.5	30.0	39.2	23.3	9.5	7.0	3.2	7.7	4.3
	c.fact.	3.9	4.0	4.4	10.0	25.7	31.4	9.2	3.9	3.3	3.7	3.0	2.3
	Δ%	-57%	…	-66%	25%	17%	25%	153%	146%	113%	-15%	153%	89%
School and pre-school camps	data	5.1	…	…	0.5	4.9	3.8	3.1	4.0	3.7	5.0	3.5	3.5
	c.fact.	4.4	6.2	6.5	12.3	24.3	27.4	9.5	8.9	9.5	9.0	8.1	8.3
	Δ%	17%	…	…	-96%	-80%	-86%	-67%	-55%	-61%	-45%	-57%	-58%
Touristic boarding houses	data	11.7	10.7	8.5	11.2	19.7	28.1	19.2	13.2	10.3	11.2	14.5	16.2
	c.fact.	15.9	19.0	20.9	22.8	28.5	32.9	24.1	21.5	20.1	21.0	18.6	18.9
	Δ%	-26%	-44%	-59%	-51%	-31%	-15%	-20%	-38%	-49%	-47%	-22%	-14%
Agroturistic boarding houses	data	9.0	9.5	6.0	12.4	22.1	31.8	20.1	12.3	9.3	11.4	13.8	14.5
	c.fact.	12.6	16.1	18.1	20.5	27.9	33.7	21.1	16.8	15.4	19.6	15.4	14.5
	Δ%	-28%	-41%	-67%	-40%	-21%	-6%	-5%	-27%	-40%	-42%	-10%	0%

75 Breusch, Pagan 1979; Godfrey 1978.

76 *Legend*: "data" = monthly statistical data from Romanian National Institute of Statistics (*Index of net using the touristic accommodation capacity in function by type of establishment and comfort category*)
"c.fact." = value of counterfactual estimated through SARIMAX model
Δ% = [(data – counterfactual)/counterfactual]·100
... = missing data
Source: Own calculation based on Romanian National Institute of Statistics data: *Index of net using the touristic accommodation capacity in function by type of establishment and comfort category*, monthly data (table TUR106C), http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (extracted on 30.06.2021).

		2020										2021	
		Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Ships	data	…	…	…	11.9	25.8	42.4	25.6	29.6	…	…	…	…
accommodation	c.fact.	35.2	34.3	35.7	24.1	23.7	38.5	39.6	38.5	38.0	39.2	39.1	38.1
spaces	Δ%	…	…	…	-51%	9%	10%	-35%	-23%	…	…	…	…

Regarding the analysed economic problem, we mention the fact that COVID-19 has had a drastic impact on the Romanian hotel sector.[77] In accordance with Cushman & Wakefield,[78] on average, 35% of employees were fired in 2020. It is considered that in Romania, as in all Eastern European countries, the situation seems more complicated because "on the one hand, the market is younger and investors are financially exposed, not yet having the time to consolidate their business, and on the other hand, because the state's reaction to the crisis that has hit the sector has been delayed and disproportionate, far below the scale of the crisis".[79] According to our calculations, the index of net using the touristic accommodation capacity in function, by type of establishment fell by about 47%, on average, in a year with the COVID pandemic (March 2020 – February 2021).

For Romania, the COVID-19 pandemic had a very strong negative impact on the index of net using the touristic accommodation capacity in function in "Hotels" (an average decrease of -53.4%, with more than 80% in April and May 2020). "Hotels" account for over 62% of the total number of accommodation places in Romanian tourism. There was also a sharp drop (-58.8%) in "School and pre-school camps", but this category has a small share in the total number of accommodation places (0.7%, for 2019-2020). Strong decreases in the index were also recorded in Hostels (-42.5%), Inns (-40.5%, with a recover in January and February 2021), Touristic boarding houses (-34.7%), Touristic villas (-31.1%). Less affected were the small accommodation units, located closer to nature. Available statistics and counterfactuals calculations showed that the Covid-19 pandemic did not affect the index of net using the touristic accommodation capacity in function in "Camping" (+33% on average, for May to September), "Houselet type units" (+53%), and "Touristic halting places" (+9.7%). Also, there were declines, but much smaller in size, for Holiday villages (-6.6%) "Touristic chalets" (-15%), and "Bungalows" (-17%).

