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ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

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POSTGRADUATE PROGRAM

The effect of good and bad news on tourism business shareholders: a time series analysis

By

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ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ & ΤΕΧΝΟΛΟΓΙΑΣ ΤΗΣ ΠΛΗΡΟΦΟΡΙΑΣ

ΤΜΗΜΑ ΣΤΑΤΙΣΤΙΚΗΣ

ΜΕΤΑΠΤΥΧΙΑΚΟ ΠΡΟΓΡΑΜΜΑ

Η επίδραση των «good and bad news» στις μετοχές τουριστικών επιχειρήσεων: Μια Ανάλυση Χρονολογικών Σειρών

Δέσποινα Στυλιανή Πανδή

ΔΙΑΤΡΙΒΗ

Που υποβλήθηκε στο Τμήμα Στατιστικής
του Οικονομικού Πανεπιστημίου Αθηνών
ως μέρος των απαιτήσεων για την απόκτηση
Διπλώματος Μεταπτυχιακών Σπουδών στη Στατιστική

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ABSTRACT

Despoina Styliani Pandi

The effect of good and bad news on tourism business shareholders: a time series analysis

August 2022

The key objective of the present thesis is to investigate the impact of Covid-19 pandemic on the economic growth of tourism stocks globally. Using daily data from Thompson Reuter's database, we focus on twenty eight countries around the world, during period March 2019 to September 2021. To estimate the relationship between the pandemic and the returns of the stocks, Multivariate Regression Models computed on Seemingly Unrelated Regressions (SURE) and Standard Ordinary Square (OLS) method have been used. Overall, our results suggest that the period of the spread of the virus, and the first days after the announcement of the first quarantine implemented in each country by its government, have been crucial for the economic development of tourism stocks. The impact of the pandemic to their economy was intense no longer than the first ten days after the restriction measures were employed, supporting the belief that the Covid-19 outbreak has been an economic shock. Finally, the daily reported cases and the policies implemented in each country had a major role to the returns of most of the stocks.

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ΠΕΡΙΛΗΨΗ

Δέσποινα Στυλιανή Πανδή

Η επίδραση των «good and bad news» στις μετοχές τουριστικών επιχειρήσεων: Μια Ανάλυση Χρονολογικών Σειρών

Αύγουστος 2022

Ο βασικός στόχος της παρούσας διπλωματικής εργασίας είναι να ερευνηθούν οι επιπτώσεις της πανδημίας του Covid-19 στην οικονομική ανάπτυξη μετοχών τουριστικών επιχειρήσεων παγκοσμίως. Χρησιμοποιώντας δεδομένα σε καθημερινή βάση από τη βάση δεδομένων Thompson Reuter's, εστιάζουμε σε είκοσι οκτώ χώρες παγκοσμίως, κατά την περίοδο Μαρτίου 2019 μέχρι Σεπτέμβρη 2021. Για να εκτιμήσουμε τη σχέση μεταξύ της πανδημίας και των αποδόσεων των μετοχών, χρησιμοποιήσαμε πολυμεταβλητά γραμμικά μοντέλα μέσω των μεθόδων Φαινομενικά μη Συνδεόμενων Εξισώσεων (SURE) και Ελαχίστων Τετραγώνων (OLS). Συνολικά, τα αποτελέσματα δείχνουν ότι η περίοδος εξάπλωσης του ιού, καθώς και οι πρώτες μέρες μετά την ανακοίνωση της πρώτης καραντίνας από την κυβέρνηση της εκάστοτε χώρας, ήταν καθοριστικές για την οικονομική πορεία κάθε τουριστικής μετοχής. Οι επιπτώσεις της πανδημίας στην οικονομία ήταν έντονες για όχι παραπάνω από δέκα μέρες αφότου είχαν εφαρμοσθεί τα περιοριστικά μέτρα, στηρίζοντας την άποψη ότι η έξαρση του Covid-19 αποτελεί ένα οικονομικό σοκ. Τέλος, τα καθημερινώς δηλωμένα κρούσματα και οι πολιτικές που εφαρμόσθηκαν σε κάθε χώρα κατείχαν σημαντικό ρόλο στην απόδοση των περισσότερων μετοχών.

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CHAPTER 1

INTRODUCTION

The outbreak of Covid-19 has evoked uncertainty in the global economy, especially in the tourism industry. On 31 of December 2019, the Wuhan Municipal Health Commission first identified and reported a novel coronavirus. Since then, a number of declarations and alerts about the outbreak of the virus have been made. On 30 January of 2020, The World Health Organization declared the Covid-19 outbreak a Public Health Emergency of International Concern, and on 11 March 2020 the beginning of a pandemic was officially announced, spreading panic and heightening uncertainty to all countries. Governments proceeded to drastic measures in order to protect the health of the citizens and the good operation of the healthcare system. In particular, these measures included partial or complete lock-downs, travel banning, closure of businesses where people gathering could spread the virus, like restaurants, recreation centers and hotels, as long as compulsory quarantining of people having Covid-19 symptoms. Contemporaneously, scientists and health care companies all over the world focused on conducting research about the new virus and embarked on creating vaccines against Covid-19. Fortunately, the vaccination campaign across the world has helped recover from the negative impacts of the pandemic, giving hopes that the economy and everyday life will surpass the past events.

