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Impact of COVID-19 on the connectedness across global hospitality stocks

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ABSTRACT

This study investigated the connectedness of top ten hospitality stocks in the world and the impact of the COVID-19 pandemic on this connectedness. For this purpose, we employ the time-varying parameter vector autoregressions (TVP-VAR) to examine the return connectedness among the world’s top ten hospitality stocks. We further utilize the wavelet coherence measure to test the impact of COVID-related indexes on the connectedness across the hospitality stocks from January 1, 2020 to July 16, 2021. Our findings explore a strong connectedness among the hospitality stocks, although the total connectedness index is considerably affected by the first wave, the second wave, and the approval of COVID-19 vaccines. France and UK hospitality stocks appeared to be dominant and were the highest net transmitters of spillover shocks to other sample stocks. We document that the COVID-19 pandemic is the prime driver of the hospitality stocks’ connectedness during the sample period. Aside from the contribution to hospitality and finance literature, our conclusions and implications can also benefit parties such as hospitality firm managers, investors, portfolio managers, and policymakers.

1. Introduction

The COVID-19 pandemic has brought unprecedented challenges to the global economic world, leading to social, economic, and financial crises. Since the COVID-19 outbreak is reported to be a source of systematic risk (Shahzad et al., 2021; Balli et al., 2021; Naeem et al., 2021), the higher uncertainty among the markets has resulted in the volatility of the stock markets, particularly when it comes to the share prices of hospitality, travel, and leisure stocks. Evidence suggests that whenever a particular pandemic hits the global world, the hospitality and tourism sector is the most affected, showing lower recovery to these pandemics (Zheng et al., 2021). For example, about 3 million employees working for the tourism and hospitality sector lost their jobs due to the outbreak of SARS in 2002 and a remarkable economic loss of around USD 20 billion in Eastern Asia (World Travel and Tourism Council, 2003). Similarly, a sharp decline of 22% of world tourists in the first quarter of 2020, after the COVID-19 outbreak, reflects the severity of the pandemic, specifically for the hospitality and travel sector (Sharma et al., 2021). Reports documenting the job loss in the hospitality industry due to COVID-19 suggest that about one million employees lost their jobs (World Tourism Organization, 2020). Within the global hospitality and tourism industry, Europe (in particular, France and UK) is considered the chief contributor, accounting for approximately 50% of the market share of the international travel and leisure industry (Abbas et al., 2021).

The tourism sector crucially contributes to the economic growth of developing and developed countries. Shahzad et al. (2017) argue that the tourism sector boosts the economy through various channels, such as employment, and that it generates tax revenues and catalyzes investment in human capital, infrastructure, and technology. It fosters the efficiency of domestic firms by raising competition among them and, most significantly, through the channel of service export, which reduces the deficit of the balance of payment. Moreover, several empirical studies have documented that the tourism sector drives the economy...
The COVID-19 pandemic has devastated the travel and leisure sector along with overall global economic activities. Therefore, government intervention—applying different degrees of a myriad of fiscal, monetary, and supply-side measures—becomes necessary to save and support the survival of the tourism sector. In this context, Anguer-a-Torrell et al. (2020) examine the response of hotels to the COVID-19 outbreak as well as various public sector measures across various countries during the period between February 24 and April 24, 2020. The study shows that the hotel industry has been inversely impacted by the COVID-19 evolution and positively correlated to economic policies. On the same note, Yeh (2021) proposes that government-sponsored loans are crucial to the survival of the hospitality industry. Our study highlights vital implications for policymakers to consider in the current and future crises facing the hospitality sector.

In this way, the current study investigates the connectedness of the hospitality stocks of ten countries with the highest number of COVID-19 cases. The top ten major tourist destinations in terms of tourist arrivals, based on the 2020 UNWTO report, are chosen in the sample. They include France (FRA), Spain (SPN), United States (USA), China (CHN), Italy (ITA), Turkey (TUR), Mexico (MEX), Germany (GER), Thailand (TH), and United Kingdom (UK). Meanwhile, the selection of stocks is based on the destinations with the most coronavirus cases. Moreover, we employed the unique methodology, the time-varying parameter vector autoregression (TVP-VAR) approach, to examine the connectedness of the top ten hospitality stocks. The TVP-VAR approach uniquely offers two benefits over other techniques. First, the TVP-VAR technique caters to the problem of arbitrary selection of rolling-window size; second, the model potentially avoids the loss of valuable observations to make the sample suitable (Adekoya and Oliyide, 2021). Moreover, TVP-VAR model determines possible changes in the connectedness of hospitality stock markets to provide evidence of whether the linear structure is derived from the probability of the shocks or from the extension of the change in responses. The model also offers peculiar characteristics to recognize potential structural breaks in time-varying dynamics and provides significant reasons to recognize the relationship among variables.