Impact of COVID-19 pandemic on the index of net using the touristic accommodation capacity in function, by comfort category

We analysed the differentiation of the impact induced by the COVID-19 pandemic on the index of net using the touristic accommodation capacity in function, *by comfort category*. As the type of establishment, we analysed "Hotels", "Touristic boarding houses" and "Agrotouristic boarding houses". Taken together, in 2019 these categories of accommodation cover 83.4% of the total number of accommodation places in the Romanian tourism industry and 84.7% in 2020. Comfort categories range from one to five stars (one to five flowers for "Agrotouristic boarding houses").

The model, built for each country separately, is of the SARIMAX (p, d, q) $(P, Q)_{s=12}$ type, similar to those described by equations (2 - 4), namely:

$$\mathbf{ln(COMF)_t = a_0 + \sum_i a_i \cdot month_i + e_t}$$
$$\mathbf{\Phi(L)\ (1 - L)^d\ (1 - \phi L^{12})\ et = \Theta(L)\ (1 - \theta L^{12})\ \varepsilon_t}$$

(5) where $\ln(COMF)_t$ means logarithm transformation of "index of net using the touristic accommodation capacity in function by comfort category" for month = t, t = Jan-1990, …, Feb-2020, and the 12 dummies months are for January, …, December. As we mentioned above, we used that transformation of the series by logarithm for all countries, to ensure a unified approach. In the error variable e_t equation, we have introduced a SARIMA (p, d, q) $(P, Q)_{s=12}$ terms to capture the remaining seasonal effect, and to control for non-stationarity and for autocorrelation. In equation (4), the symbols used are identical to those described for equation (2 – 4). In Table 5 we show the nature of the series and the SARIMAX specifications of models used to build the counterfactual dynamics for the Romanian "index of net using

[77] Iştoc, Băleanu, 2020, 12-20.
[78] Cushman, Wakefield 2020.
[79] Ilie 2020, 10.

the touristic accommodation capacity in function". The specification of each model is selected via automatic ARIMA forecasting method, with $d \leq 1$, $p \leq 11$, $q \leq 11$, $P \leq 1$ and $Q \leq 1$.

Before building econometric models, we tested the stationarity of time series concerning the "index of net using the touristic accommodation capacity in function by comfort category". We used the ADF tests (for which the null hypothesis is non-stationarity) and KPSS (for which the null hypothesis is the stationarity). For the sake of robustness, we also applied the seasonal unit roots tests, namely HEGY tests.[80] In accordance with the Augmented Dickey-Fuller[81] test and Kwiatkowski-Phillips-Schmidt-Shin test,[82] all the series concerning "index of net using the touristic accommodation capacity in function" for the 1-Star comfort category and 2-Stars for Hotels are stationary. For the other data series, at least one test indicates non-stationary. As results of seasonal unit root tests, we mention that, for the comfort category between 3 - 5 Stars (flowers, in the case of agrotourism), the HEGY tests[83] do not reject the hypothesis of unit root at zero frequency (at 0.01 significance level), in the models with intercept as non-seasonal deterministic exogenous variable and with monthly dummies variables, instead they reject the null hypothesis of unit roots at all seasonal frequencies (any of the individual or harmonic pair frequencies and on joint tests of all seasonal frequencies). All the tests were carried out for the period 2010 – 2020 (Feb.) and the outcomes or unit root tests and the specifications automatically selected for the SARIMA models are in Table 5.