Plenty of researches have been conducted in order to understand the factors that affect the global and local economy under times of crisis, predict a possible impact on the economy and, therefore, the investors' behaviour towards economic shocks. The present thesis seeks to investigate how the Covid-19 crisis affected firms of the tourism field in 28 countries around the globe, using daily data in the period 2019-2020. In particular, the research considers the following variables for each of the 28 countries: number of reported cases per million of citizens, number of victims of the pandemic per million of citizens, GRI ("Government Response Index", indicating the policy measures by the government), Stringency (index indicating the restriction measures), and dummy variables which refer to the period of time examined during

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the pandemic. The data analysis is conducted through SURE models, allowing firms to be correlated, and therefore, research about the connectedness between them.

The thesis is organized as follows. Chapter 2 provides a literature review on the results of recent studies about the impact of Covid-19 crisis on the economy. Chapter 3 provides the theoretical framework associated with the methods used in this research. Chapter 4 describes the data and methodology used in the research, Chapter 5 presents the empirical results of regression analysis, and Chapter 6 provides the conclusions of this study as well as suggestions for further research.

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CHAPTER 2

LITERATURE REVIEW

Several researchers have centered their empirical studies on the effect of the pandemic to the economy. The Covid-19 outbreak has aroused interest about the effects of it on the economy. A collection of recent studies is presented below aiming to justify and support the contribution of this paper to the existing literature.

A considerable amount of literature has been published on the effects of unexpected non-macroeconomic factors to the financial markets. Terrorism attacks, outbreaks of viruses like SARS and Covid-19, war conflicts, athletic events, as long as natural phenomena like earthquakes and floods seem to affect the global economy. Such a research was conducted by Zopiatis et.al (2017), investigating the reaction of five hospitality/tourism stock indices to 150 incidents occurring in the 21st Century. Applying an extension of the traditional GARCH model (GJR specification) on five hospitality/tourism stock indices at daily frequency, including dummy variables indicating the existence of an event or not, they claim that non-macroeconomic incidents did have a negative effect on the stock indices. Their findings though suggest that unexpected non-macro incidents caused a short-term transitory effect on H/T stock indices, according to the region under examination, as long as the incident and the respective media coverage. Terrorist incidents, in particular, formed the central focus of a study by Mahdi Hadi, Katircioglu and Adaoglu (2019) in which the authors investigated the relationship between terrorism and tourism stock performance and volatility. The sample countries were among the top ten world's tourist destinations and the tourism sector indices from 1995 to 2017 were obtained for the aim of the survey. In this study, the standard event study methodology, namely the standard market model (MacKinlay, 1997) was used to measure the reaction of the tourism indices to the terrorist incidents. Moreover, ARCH, GARCH and EGARCH models have been used to estimate the volatility of the data. Their results confirmed previous findings revealing the significant effects of terrorist attacks on tourism firms' performance and stock volatility overall, but also demonstrated that the effect was not the same in all countries, since China and Germany were found not to be affected by

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such incidents. The no-effect on specific countries- in particular the ones with most strong economy mechanisms- is in line with the findings of Zopiatis et.al (2017).

Bissoondoyal-Bheenick et.al (2021) argues that an industry might learn from prior experiences. Taking SARS 2003-experience under consideration, they discuss the impact of Covid-19 for countries affected by SARS. Using a sample of the G20 countries over the period 22 January 2020 to 20 May 2020, they construct the generalized total return and volatility connectedness index of each pairwise countries in G20 within a bivariate fractionally integrated Vector Autoregressive (FIVAR) model. In order to capture the experience in SARS 2003 of each pair of G20 countries and the development of the Covid-pandemic as well, they included dummy variables in the model. The results are consistent with the existing literature, suggesting that connectedness in global financial markets is intensified with the rapid development of the pandemic. However, connectedness is considerably lower if a country experienced SARS death(s) in 2003. This view is supported by Kumar, Rangappa and Suchitra (2022) who argue that in the second wave of Covid-19 crisis, globally the nations were more prepared as most of the nations had put in place adequate infrastructure to systematically deal with the pandemic. Constructing ARCH models to capture the effect of the health crisis on Indian economy, they point out that first wave had created a global disruption across all the countries, however support and relaxations given by the Indian government to construction and transportation companies made them less vulnerable during the second pandemic induced lockdown, emphasizing the need for measures in order to recover from such crises.

Skare, Soriano and Porada-Rochon (2020) measured and predicted the effects of the Covid-19 pandemic on the tourism industry worldwide. Using annual data from 1995 to 2019 in 185 countries (grouped in 16 world regions), they set up a dynamic panel structural vector auto-regression model (PSVAR, Pedroni, 2013) including real-time data parameters connected to Covid-19. The parameters included are: R_0 for Covid-19, a proxy for government responses (Hale et al., 2020), country's/region's economic policy responses (RBA Research International), the share of export in the GDP, the travel and tourism sector share in the GDP, the phase of the financial cycle (credit-to-GDP gaps - BIS data), private debt share in the GDP, and tourist arrivals. In particular, they considered tourist arrivals under three scenarios. The first scenario was a lockdown as it occurred during March 2020 and continuing in April (scenario one from January 1, 2020 to April 1, 2020). The second scenario projected the