In addition, we employed wavelet coherence analysis to further investigate the impact of COVID-induced indexes on the connectedness of hospitality (TLS) stocks. Specifically, the COVID-19 indexes are: (1) panic index, which measures the level of news and rumors referring to panic or hysteria during coronavirus; (2) media coverage index, which calculates the percentage of all news sources covering the topic of the novel coronavirus; (3) sentiment index, which measures the level of sentiment across all entities mentioned in the news alongside the coronavirus; (4) fake news index, which measures the level of media gossip about the novel virus that makes reference to misinformation or fake news alongside COVID-19; (5) media hype index, which measures the percentage of news about the novel coronavirus; and (6) infodemic index, which calculates the percentage of all entities (e.g., places and companies) that are somehow linked to COVID-19. In addition, all these indexes are available from January 2020 to calculate the media sentiments and analysis during the pandemic to provide a comprehensive tool for examining the impact of media sentiment indexes on the connectedness of travel and leisure stocks during COVID-19.

In the light of the above arguments, the current study contributes to the extant literature in multiple ways. First, this is the pioneer study to examine the connectedness of the hospitality stocks during COVID-19 of the top ten tourist destinations with the highest number of coronavirus cases. Second, the study employs the time-varying parameters vector autoregressions (TVP-VAR) approach, proposed by Primiceri (2005) and extended by Antonakakis and Gagaber (2017), to advance in the current body of literature. Third, we employed wavelet coherence analysis to investigate the co-movements of the hospitality stocks and COVID-induced indexes. Fourth, this is the first study that cumulatively examines the impact of six COVID-related indexes that significantly influence the connectedness of travel and leisure stocks. Finally, we proposed useful implications for hospitality firms, managers, stakeholders, investors, portfolio managers, policymakers, and regulatory authorities to be considered in the future during episodes of uncertainty.

Our findings highlight that, out of the top ten destinations, France and UK are the net transmitters of spillovers. As indicated by the World Travel Organization (2021), European countries are at the epicenter of the world’s most appealing tourist destinations. The time-varying dynamics indicate that TLS has undergone significant variations during COVID-19, particularly in March 2020, when World Health Organization (2020) officially declared the coronavirus a global pandemic and imposed several restrictions based on observing social distancing and quarantine requirements. Consistently, the wavelet coherence analysis shows that COVID-induced indexes significantly drive the connectedness of the hospitality stocks during COVID-19. With these findings, we portrayed significant implications for hospitality firms and managers to carefully tackle the security and safety measures of travelers while keeping in view their health concerns as a matter of prime importance. The study devises useful implications for policymakers and regulatory authorities of the hospitality industry to reformulate their existing policies to ensure travelers’ health and safety and re-developing strategies in the recovery period to curb the destructive impacts of COVID-19.

The remainder of the study is structured as follows. Section 2 explains prior studies of the research field in a literature review. Section 3 describes sample countries’ TLSs data and period, COVID-19 measures, and descriptive statistics. Section 4 demonstrates the methodological framework of TVP-VAR and wavelet coherence techniques. Finally, in Section 5, we conclude and offer significant implications for various constituents of the hospitality and travel and leisure sector.

2. Literature review

Using various methodologies, prior research examined the dependence structures between the hospitality stocks for different periods. The application of network analysis in the hospitality and tourism industry identifies various interlinks of different travel and leisure stocks. The study of Stokowski (1994) is considered as one of the developer studies that employed network analysis to study the relationship between travel and leisure stocks and their groups. Numerous studies applied connectedness approaches (for instance, Baggio, 2007; Baggio et al., 2010; Scott et al., 2011). The main exercise of a connectedness investigation is to obtain the spillover analysis and choose the most attractive (destructive) hospitality nations; while its other purpose is to offer useful policy implications for businesses, the hospitality industry, and the stakeholders. In addition, the connectedness analysis investigates the time-varying attributes, addressing the evolution of different periods and the connectedness of hospitality stocks over a particular period to draw some policy and practical ramifications (Carley and Columbus, 2013).

Studies examined the impact of the earlier SARS pandemic on the hospitality sector of selected Asian countries. Specifically, severe consequences of the SARS outbreak on Hong Kong hotels have been drawn by Pine and McKencher (2004) on the Korean hotel industry by Hend-erson and Ng (2004) and Kim, Chun, and Lee (2005); on Hong Kong restaurants by Alan, So, and Sin (2006); and on Taiwanese hotels by Chen, Jang, and Kim (2007). Hence, we argue that the response of the hospitality sector segments to the SARS outbreak across different countries in the East Asia region is evident for the connectedness of TLS during health crises. The COVID-19 outbreak has a more pronounced and long-lasting inverse impact on the tourism industry and economy (Kaushal and Srivastava, 2021; Skare et al., 2021). On the same note, Fotiadis, Polyzos, and Huan (2021) capture a huge decline (about 98%)
in international tourism demand during 2020 and expect it to continue in 2021. It is noteworthy that international tourism demand has a strong direct impact on the performance of equity indexes (Balli et al., 2021). Moreover, as a consequence of the COVID-19 outbreak, many countries’ hospitality, travel, and leisure operations have been virtually shut down, and international and domestic travel has all but ceased.