Table 5. Models used for the counterfactual's construction for Romanian index of net using the touristic accommodation capacity in function[84]

Comfort category	Hotels		Touristic boarding houses		Agroturistic boarding Houses*)	
	ADF / KPSS / HEGY	SARIMAX (p,d,q)(P,Q)	ADF / KPSS / HEGY	SARIMAX (p,d,q)(P,Q)	ADF / KPSS / HEGY	SARIMAX (p,d,q)(P,Q)
1-Star	0 / 0 / 0	(4,0,0) ((0,0)	0 / 0 / 0	(1,0,0) (0,1)	1 / 0 / 0	(4,0,2) (0,1)
2-Stars	0 / 0 / 1	(1,0,0) (1,0)	1 / 1 / 1	(1,1,1) (0,0)	1 / 0 / 0	(4,0,2) (0,1)
3-Stars	1 / 1 / 1	(2,1,0) (1,0)	1 / 1 / 1	(0,1,2) (0,1)	1 / 1 / 1	(3,1,2) (1,0)
4-Stars	1 / 1 / 1	(1,1,1) (0,0)	1 / 1 / 1	(2,1,3) (0,0)	1 / 1 / 1	(0,1,1) (0,0)
5-Stars	1 / 1 / 1	(4,1,0) (1,0)	1 / 1 / 1	(3,1,1) (0,0)	1 / 0 / 1	(1,0,1) (1,1)

*) For "Agroturistic boarding Houses", the comfort categories are evaluated in 1 to 5 flowers.

The results or SARIMAX models are shown in Figure 1. For "Hotels" the average decrease of the index of net using the touristic accommodation capacity was -53.4%, between March 2020 and February 2021, but this decrease is significantly differentiated according to the comfort category (left panel of Figure 1): the decrease is stronger as the comfort category increases.

This dynamic can be explained by the fact that the COVID-19 pandemic has hit business/corporate tourism greatly rough.[85] The accommodation capacity in "Hotels" stands for about 60 percent of the total Romanian tourism accommodation capacity.

The accommodation capacity in "Touristic boarding houses" represents about 11 percent of the total Romanian tourism accommodation capacity. For this establishment category, the average decrease in the

80 Hylleberg et al. 1990.
81 Dickey, Fuller 1979.
82 Kwiatkowski et al. 1992.
83 Hylleberg et al. 1990.
84 *Legend*: "ADF / KPSS" mean Augmented Dickey-Fuller (Dickey, Fuller 1979) and Kwiatkowski-Phillips-Schmidt-Shin (Kwiatkowski et al. 1992) unit root tests, respectively. "HEGY" is a seasonal unit roots test (Hylleberg et al. 1990). For ADF and KPSS the models contain the constant as an exogenous variable. We presented the results of HEGY tests for the hypothesis of unit root at zero frequency in models with intercept as non-seasonal deterministic exogenous variable and with monthly dummies variables. For ADF and HEGY tests the null hypothesis is non-stationarity, while for the KPSS test the null hypothesis is the stationarity. For all the tests, "0" means "stationarity" at least 0.05 level of significance, in other words, the series is I(0), while "1" means "non-stationary" in level and stationary in first difference, that is the series are I(1). All the tests were carried out for the period 2010-2020 (Feb.). *Source*: Own calculation based on Romanian National Institute of Statistics data: *Index of net using the touristic accommodation capacity in function by type of establishment and comfort category*, monthly data (table TUR106C), http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table (extracted on 30.06.2021).
85 Drăghici 2020, 10.

index of net using the touristic accommodation capacity was environ -35%, much lower than for "Hotels" (central panel of Figure 1). With the exception of the "one star" comfort categories, for which the decrease is only -6.5%, for the categories from two to five stars, the decrease is more accentuated (with the decrease index located in the range from – 30.3% to -41.1%). As for "Hotels", this decrease is differentiated according to the comfort category: the decrease is stronger than the high comfort category.