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continuation of the lockdown from April 1, 2020 to August 1, 2020. The third and worst scenario of the pandemic outbreak projected it staying in the environment until the end of 2020 (scenario three from August 1, 2020 to December 31, 2020. Model results demonstrate that aggregate indicators in the travel and tourism industry would register a significant fall in 2020, while the pandemic effects of Covid-19 on the tourism industry shared the effect of a common shock, however some regions were less vulnerable than others to the negative impacts of the pandemic shock. Nhamo, Dube, and Chikodzi (2020) also observed different behavior of stock prices according to the development of the healthcare crisis. In particular, three major events were noted to have significantly shocked the stock markets around the world during the COVID-19 pandemic. These were the lockdown in Wuhan, China, in January 2020, the lockdown in Lombardy, Italy, in February 2020 and the declaration of COVID-19 a pandemic by the WHO on 11 March 2020. Using the event study methology, they agree that tourism stock markets reacted negatively to the emergence spread of the disease, with some losing up to 80 (!) of their value within a 2-week period, whilst cruise ship and airline companies were the hardest hits in the tourism segment. Contrary to expectations, they point out that restriction measures implemented by governments around the world to contain and limit the spread of the contagion were disruptive to the global value chains of different industries, especially in the tourism sector, as they further heightened levels of uncertainty on global stock markets leading to further declines in stock values. Rescue packages did contribute to the recovery of economy, however shares of tourism stocks remained negative, as the uncertainty heightened by the media affected investors confidence about the longevity of the crisis.

This view is also supported by Chen et.al (2020) who claim that tourism sector is the “epicenter” of the pandemic’s impact. In addition, they further discussed on the pandemic impact along another dimension: serious-impact regions. They conducted regression analysis on financial data of Chinese companies from 2013 to 2019 to predict their performance in the first quarter of 2020 as long as financial data of the first quarter of 2014–2020 to quantify the pandemic impact. Moreover, they used dummy variables relevant to the stages of Covid-19 outbreak, and investment growth and total revenue as moderating variables to investigate the mechanism of the pandemic impact. Dividing sample companies into high- and low-affected groups by region and industry dimensions, their study confirmed the significant negative impact

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of the COVID-19 outbreak on the performance of Chinese companies by decreasing investment scales and reducing the total revenue. Along the regional dimension, the results indicate that the negative impact is much more pronounced in high-affected areas as strict quarantine measures attenuate investors' hopes for returning back to normality. Nevertheless, they argue that impact has a large scope yet a short duration.

Table 2.1: Summary of relevant research (1)

Researches	Models	Results
Zopiatis et.al.(2017)	GARCH	Non-macroeconomic incidents cause a short term effect on tourism stock indices
Mahdi Hadi, Katircioglu and Adaoglu (2019)	E.S.M., Standard market model, ARCH, GARCH, EGARCH	China's and Germany's economy were vulnerable in terrorism incidents
Bissoondoyal-Bheenick et.al. (2021)	FIVAR	Countries with SARS experience are less affected by Covid-19
Skare, Soriano and Porada-Rochon (2020)	PSVAR	Covid-19 caused a common shock in economies
Nhamo, Dube, and Chikodzi (2020)	E.S.M.	Restriction measures for pandemic increased uncertainty
Chen et.al (2020)	Linear regression	High-affected areas by covid were impacted the most
Chena, W.G. Kim and H.J. Kim (2004)	Linear regression	Health crises have the larger effect between non macroeconomic events

Amplifying a different approach, Chena, W.G. Kim and H.J. Kim (2004) aimed to examine the relationship between both macroeconomic and non macroeconomic variables, and hotel stock returns using hotel companies listed on the Taiwan Stock Exchange. Initially, they formed a regression model using five macroeconomic variables on monthly hotel stock prices of five hotels, over a 14-year period (from January 1989 to August 2003). In the next step, non-macroeconomic

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forces were incorporated into the model, in order to capture the effect of them to the stock prices. For that purpose, dummy non-macroeconomic variables regarding political events (the first and second democratic presidential elections in Taiwan), natural disasters (the earthquake of September 21, 1999), the outbreak of Severe Acute Respiratory Syndrome (SARS) on April 22, 2003, sports megaevents (the 2000 Sydney Olympics and the 2002 Japan/Korea World Cup), the 1997–1998 Asian financial crisis, the Iraqi war in 2003 and the terrorist attacks of September 11, 2001 in the US were incorporated in the model. The results suggest that all nine events had a significant impact upon the hotel returns, with the SARS outbreak to damage more seriously the returns. It is worth mentioning that the majority of the non-macroeconomic variables were much stronger influencers than macroeconomic variables.

From a different perspective, Wu et al. (2021) employed the Event Study Methodology (ESM) to analyse the impact of the Covid crisis on the stock price movements in China's tourism sector. Using a sample of 69 stocks, they chose January 20, 2020, as the event day (t=0) and calculated the returns R_i as follows:

$$R_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}})$$

, while $P_{i,t}$ and $P_{i,t-1}$ are the closing prices of firm i on days t and t − 1, respectively.