Although scholars, hospitality firm managers, investors, and portfolio managers must know the deep potential impact of the COVID-19 pandemic outbreaks on the hospitality, travel, and leisure industry, thus far the literature lacks empirical studies on the pandemic’s influences on the performance of hospitality, travel, and leisure firms. Additionally, the current studies have eminently limited concerns concerning the samples and periods considered. For instance: Song, Yeon, and Lee (2020) explore the vital role that firm characteristics play in the stock decline in response to the COVID-19 pandemic shock in the US from January 3 to May 15, 2020. Gil-Alana and Pozo (2020) study the behavior of tourism stocks in Spain in the period of May 14, 2018 to May 14, 2020, and conclude that the coronavirus crisis has increased the persistence in the data, moving in some of the series from a mean-reverting process to a non-mean-reverting one. By reviewing the aftermath of the earlier crisis on the travel and leisure sector, Skare et al. (2021) estimate the implications of the COVID-19 pandemic and address the long-lasting negative effect of the pandemic on the travel and leisure sector.

Further, by using accounting data, Crespi-Gledera, Martin-Oliver, and Pascual-Fuster (2021) examined the financial distress of Spanish and Portuguese hospitality firms during the COVID-19 outbreak. The study observes that financial distress affects mainly small firms. On the same note, considering the period from January 6, 2020 to March 23, 2020, Kaczmarek et al. (2021) show that global travel and leisure firms with low valuations, limited leverage, and high investments have been more immune to the pandemic-induced crash between January 1, 2020, and conclude that the spillover of shocks related to investor mood, fear, sentiment, and policy uncertainty to the tourism sector in the United States during the COVID-19 era. Lastly, Shahzad, Hoang, and Bouri (2021) explored that the results show that the bad contagion among tourism firms significantly increased in the United States with the outbreak of the COVID-19 pandemic, and spillover among firms is still high. To this end, unlike earlier studies, our study offers a comprehensive analysis of the contribution of the COVID-19 pandemic to the world’s top TLS.

The above literature reveals that the hospitality industry substantially contributes to economic well-being. However, the COVID-19 pandemic has posed enormous challenges to the sector as it worked to confirm its survival during the outbreak with the restrictions imposed by the World Health Organization (WHO, 2020). For all these reasons, the current study is novel in presenting its contribution to the extant literature for the given study period to position the hospitality countries with the most susceptibility to the outbreak risk and subsequently extract beneficial implications, particularly during COVID-19.

### 3. Data and methodology

#### 3.1. Data

We utilize the Travel and Leisure sector indexes from Datastream to represent international tourism stock markets. The top ten major tourist destinations in terms of tourism arrivals, based on the 2020 UNWTO report,’ are chosen in the sample. They include France (FRA), Spain (SPN), United States (USA), China (CHN), Italy (ITA), Turkey (TUR), Mexico (MEX), Germany (GER), Thailand (THI), and United Kingdom (UK). Meanwhile, the selection of stocks is based on the destinations with the most coronavirus cases. We introduce travel and leisure indexes to represent the hospitality firms’ stocks in the top tourist destinations in the world (Hadi et al., 2022; Hadi, Irani, and Gokmenoglu, 2020; Balli et al., 2021). We retrieved the stock prices from Datastream. Further, use six COVID-19 proxies in our analysis: (1) panic index; (2) media coverage index; (3) sentiment index; (4) fake news index; (5) media hype index; and (6) infodemic index. Lastly, since our focus is on the COVID-19 period, we utilize daily data from January 1, 2020 to July 16, 2021. Additionally, for our analyses, the stock prices are converted to change rates, calculated as \( \Delta \text{s_DXY} = \frac{P_{s,DXY} - P_{s-1,DXY}}{P_{s-1,DXY}} \times 100 \), where \( P_s \) is the daily stock price for each country’s hospitality index at day \( t \).