For "Agrotourism boarding houses", the average decrease in the index of net using the touristic accommodation capacity in function was environ -27%, the smallest decrease among the three categories analysed (right panel in Figure 1). This could be explained by the smaller number of accommodation places in such units, their close proximity to nature and the better possibility of distancing people in the context of the COVID-19 pandemic. The accommodation capacity in "Agrotourism boarding houses" stands for about 13 percent of the total Romanian tourism accommodation capacity. For this establishment category, the decrease is more uniform (with the decrease index volatility located in the range from – 20% to -34%). For high comfort category (5 Flowers), the sharp drop in 2020 (March-December, -37.1%) was offset by a remarkable rebound in January (31%) and February 2021 (+78%).

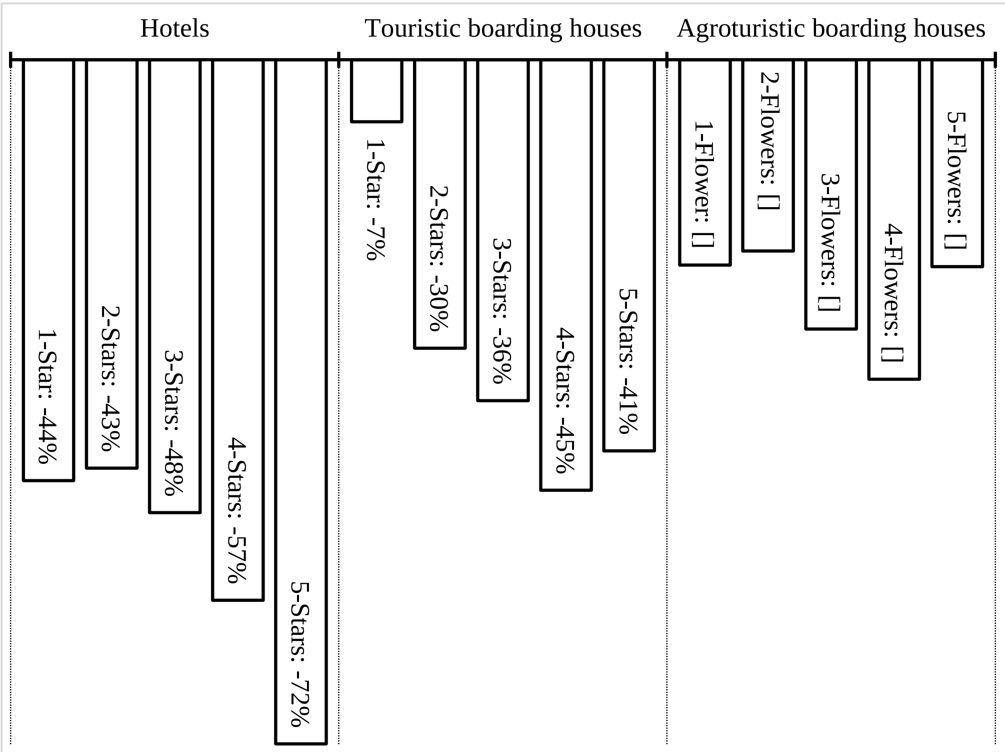

Fig. 1. Impact of COVID-19 pandemic on Romanian index of net using the touristic accommodation capacity by comfort category (Source: see Table 1).

DISCUSSIONS AND CONCLUSIONS

Tourism has been one of the sectors most affected by the COVID-19 pandemic. The number of international tourist arrivals was affected by the fact that the countries applied travel restrictions (which went up to temporary complete border closures to foreigners) in order to limit the spread of coronavirus. Besides, the established nationwide lockdowns, in an effort to help contain the pandemic, have affected domestic travels.