Subsequently, they estimated the $AR_{i,t}$ of the sample using the market model and employed quantile regression including Covid-related variables (such as GRI-Government Response Index- and daily growth rate of Covid-19 confirmed cases), logarithm of market capitalization, and price-to-book ratio. The results suggest that the pandemic had a negative effect on the majority of the stocks under examination, however, after the fourth month of the outbreak tourism field was gradually recovering, probably owing to the effective policies implemented by government. In line with Wu et. al., Z.Habibi, H.Habibi and Mohammadi (2022) discuss the impact of COVID-19 on the Economy of China, investigating the relationship between Covid-19 and the GDP of China. Making use of the OLS regression and a model from Zhang and Hu (2021), they also conclude that, even though China's economy shrank 6.8 in the first quarter of 2020 due to nationwide lockdowns, it finally managed to recover from the COVID-19 pandemic within the same year.

Another approach attempting to capture the effect of Covid-19 to the financial markets, was that of Haroon and Rizvi (2020), whose interest focused on the relationship between media-coverage and volatility of equity markets. They used benchmark indices for world and US and 23 sectoral indices for US, in the period from 1 January 2020 till 30 April 2020. Similarly with the survey of Wu et.al (2021), the daily returns were calculated using the equation:

$$R_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}})$$

, while $P_{i,t}$ and $P_{i,t-1}$ are the closing prices of firm i on days t and t − 1, respectively. They relied on Exponential GARCH models to understand the volatility of the Stock market, and Ordinary Least Square Regressions in multiple models to explore the question, of how much sentiment, panic and media coverage has influenced the market volatility in the Covid-19 crisis. They concluded that negative sentiment in the news communications is associated with increasing volatility in returns in the US market, with the association being strongest for the hardest hits by the pandemic, i.e. Transportation, Auto-mobiles and Components, Energy and Travel-Leisure industries. Additionally, they found that Panic Index and Media Coverage were related to reports of increases in confirmed cases but not related deaths. The US uncertainty caused by the pandemic shock did affect other countries too, due to the dominant position of the United States in financial markets (Moran, Stevanovic, and Toure, 2022). In their study, they constructed a measure of Canadian macroeconomic uncertainty, by applying the Jurado et al. (2015) method to a large database, and used vector autoregressions (VARs) to compute the macroeconomic consequences of uncertainty shocks over the period of 1982-2020. In particular, they analyze both the consequences of shocks to US uncertainty and to its Canadian counterpart, taking care to identify and control for the possible spillovers between these measures. As expected, the results suggest that the COVID-19 pandemic has coincided with extremely sharp increases in Canadian macroeconomic uncertainty. Conversely, Canadian shocks to financial volatility appeared to have no impact on the Canadian economy. However, the spike in US uncertainty caused GDP's decline to reach −7 in the third quarter after the shock, while investment declined by almost 20. This implies that the Covid shock had a truly global impact on uncertainty. From a different perspective, Gozgor et. al (2021) stress out the underline the moderating role of the social globalization in alleviating the adverse effect of geopolitical risks, including

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pandemic of Covid-19 as well. Obtaining firm-level data of 18 developing countries between 1995 and 2018, they used fixed-effects models and least squares methods. Their findings demonstrate the negative affect of geopolitical risks, such as natural disasters and health crises, on capital investment in travel and tourism. Nevertheless, they argue that social globalization significantly suspends the impact of such events on tourism investments, stressing that in-time, accurate, and easy-to-access information (informational globalization) plays an essential role in soothing the spread of panic to the citizens and the investors. However, they also point out that media coverage in times of crises should be careful about the turmoil they may cause to the people and policy makers have to be vigilant about that and provide incentives if needed. Finally, they observe that geography has a vital role on the consequences of the pandemic on each country, as small countries and islands have some advantages over the spread of COVID-19, even though they are considered more vulnerable to COVID-19–related uncertainty shocks.

Another interesting approach is that of Amar et. al(2020), who investigated the spillovers and co-movements among commodity and stock prices in the major oil-producing and consuming countries during Covid-19 shock. Using daily stock prices in four oil-producing and consuming countries and reported Covid-cases over the period December 31, 2019 to May 6, 2020, they employed two complementary co-movement measures- the spillover index and the bivariate squared cross-wavelet coherence- to examine the effect of COVID-19 pandemic. In line with previous studies, they suggest that the Covid-19 pandemic generated volatility spillovers from January 2020 to the end of the observed period, since a consistent positive co-movement between spillovers and COVID-19 was observed. In a similar vein, Ozili and Arun (2020) explored the spillover effect of COVID-19 on the global economy. More specifically, they conducted two analyses. In the first analysis, collecting data from stock markets in four continents, and using dummy variables related to the duration of the lockdowns, as well as explanatory variables capturing social distancing policies and restrictions calculated on their natural logarithm, they investigated whether social distancing policies affected economic activities. The authors found out that the number of lockdown days significantly affected the closing, opening, lowest and highest stock prices and the level of general economic activities. On the other hand, the second analysis included data for ‘global energy commodity price index’, ‘world GDP growth’, ‘global inflation rate’ and ‘global unemployment

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rate' for the year 2020 to 2021. The estimation was conducted through ordinary least square regression and results indicate that the rising number of COVID cases and deaths led to a led to a rise in global inflation rate, unemployment rate and energy prices.