Descriptive statistics are explored in Table 1. During the sample period, except for the US index, the average return of all other indexes is highly negative. The positive mean return is not surprising. The positive mean return is associated with moderate volatility and probably obtained with the support of the stimulus and rescue packages of the US government (Anguera-Torrell et al., 2020). Spain reports a maximum (22.74%) and a minimum (−21.39%), and highest return volatility (3.564) among the sample indexes is during the pandemic period. In Spain, the hospitality sector contributes to the economy, which makes it one of the most vulnerable countries when a crisis affects this industry. The negative image of the country due to the high infection rates harmed travel and hospitality (Moreno-Luna et al., 2021). The minimum daily returns are far higher than the maximum daily returns, reflecting the fear and uncertainty among investors regarding the future performance of hospitality companies. Lastly, Spain’s and Germany’s hospitality indexes are seen to be the most and Mexico’s index the least volatile.

Table 2 presents the Breakpoint Unit Root Test of Augmented Dickey-Fuller, employed to examine the stationarity of the hospitality stock indexes. The breakpoint analysis provides in Table 2.

### Table 1

| Country  | Symbol | Mean | Maximum | Minimum | Std. Dev. | Skewness | Kurtosis | J-B |
|----------|--------|------|---------|---------|-----------|----------|----------|-----|
| France   | FRA    | -0.072 | 14.05 | -14.13 | 2.386 | 0.244 | 10.468 | 940.614² |
| Spain    | SPN    | -0.056 | 22.74 | -21.39 | 3.564 | 1.132 | 16.727 | 3250.273⁴ |
| United States | US | 0.010 | 13.48 | -14.99 | 2.384 | -0.828 | 12.989 | 1721.639⁸ |
| China    | CHN    | -0.009 | 11.04 | -8.75 | 2.305 | 0.182 | 5.035 | 71.793³ |
| Italy    | ITA    | -0.106 | 15.10 | -21.35 | 2.639 | -1.203 | 18.232 | 3993.345⁷ |
| Turkey   | TUR    | -0.048 | 9.52 | -12.58 | 2.699 | 0.045 | 6.468 | 202.109² |
| Mexico   | MEX    | -0.024 | 4.87 | -14.9 | 1.745 | -2.409 | 19.917 | 5195.402² |
| Germany  | GER    | -0.109 | 15.04 | -13.97 | 3.088 | 0.184 | 6.587 | 218.266⁶ |
| Thailand | TAI    | -0.062 | 13.79 | -14.23 | 2.481 | -0.277 | 13.796 | 1962.226⁶ |
| United Kingdom | UK | -0.062 | 14.00 | -20.00 | 2.938 | -0.693 | 12.989 | 1707.569⁶ |

Note: J-B represents Jarque-Bera test of normality. “a” indicates rejection of null hypothesis at 1%

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7 Please see: https://coronavirus.ravenpack.com
8 See: https://www.e-unwto.org/doi/book/10.18111/9789284422456
9 During this period, some of the indexes such as the US and Spain rebounded to pre-COVID-19 pandemic prices while some others such as Italy, UK, and Turkey didn’t.
10 COVID-19 proxies are synchronized to match the corresponding trading dates for each stock indexes.
Table 2
Breakpoint Unit Root Test.

|          | ADF   | Break Date       |
|----------|-------|------------------|
| FRA      | 20.165** | 03/02/2020      |
| SPN      | 20.339** | 03/02/2020      |
| US       | 20.863** | 03/02/2020      |
| CHN      | 19.935** | 03/02/2020      |
| ITA      | 22.763** | 03/02/2020      |
| TUR      | 19.921** | 03/02/2020      |
| MEX      | 16.818** | 03/02/2020      |
| GER      | 19.247** | 03/02/2020      |
| TAI      | 22.303** | 03/02/2020      |
| UK       | 15.604** | 03/02/2020      |

Note: ADF represents the Augmented Dickey-Fuller test with breakpoint.
* ** indicates significance at 1%

stationarity in the time series. The findings in Table 2, arrived at by using the breakpoint analysis, suggest that almost all of the Travel and Leisure stocks indicated negative values given the period of March 2020, thus reflecting the onset of COVID-19 and the global emergency call by the World Health Organization (WHO, 2020) to observe social distancing measures, quarantine requirements, and restrictions on travel across borders to avoid contagious attacks of the coronavirus. Earlier literature (Abbès et al., 2021; Rastgar et al., 2021; Kim et al., 2021; Song et al., 2021) also reported that the COVID-19 pandemic had brought unprecedented challenges to the hospitality, travel, and leisure industry.

3.2. Methodology

This study first uses the time-varying parameter vector autoregressions (TVP-VAR), which measured the connectedness of top hospitality stock markets. Second, we test the time-frequency impact of COVID-related factors on the connectedness of hospitality stocks by employing wavelet coherence.