In order to evaluate the dimension of pandemic impact on tourism, we estimate the average conditioned values of net occupancy rates of bed-places in hotels and similar accommodation for European countries, between March and December 2021. Instead of the traditional (statistic) procedure, by which the comparison of current values (2020) is made with the values of the previous year (2019) (i.e., counterfactual values built through naïve forecasting), in our analysis, the average expected values were computed in the hypothesis of maintaining pre-pandemic conditions (counterfactual as the expected conditionate values). For this purpose, using monthly data on net occupancy rates of bed-places in hotels and similar accommodation, between January 2010 and March 2020, we built SARIMAX (Seasonal Autoregressive Integrated Moving Average with exogenous factors) forecasting models for 32 European countries.

In Europe, the net occupancy rate of bed-places in hotels and similar accommodation, dropped dramatically since March 2020. The largest decreases were recorded at the beginning of the pandemic (March, but especially April and May). In April, the decrease was almost 90%, in most European countries analysed.

The acceptance of some measures to ease the restrictions during the summer led to a slight recovery in the net occupancy rates of bed-places in hotels and similar accommodation, but the autumn and onset of winter brought further serious declines in the respective indices. This is because, in the warm season, the accommodations in small establishment units, outdoors, in the middle of nature, such as campsites, tourism pensions, agritourism pensions, bungalows were possible. These units offer the possibility to keep distance between people in the context of the COVID-19 pandemic and to carry out tourist activities in small groups or within the family. And these activities were in line with protective measures against the COVID-19 pandemic (after a slight relaxation of protective procedures, during the summer).

The passing of the summer peak in tourist season, the beginning of school courses, the failure of the activities related to business and corporate tourism, and the occurrence of a new peak of the pandemic, led to a new sharp decrease in tourist activities. The decreases in the winter 2020-2021 months (December to February) were -96% in net occupancy rates for Austria, about -80% in Czechia, Hungary, and Iceland, and more than -70% for Germany, Denmark, Italy, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Slovakia. In most other countries, the decrease was between -60% and -70%.

As a fact, not positive (we are talking, however, about a decrease in activity), but only less painful, we mention that the smallest decrease in tourist activities was registered in the case of low comfort categories and in small accommodation units, in close proximity to nature and with a better possibility of distancing people in the context of the COVID-19 pandemic. The literature confirms that, for these types of accommodation, water and electricity consumption is lower, compared to accommodation in large establishments and high comfort categories. We mention, in this line, the studies carried out by Styles, Schönberger & Martos,[86] Becken, Frampton & Simmons,[87] Lundie, Dwyer & Forsyth,[88] Priyadarsini, Xuchao, Eang 2009,[89] Dibene-Arriola et al.[90]

In order to verify the hypothesis that the COVID-19 pandemic pushed tourists to accommodations at smaller establishments and at lower comfort, we detailed the analysis by studying the structure of accommodation, through the indices of the net use of the touristic accommodation capacity, by type of establishment and comfort category, in Romania. We showed that, as an average between March-2020 and February-2021, COVID-19 pandemic did not affect the index of net using the touristic accommodation capacity in function in "Camping" (+33% on average, for May to September – 2020), "Houselet type units" (+53%) and "Touristic halting places" (+9.7%). Also, there were declines, but much smaller in size (as compared to "Hotels", for example), for Holiday villages (-6.6%) "Touristic chalets" (-15%), and "Bungalows" (-17%). The biggest decreases are in Hotels, Hostels and Inns.

Regarding the comfort categories, for "Hotels" and "Touristic boarding houses" the decrease is stronger as the comfort category increases. For "Agrotourism boarding houses", the index of net using the touristic accommodation capacity registered a smaller decrease than in "Hotels" and "Touristic boarding houses" and the decrease by comfort category is more uniform (the volatility of the decrease is small).

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86 Styles, Schönberger, Martos 2013.
87 Becken, Frampton, Simmons 2001.
88 Lundie, Dwyer, Forsyth 2007.
89 Priyadarsini, Xuchao, Eang 2009.
90 Dibene-Arriola et al. 2021.

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