Table 2.2: Summary of relevant research (2)

Researches	Models	Results
Wu et al. (2021)	E.S.M.	Recovery from pandemic occurs after 4 months
Wu et. al., Z.Habibi, H.Habibi and Mohammadi (2022)	Linear regression	China's economy recovered after 3 months
Haroon and Rizvi (2020)	EGARCH	Negative sentiment in news increase volatility. For US, number of reported cases are more significant than deaths
Moran, Stevanovic, and Toure (2022)	VAR	Covid-19 has a global effect on economy
Gozgor et. al (2021)	Linear regression	Restriction measures for pandemic increase uncertainty
Ozili and Arun (2020)	Linear regression	Number of cases, deaths and days of lockdowns affect the stock prices
Gozgor et. al (2021)	Fixed effects linear regression	Information about pandemic reduces uncertainty and panic of citizens and investors.

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CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Seemingly Unrelated Regression Equations Models (SURE)

Many theoretical models that are econometrically estimated consist of more than one equation. The disturbance terms of these equations are likely to be contemporaneously correlated, because unconsidered factors that influence the disturbance term in one equation probably influence the disturbance terms in other equations, too, meaning that the equations may be linked statistically. These equations consist of a system known as "system of seemingly unrelated equations- SURE model". Taking the covariance structure of the residuals into account, leads to more efficient estimates (in comparison with the regression estimates) as the pooling of observations creates a bigger sample, and gives the opportunity to check for heterogeneity between the behavior of individuals.

Consider a system of N equations, where the i^{th} equation is of the form

$$y_{it} = \sum_{j=1}^{K} x_{itj}\beta_{ij} + \varepsilon_{it}\ ,\ i=1,2,\dots,N;\ t=1,2,\dots,T;\ j=1,2,\dots,K \quad (1)$$

where y_{it} is the t^{th} observation of the dependent variable in the i^{th} regression equation, x_{itj} is the t^{th} observation on j^{th} explanatory variable appearing in the i^{th} equation, β_{ij} is the coefficient associated with x_{itj} at each observation and and ε_{it} is the t^{th} value of the random error component associated with i^{th} equation of the model. These N equations, each of them including K independent variables, can also be written as:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \dots & 0 \\ 0 & X_2 & \dots & 0 \\ \vdots & \vdots & \dots & 0 \\ 0 & 0 & \dots & X_N \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_N \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_N \end{bmatrix} \qquad (2)$$

or $y=X\beta+\varepsilon$

where the orders of y is $(NT \times 1)$, X is $(NT \times NK)$, β is $(NK \times 1)$ and ε is $(NT \times 1)$.

We assume that there is no correlation of the disturbance terms across observations, so that

$$\mathrm{E}\left[\varepsilon_{it}\varepsilon_{js}\right] = 0,\ \forall\, t \neq s$$

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where i and j indicate the equation number and t and s denote the observation number, where the number of observations is the same for all equations. Moreover, individuals are assumed to have equal covariance for each of the time observations, meaning

$$\mathrm{E}\left[\varepsilon_{it}\varepsilon_{jt}\right] = \sigma_{ij},\ \forall\, t=1,2,\ldots,T$$

Contemporaneous correlation between observations of the random error components of different individuals *(i=1,…N)* can be attributed to random, nonsystematic factors, like economic shocks, affecting all the individuals.

Thus,

$$\mathrm{E}\left[\boldsymbol{\varepsilon}_{\mathbf{i}}\boldsymbol{\varepsilon}'_{\mathbf{j}}\right] = \mathrm{E}\left\{\begin{bmatrix}\varepsilon_{i1}\\ \varepsilon_{i2}\\ \vdots\\ \varepsilon_{iT}\end{bmatrix}\begin{bmatrix}\varepsilon_{j1} & \varepsilon_{j2} & \cdots & \varepsilon_{jT}\end{bmatrix}\right\} = \begin{bmatrix}\sigma_{ij} & 0 & \ldots & 0\\ 0 & \sigma_{ij} & \ldots & 0\\ \vdots & \vdots & \ldots & \vdots\\ 0 & 0 & \ldots & \sigma_{ij}\end{bmatrix} = \sigma_{ij}\,\mathbf{I}_{\mathrm{T}}.$$

Compactly, the covariance matrix of the error terms is equal to

$$\Omega = \mathrm{E}[\boldsymbol{\varepsilon}\boldsymbol{\varepsilon}'] = \begin{bmatrix}\sigma_{11}I_T & \sigma_{12}I_T & \ldots & \sigma_{1N}I_T\\ \sigma_{21}I_T & \sigma_{22}I_T & \ldots & \sigma_{2N}I_T\\ \vdots & \vdots & \ldots & \vdots\\ \sigma_{N1}I_T & \sigma_{N2}I_T & \ldots & \sigma_{NN}I_T\end{bmatrix} = \Sigma \otimes I_T$$

where $\otimes$ denotes the Kronecker product operator, I_T is an identity matrix of dimension T, and $\Sigma = ((\sigma_{ij}))$ is a $(N \times N)$ (= [σij] is the (contemporaneous) disturbance covariance matrix,) positive definite symmetric matrix.