3.2.1. TVP-VAR Technique

We use the time-varying parameter vector autoregressions (TVP-VAR) model of Primiceri (2005), which was later extended by Antonakakis and Gabauer (2017). This technique discloses two merits: (1) it assists in overcoming the challenge of arbitrarily choosing the optimal rolling-window size, and (2) it circumvents the issue of loss of valuable observations, thus making it suitable for a short sample as well (Adekoya and Oliyide, 2021). The TVP-VAR model determines the possible changes in the connectedness of hospitality stock markets to provide evidence of whether the linear structure is derived from the probability of the shocks or from the extension of the change in responses. The model also offers peculiar characteristics to recognize potential structural breaks and provides significant reasons to recognize the relationship among variables.

In contrast to this, the dynamic copula technique proposed by Liu et al. (2017) is based on a bivariate model and measures tail-dependence between two set of variables. Since the current study is based on a multivariate model, the dynamic copula approach cannot be employed on the given set of variables. Therefore, the current study measures the time-varying connectedness of hospitality stocks using the TVP-VAR approach. Thus, a detailed methodology is given in the following sections.

The model is stated as:

\[ y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_p y_{t-p} + \epsilon_t = X_t \theta_t + \epsilon_t, \]

\[ X_t = [1, y_{t-1}, \ldots, y_{t-p}] \]

Here, \( y_t \) is an \((n \times 1)\) vector for the dependent variable and \( \alpha_{0,1,p} \) denotes \((n \times n)\) time-varying coefficients, which are rewritten as \( \Theta_t \) matrix. \( X_t \) represents an \((n \times k)\) matrix comprising intercepts and lags of the time-dependent variables. \( \epsilon_t \) denotes structural shocks with \((n \times 1)\) heteroskedastic distribution term, with zero mean and time-varying variance-covariance matrix \( \Omega_t \). Given the log-differenced returns of green, Islamic, and conventional financial markets, the variance-covariance matrix is segregated as:

\[ \Omega_t = M^{-1}_t H_t (M^{-1}_t) \]

Here, \( M^{-1}_t \) shows simultaneous relationships of variables and \( H_t \) presents stochastic connectedness. Moreover, the transitions in the time-varying parameters are observed as follows,

\[ \Theta_t = \Theta_{t-1} + \epsilon_t \approx N(0,S) \]

\[ \beta_t = \beta_0 + \xi_t \approx N(0,Q) \]

\[ \ln h_t = \ln h_{t-1} + \sigma_h \eta_{t} \approx N(0,1) \]

Eq. (4) and (5) estimate the time-varying parameters following a random walk process, and Eq. (6) examines the stochastic connectedness following the independent random walk. Primiceri (2005) proposed that coefficients among variables change independently for simplifying the inference and increasing the efficiency of the estimates. It denotes that the main equation error term is independent of the transition equation.

3.2.2. Wavelet Coherence

To examine the time-frequency impact of COVID-related factors on the connectedness of hospitality stock markets, we employ a wavelet coherence that provides a widespread analysis of time-series, irrespective of the sample period. Wavelet coherence is divided into two sub-categories: (1) first cross-wavelet power; and (2) cross-wavelet transform. Torrence and Compo (1998) explained that cross wavelet transform is clarified by two-time sequences, that is, \( a(t) \) and \( b(t) \), which is stated as:

\[ N_{ab}(p,q) = N_a(p,q) N_b(p,q) \]

where \( N_a(p,q) \) and \( N_b(p,q) \) illustrate two continuous transforms of \( a(t) \) and \( b(t) \).
and b(t) independently; p is the location index; q is the measure; and composite index is shown by (*). In addition, cross-wavelet transform is used to calculate wavelet power by $|N_a(p,q)|$. The spectra of cross wavelet power reveal a strong concentration of the variables by cumulus of the restrained variance comparatively in the time-frequency domain and time-series under investigation. The unexpected and uncertain events of markets are exhibited by the wavelet coherence with specific parts in the time series through the co-movement of the markets. The coefficient of adjusted wavelet coherence is identified as:

$$W_2(p, q) = \frac{M[M^{-1}N_{ab}(p, q)]^2}{M[M^{-1}N_a(p, q)]^2} M[M^{-1}N_b(p, q)]^2. \quad (8)$$

$M$ reveals a smoothing mechanism whereas $0 \leq W_2(p, q) \leq 1$ indicates a range of squared wavelets, assuming closeness to zero indicates no correlation, and closeness to unity indicates high correlation.

4. Empirical results

4.1. Time-varying connectedness analyses

Before we examine the effect of the COVID-19 pandemic on the connectedness of the hospitality stocks, it is essential to estimate the spillover among the sample hospitality stocks. In Table 3, the total directional spillovers from and to specific stocks, net directional spillovers, and total connectedness index (TCI) for country travel and leisure stocks are reported. The rows in Table 3 represent the contribution of each TLS to the forecast error variance of one individual TLS in the system, while the columns represent the effect of one specific TLS on all other TLSs separately.