Since $\mathrm{E}[\boldsymbol{\varepsilon}\boldsymbol{\varepsilon}']$ is not diagonal, least squares estimation of **β** in the system of equations (2) is not efficient. However, the generalized least squares (GLS) estimation of **β**, defined as

$$\hat{\beta}_{GLS} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}\mathrm{y} = [X'(\Sigma \otimes I_T)^{-1}X]^{-1}X'(\Sigma \otimes I_T)^{-1}y =$$

$$[X'(\Sigma^{-1}\otimes I_T)X]^{-1}X'(\Sigma^{-1}\otimes I_T)y \quad (3)$$

is efficient.

Its variance is given by:

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$$\mathrm{Var}\,(\hat{\beta}_{GLS}) = (X'\Omega^{-1}X)^{-1} = [X'(\Sigma^{-1}\otimes I_T)X]^{-1}$$

Since Σ is not known, and therefore Ω is not known as well, the GLS estimator is not feasible. It can be shown (Tzavalis, chapter 13) that the elements of Σ can be consistently estimated by least squares estimations of (1), through the following equation:

$$\hat{\sigma}_i{}^2 = \frac{1}{T}\sum_{t=1}^{T}(y_{it} - x'_{it}\hat{\beta}_{LS,i})^2 = \frac{1}{T}\sum_{t=1}^{T}(\hat{\varepsilon}_{it})^2\ ,\ i=1, 2, \ldots, N$$

where $x'_{it} = (1, x_{it2,}x_{it3}, \ldots, x_{itK})$

and $\hat{\beta}_{LS,i} = \left(\hat{\beta}_{LS,i1}, \hat{\beta}_{LS,i2}, \ldots, \hat{\beta}_{LS,iK}\right)'$

while the covariance σ_{ij} can be estimated through the estimator:

$$\hat{\sigma}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(y_{it} - x'_{it}\hat{\beta}_{LS,i}\right)\left(y_{jt} - x'_{jt}\hat{\beta}_{LS,j}\right) = \frac{1}{T}\sum_{t=1}^{T}\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}$$

Replacing the estimations presented above to the GLS estimator (3), we get a consistent feasible generalized least squares estimator (FGLS) for the coefficients **β** of the SURE model. Its variance can be estimated with the same way as well.

Providing that the vector of time observations of the random error components of the SURE model follows the classical assumptions, so that

$$\varepsilon_i \sim IID(0, \sigma_i^2 I_T),\ \forall\, i=1,\ldots, N$$

,it can be proven that for a large sample of time observations T, the distribution of estimator $\hat{\beta}_{GLS}$ is Normal. In particular,

$$\hat{\beta}_{GLS} \sim N[\beta, Asy\mathrm{Var}(\hat{\beta}_{GLS})]$$

where

$$Asy\mathrm{Var}(\hat{\beta}_{GLS}) = \frac{1}{N}\,\sigma^2\,(Q_{X\Sigma X})^{-1}$$

and $Q_{\Sigma X\Sigma} = \mathrm{E}\left\{\frac{1}{N}\,[X'(\Sigma^{-1}\otimes I_T)X]^{-1}\right\}$.

The asymptotic distribution of the GLS estimator can be used for conducting statistical tests for them. Two of them are the most interesting within SURE

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modeling, the test for the heterogeneity of the coefficients and the test for the contemporaneous correlation between random components of different individuals.
The test for the heterogeneity of the coefficients of the SURE model across different individuals (i=1,..., N) is based on the zero hypothesis

$$H_0 : \boldsymbol{\beta}_1 = \boldsymbol{\beta}_2 = \ldots = \boldsymbol{\beta}_N = \boldsymbol{\beta}$$

The above hypothesis can also be written as J linear restrictions on the vector of coefficients **β** of the SURE model:

$$H_0 : \mathrm{R}\ \beta = \mathrm{r}$$

where R is the design matrix with rank J×NK, and r is the vector of the values of the restrictions with rank J×1. The rank of β is equal to NK×1.

The aforementioned hypothesis can be tested by W, LR or LM criteria. We will present the W criterion. This is written as:

$$\mathrm{W}= (R\hat{\beta}_{GLS} - r)' \left\{R\left[X'\left(\hat{\Sigma}^{-1} \otimes I_T\right)X\right]^{-1} R'\right\}^{-1} \left(R\hat{\beta}_{GLS} - r\right)$$

According to the asymptotic distribution of GLS estimator for large number of time observations, it is proven that criterion W follows chi-squared distribution with J degrees of freedom.

Testing the contemporaneous correlation between random components of different individuals is crucial for the choice of the right method for the estimation of coefficients β. If there is such correlation, then an effective estimator for the coefficients is GLS estimator. Otherwise, LS estimators can be used too.

The test is based on the covariance σ_{ij} of the random errors ε_i and ε_j for all possible combinations of individuals i and j. We consider the following zero hypothesis:

$H_0 : \sigma_{ij} = 0, \forall i \neq j$

as long as the alternative:

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$$H_\alpha : \sigma_{ij} \neq 0, for\ some\ i \neq j$$

A criterion used for this test is q:

$$q= T \cdot \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} r_{ij}^2\right),$$

where

$r_{ij}^2 = \left(\frac{\sigma_{ij}}{\sigma_i \sigma_j}\right)^2.$

The value of r_{ij}^2 can be estimated from the residuals of equations i and j of the SURE model, which coefficients are estimated through LS method. It is proven, that for large number of time observations, under the zero hypothesis, criterion q follows the chi-squared distribution with N(N-1)/2 degrees of freedom.

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CHAPTER 4

DATA AND RESULTS

4.1 Description of data

The tourism sector is a wide-ranging industry (Lori and Ashley 2018; Lee et al. 2021) that involves many aspects, such as food, hospitality, travel, visiting, shopping, and entertaining. To comprehensively analyse the impact of the COVID-19 pandemic outbreak on the tourism stocks, we collected daily closing prices of tourism-related stocks (including airlines; marine; road and rail; travel agencies and hotels, restaurants, and leisure) from the Thompson Reuters Database, and daily covid-related data from the same database and OWID (Our World in Data) database as well. More specifically, the sample period starts from 28/03/2019 till 20/9/2021, with 648 observations, seeking to investigate the behaviour of such stocks under normal circumstances and the pandemic shock as well. The present survey studies the effect of the covid outbreak worldwide, and so, data from 28 countries were obtained. In particular, we investigate countries included in four regions: Mediterranean countries (Bosnia Herzegovina, Slovenia, Croatia, Montenegro, Malta, Italy, Greece, Morocco, France, Spain, Egypt, Cyprus, Turkey), Asia (China, Hong Kong, Indonesia, Israel, Japan, Singapore, Taiwan, Thailand), South America (Colombia, Brazil), North America (US, Canada, Mexico). United Kingdom and Portugal were also included in the sample. As it has been suggested by several studies (Wu et al.(2021), Haroon and Rizvi (2020)), daily tourism stock returns (R_t), were calculated from the values of closing prices (P_t) given the continuous compounding:

$$R_t = \log\left(\frac{P_t}{P_{t-1}}\right),\ t=1,\dots,T$$

Covid-related data was also collected in a daily basis. In particular, for each of the aforementioned countries, we collected daily reported cases, victims, and two indices, Government Response Index (GRI), concerning measures taken by the governments in order to lessen the effect of the worldwide crisis, and Stringency index, a composite measure of nine of the response metrics: school closures; workplace closures; cancellation of public events; restrictions on public gatherings; closures of public transport; stay-at-home requirements; public information campaigns; restrictions on internal movements; and international travel controls (OWID-ourworldindata).

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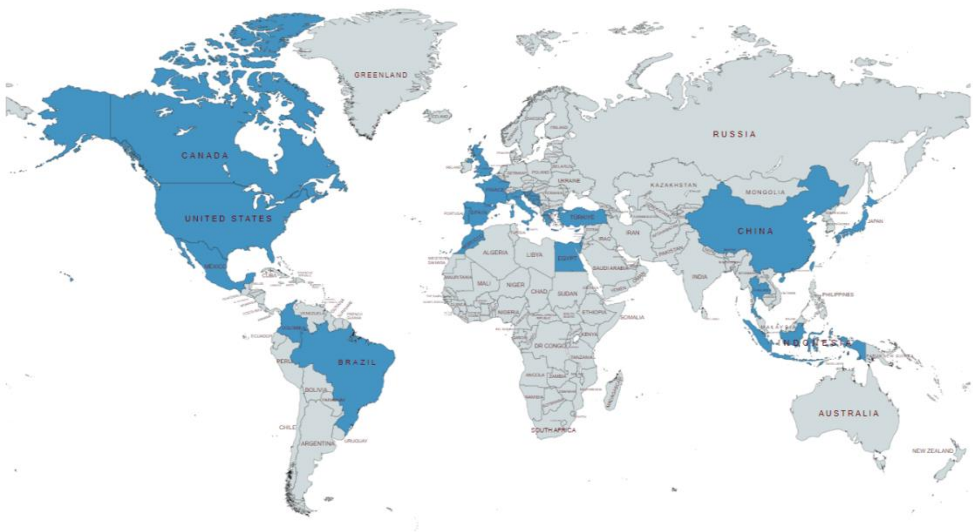
Moreover, in order to capture the evolution of the pandemic, we split the time span creating dummy variables according to several events related to the pandemic, such as the announcement of the first reported case and the declaration of the outbreak as a "pandemic" by the WHO. In-depth analysis of these variables, as long as the models used in this thesis will be presented below.

Data analysis and graphical representations were performed using the programming language R and, in particular, the package "SURE", for the estimation of the models.

Figure 4.1: Countries included in the sample



4.1.1 Variable Description

COVID-19 is a major health emergency worldwide. Several governments immediately imposed restrictions on the citizens so as to limit the spread of the virus, while others did not react to the pandemic with strict measures, only until the needs in the healthcare system were severe, like the UK. As a result, the spread of the coronavirus appeared to be different across the countries and the number of the reported cases as well. For the purpose of the present thesis, we are interested in the daily cases and victims reported by each country included in the sample. However, owing to the different sizes of populations across the countries, we include daily reported cases per million of citizens, obtained by OWID (ourworldindata) database. Thus, the variable is calibrated. Even though the first case was reported on 31/12/2019 in Wuhan (OWID), available dataset starts from 2/03/2020, as time passed until the virus spread around the world. As a result, the dataset contained only

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405 observations. However, supposing that there were no cases reported until 2/03/2020, we filled the dataset with zero values, in order for the dimensions to be equal. Total sum of the cases and cases per million of population of each country are presented in Table 4.1 below. It is apparent from Table 4.1 that the mean of reported cases divided with the size of population in the Asian countries is impressively lower than those of European or American countries. This might be due to the extreme restriction measures implemented by their governments. Canada and Mexico had relatively low means, too.