The results in Table 3 show that French, Spanish, US, German, and UK hospitality stocks are net transmitters of shocks, while Chinese, Italian, Turkish, Mexican, and Thai stocks are net receivers of shocks. Net pairwise connectedness is reported in Table 2, which illustrates the spillover effects among individual selected TLS. The contribution of individual stocks to others ranges between 100.6% and 34.1% from-connectedness lies between 77.9% and 60%, and net connectedness among the selected TLS ranges between 22.7% to –29.2%. Interesting implications can be drawn from the findings. France, followed by the UK, appeared to be the dominant TLS with the highest connectedness to/from other stocks in our network system. Likewise, France and the UK TLS are noted as the highest transmitters of spillover shocks to the system, whereas Thailand and Mexico TLS are the highest receivers of spillover shocks. This result corroborates the prior studies of Shahzad et al. (2021) and Nhano et al. (2020), who reported that risk connectedness was significantly enhanced in the tourism firms during COVID-19 and that COVID-19 was a source of systemic risk for various sectors, including the hospitality sector, creating uncertainty in the travel and leisure stocks in particular. Meanwhile, France and UK are considered the most attractive destinations by World Tourism Organization (2021)\footnote{Please see: World Tourism Organization (2021), International Tourism Highlights, 2020 Edition, UNWTO, Madrid, https://doi.org/10.18111/9789284422456}; therefore, both travel destinations transmitted major risk spillovers to other countries.

To extend our analysis, Fig. 1 presents the net time-varying connectedness of travel and leisure stocks over the study period. It segregates the stocks in terms of their net transmission and net reception of the spillovers during COVID-19 and reveals whether stocks indicated positive (negative) spillovers for the period under study. Thus, Fig. 1 illustrates whether the role of each TLS is persistent throughout the period considered vis-à-vis all other TLS. Apparently, in line with the results of Table 3, French, US, German, and UK TLS remain as persistent net transmitters of spillover shocks, and Chinese, Turkish, Mexican, and Thai TLS remain as constant net receivers of spillover shocks of our network over the entire period under consideration. However, the Spanish and Italian TLS appeared to have both roles over the sample...
period. This echoes the fact that both Spain and Italy were among the most affected countries during the spread of the pandemic in Europe. Notably, COVID-19 is directly responsible for this behavior of TLS. To be precise, Spanish and Italian are net transmitters of spillover shocks until the peak of the first wave in March 2020. They turn to be the net receivers of spillover shocks to the second wave of the COVID-19 outbreak in November 2020. Notably, they had become net transmitters since the approval of COVID-19 vaccines in the UK in late November 2020 and in the US in December 2020. Exceptionally, Italian TLS shifts its role in the system to a net receiver of shocks when Italy returns to a strict lockdown in April 2021.

On a final note, we look into TCI results, as 70.3% of the forecast error variance within this system of the world’s top TLS deemed the product of cross-stock innovations. This implies that the world’s top TLS tend to co-move considerably. Theoretically, this is due to the resemblance and competitiveness of hospitality-related firms in their business activities. This is further corroborated by Hadi et al. (2022), who report a similar reaction of top TLS to external shocks [terrorist incidents], as well as Liu and Pratt (2017), who found an identical response of the tourism sector to terrorist attacks in 95 countries. Empirically, our findings aligned with Henderson and Ng (2004), Kim et al. (2005), and Chen et al. (2007), who examine the impact of the SARS outbreak on different hospitality segments, and with recent empirical studies by Gil-Alana and Poza (2020) and Škare et al. (2021), who document the severe implications of the COVID-19 pandemic on hospitality-related firms. In addition, the value of TCI varies significantly over the sample period. This can be immediately noted in Fig. 2.

Fig. 2 magnifies the time-varying dynamics of the travel and leisure stocks, which reveals the variation in the connectedness of the stocks during the pandemic periods. The panic of COVID-19 started in January 2020, when Thailand reported the first case out of China. Global air travel was restricted by February 2, 2020. Notably, the dynamic connectedness of TLS is at the highest [above 80%] level at the pandemic’s peak in March 2020 and it starts to decline when governments implement various fiscal and monetary policies to relieve their economies (Akhtaruzzaman et al., 2021). These actions by states changed investors’ sentiments to become optimistic about the private sector’s future performance, including the hospitality firms. We further find another peak of spillovers at the beginning of the second pandemic wave in November 2020, and then a considerable decrease due to further fiscal and monetary policies and the approval of COVID-19 vaccines in the UK in late November 2020 and in the US in December 2020. This confirms the harmful role of the COVID-19 pandemic in the dynamic variation in the connectedness among the TLS and implies that, when including TLS in portfolios, investors and portfolio managers need an effective diversification strategy to avoid severe consequences of exogenous shocks such as the COVID-19 pandemic. Concurrently, previous studies also highlighted that the COVID-19 outbreak proved to be devastating for the global economy (Naeem et al., 2021), multiple stock markets Karim et al., (2022a, 2022b), and financial markets (Nguyen et al., 2020; Naeem & Karim, 2021), which extends the heated debate of scholars to examine whether similar practices and contagion effects prevail in the hospitality and tourism sector. Therefore, the time-varying dynamics of the hospitality and tourism stocks entail that high-peaks and jumps in the graph point to similar contagion influence on the TLS in the period of COVID-19.

Fig. 2. Time-varying Total connectedness, Note: This figure shows the time-varying total return connectedness between the country tourism stocks using TVP-VAR model from January 1, 2020 to July 16, 2021.

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12 See https://www.weforum.org/agenda/2020/12/italy-death-toll-pandemic-covid-coronavirus-health-population-europe/ retrieved on August 10, 2021.
13 See https://www.voa.com/news/covid-19-pandemic/spain-struggles-contain-rising-covid-infections retrieved on August 10, 2021.
14 See https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-submit-emergency-use-authorization retrieved on August 13, 2021.
15 See https://www.fda.gov/news-events/press-announcements/fda-takes-additional-action-fight-against-covid-19-issuing-emergency-use-authorization-second-covid retrieved on August 13, 2021.
16 See https://www.bbc.com/news/world-europe-56621342 retrieved on August 30, 2021.
17 See https://www.ajmc.com/view/a-timeline-of-covid19-developments-in-2020 retrieved on August 25, 2020.
Fig. 3. Impact of COVID-19 on the connectedness, Note: Wavelet coherence between the connectedness and COVID related indexes. The 5% significance level against the noise is shown as a thick contour. The relative phase relationship is shown as arrows (with in-phase pointing right which implies positive co-movement, anti-phase pointing left which implies negative co-movement, and COVID related index leading connectedness by 90° pointing straight down, which implies a strong positive co-movement between the connectedness and the COVID-19 indices).
Thus, the study should frame multiple policy implications to respond proactively to uncertain circumstances in order to save hospitality firms from future crises.

4.2. Wavelet coherence

Wavelet coherence analysis co-movement of two variables. This subsection presents the impact of COVID-induced indexes on the connectedness of travel and leisure stocks to investigate their impact on connectedness. To determine the extent to which the indexes related to COVID-19 are leading the connectedness of TLS, we adopt the wavelet coherence technique. As mentioned earlier, we utilize six COVID-19 measures for our analysis. Fig. 3 shows coherency and phase difference between COVID-19 indexes and TLS. Overall, the degree of movements varies across time and frequencies. A strong co-movement among all COVID-19 indexes and TLS connectedness is observed at high frequency [2–8 days] during the first pandemic wave in March 2020. Additionally, arrows point right, implying that COVID-19 positively leads TLS connectedness. These results strongly align with expectations, and they corroborate the total connectedness result in Fig. 1 and identify the vulnerability of TLS to the pandemic. Moreover, at a lower frequency [8–32 days], we find right-turn arrows during the first and second pandemic waves. During the second wave, all COVID-19 indexes positively led the TLS connectedness with a moderate coherence (around 50%). Exceptionally, panic and fake news indexes appear to drive the TLS connectedness at a frequency of [8–32 days] during the entire sample period with no gap. This is not surprising, as health communication strategies and measures (social distancing, community lockdowns, travel, mobility bans, stay-at-home campaigns, self-quarantine, and mandatory-quarantine curbs crowding) have halted global travel, hospitality, and leisure. This creates fear and concern regarding the earning prospects of hospitality-related firms and, consequently, reflects a decline in the stock prices and a rise in the volatility of TLS.

Lastly, our findings corroborate Chen et al. (2007), who examine the impact of SARS on Taiwanese hotels; Song et al. (2021), who find a negative effect of COVID-19 on US restaurants; and Anguera-Torrell et al. (2020), who examine how the stocks of 20 world-largest hotels respond to COVID-19 and find a negative effect of the pandemic on the hotel industry. In line with Kaczmarek et al. (2021), our findings attempt to determine what protects travel and leisure companies from a global pandemic. Finally, in line with Crespi-Cladera et al. (2021), our study finds evidence of financial distress in the hospitality industry during the COVID-19 disaster.

5. Conclusion

Being highly vulnerable to political, environmental, and pandemic outbreak shocks, firms in the travel, hospitality, and leisure sectors are the most affected by the COVID-19 pandemic. Using the TVP-VAR approach, we examine the spillover among the world’s top ten travel and leisure stocks. Unlike earlier studies, our sample covers the period of first and second waves of the pandemic as well as the approval of the vaccine and its availability. TCI revealed a strong volatility spillover among the stocks, and the pronounced connectedness between the stocks evident a peak around March 2020 and November 2020 [the beginning of the first and second wave]. In addition, we investigate the time-frequency lead/lag relationship between six proxies of the COVID-19 outbreak and TLS connectedness using the wavelet coherence technique. The pandemic appeared to lead the TLS connectedness with strong coherence at [2–8 days] frequency. At the lower frequency [8–32], though, all COVID-19 measures appeared to drive TLS connectedness during the first and second pandemic waves. Exceptionally, panic and fake news indexes appear to drive the TLS connectedness at the frequency of [8–32 days] during the entire sample period with no gap. The results of our analyses were expected, as health strategies and procedures during the pandemic were on all on the cost of hospitality, tourism, travel, and leisure firms.

Our sample consists of the top hospitality stocks around the globe. Specifically, we use the travel and leisure indexes of countries to represent the performance of all hospitality firms in each country. The limitations of our study are that we did not include individual firm stocks or other firm specifications from the financial statements. Further, we examined the connectedness among global hospitality stocks considering only the COVID-19 period. Indeed, our limitations call for further research in this area.

Aside from our original contribution to the finance and hospitality literature, we devised several useful implications for hospitality firms, managers, stakeholders, investors, portfolio managers, policymakers, and regulatory bodies of the travel and leisure sector to relish the findings of the study. First, our findings can benefit hospitality firms by carefully examining the unexpected threats and challenges raised by unexpected pandemics and externalities. In these circumstances, these firms can opt for several strategic measures to provide extra safety to their clients and customers, thus ensuring their health and protecting them from the destructive impacts of COVID-19. Second, hospitality firm managers need to study the implication of the pandemic on their firm’s performance and market value to establish the best crisis management plan. Specifically, as various generations of the coronavirus potentially appear at any time, it seems that the effects of the pandemic may last for a longer time and fluctuate in the future. Thus, hospitality firms are recommended to hold sufficient cash, develop vigorous tourism attraction plans, implement contingency plans to diminish the impact of pandemic-related uncertainty and be resilient to systematic risks until the pandemic comes to an end. The travel and leisure industry stakeholders need to be aware of potential contagions coming in the way of their businesses and cautiously allocate resources amidst COVID-19. Further, investors and portfolio managers are required to make a rational trading decision and establish the best hedging and diversification strategies, as the pandemic has proven itself to be a drastic factor for investment avenues. Thus, investors and portfolio managers must prudently assess the pros and cons of their investment streams. Correspondingly, policymakers need to reformulate their existing travel and hospitality sector policies to ensure the health and safety of their affiliates and foreigners, and to provide them a real-time experience of safe travel. Finally, regulatory bodies and their constituents must introduce effective plans to anticipate the pandemic’s drastic impacts, continue their inter-state affairs at a smooth pace, and maintain foreign alliances to increase the number of travelers in the hospitality and leisure sector.

Data Availability

Data will be made available on request.

References

Abbas, J., Mubeen, R., Jorember, P., Raza, S., Mamirkulova, G., 2021. Exploring the impact of COVID-19 on tourism: transformational potential and implications for a sustainable recovery of the travel and leisure industry. Curr. Res. Behav. Sci. 2, 100033.

Adedoyin, O.B., Oliyide, J.A., 2021. How COVID-19 drives connectedness among commodity and financial markets: evidence from TVP-VAR and causality-in-quantiles techniques. Resour. Policy 70, 101898. https://doi.org/10.1016/j.resourpol.2020.101898.

Akhtaruzzaman, M., Boubaker, S., Umur, Z., 2021. COVID-19 media coverage and ESG leader indices. Financ. Res. Lett., 102170 https://doi.org/10.1016/j.frl.2021.102170.

Alan, C.B., So, S., Sin, L., 2006. Crisis management and recovery: how restaurants in Hong Kong responded to SARS. Int. J. Hosp. Manag. 25 (1), 3–11. https://doi.org/10.1016/j.ijhlm.2004.12.001.

Anguera-Torrell, O., Aznar-Alarcón, J.P., Vives-Pérez, J., 2020. COVID-19: hotel industry response to the pandemic evolution and to the public sector economic measures. Tour. Recreat. Res. 1–10. https://doi.org/10.1080/02508281.2020.1826225.

Antonakakis, N., Gabauer, D., 2017. Refined measures of dynamic connectedness based on TVP-VAR.

Baggio, R., 2007. The web graph of a tourism system. Phys. A 379, 727–734.