Table 4.1: Total sum of the reported cases, deaths, mean and standard deviation of cases per million of population of each of the country (405 observations).

Countries	Total sum of reported cases	Total sum of victims	Mean of cases per million	Standard Deviation of cases per million
Bosnia Herzegovina	198.973	9.943	150.2	184.2
Slovenia	204.949	3.228	252.8	325.9
Croatia	279.284	6.095	168.7	242.5
Montenegro	92.294	1.455	361.9	367.2
Malta	26.595	340	126.9	145.8
Italy	3.291.763	97.379	133.1	146.2
Greece	488.384	10.586	115.3	118
Morocco	743.221	10.742	43.5	60
France	5.598.858	96.759	192.7	220.5
Portugal	760.901	12.846	184	260.5
Spain	5.141.805	78.761	260.9	287.2
Egypt	209.787	12.023	5.0	4.05
Turkey	4.439.390	44.570	128.6	158.7
Cyprus	85.830	424	235.9	294.2
China	12.939	1.748	0.1	0.02
Hong Kong	8.492	161	2.8	3.9
Indonesia	3.026.683	103.455	27.0	36.5
Israel	962.956	5.334	251.4	327.1
Japan	1.164.634	12.190	23.2	36.5
Singapore	50.179	55	25.4	41.9
Taiwan	11.578	539	1.2	3.9
Thailand	417.123	3.817	36.9	77.8
Colombia	3.511.452	90.040	168.7	146.1
Brazil	16.382.425	465.117	188.8	117.1
Canada	1.140.767	20.337	78.5	70.4
Mexico	2.358.559	199.848	50.0	42.9
US	29.793.390	50.3778	238.7	208.3
UK	5.279.323	104.332	195.2	214.7

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Another variable included in the following models is GRI (Government Response Index). Governments have taken different policy measures to tackle COVID-19, and so the particular index represents a scale to reflect the extent of government action. Furthermore, another index related to the measures takes in order to limit the pandemic effect is the Stringency Index. According to OWID, it is a composite measure of nine of the response metrics mentioned before, recording the strictness of government policies. The index is calculated as the mean score of the nine metrics, each taking a value between 0 and 100. A higher score indicates a stricter response. Available dataset starts from 1/1/2020 (446 daily observations), so we filled in with zero values the rest of the observations in order to have the same dimensions with the rest of the variables. The mean of these indices are displayed in Table 4.2.

Finally, to represent the evolution of the covid-outbreak, time span was split into periods of time, according to important events associated with the pandemic. More specifically, we consider the following periods: 28/3/2019-31/12/2019 as the non-covid time span, 1/1/2020-6/3/2020 as the spread of the virus, 9/03/2020-30/6/2020, when the first lockdown was implemented, 1/7/2020-26/10/2020, the period after the first lockdown, 27/10/2020-31/3/2021, the period of the second lockdown and 1/4/2021-20/09/2021 as the normality period after the second lockdown.

So, we consider the following seven dummy variables:

$$\text{ipandemic}=\begin{cases}1, & if\ the\ pandemic\ had\ occured\ in\ that\ date\\ 0, & otherwise\end{cases}$$

$$\text{non\_covid} = \begin{cases}1, & for\ the\ time\ period\ \ 28/3/2019-31/12/2019\\ 0, & otherwise\end{cases}$$

$$\text{spread} = \begin{cases}1, & for\ the\ time\ period\ \ 1/1/2020-6/3/2020\\ 0, & otherwise\end{cases}$$

$$\text{lock\_1} = \begin{cases}1, & for\ the\ time\ period\ 9/03/2020-30/6/2020\\ 0, & otherwise\end{cases}$$

$$\text{norm\_1} = \begin{cases}1, & for\ the\ time\ period\ 1/7/2020-26/10/2020\\ 0, & otherwise\end{cases}$$

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$$\text{lock\_2} = \begin{cases} 1, \ for\ the\ time\ period\ 27/10/2020 - 31/3/2021 \\ 0\ , otherwise \end{cases}$$

$$\text{norm\_2} = \begin{cases} 1, \ for\ the\ time\ period\ 1/4/2021 - 20/09/2021 \\ 0\ , otherwise \end{cases}$$

Table 4.2: Mean of GRI and Stringency Index of each of the countries (446 observations)

Countries	Mean of GRI	Mean of Stringency Index
Bosnia Herzegovina	65.6	49.0
Slovenia	53.6	52.5
Croatia	61.5	45.0
Montenegro	48.0	-
Malta	46.6	51.7
Italy	67.2	69.6
Greece	57.3	64.8
Morocco	57.3	65.8
France	50.9	57.1
Portugal	60.1	61.3
Spain	56.7	59.8
Egypt	63.1	53.7
Turkey	61.2	60.6
Cyprus	49.2	61.6
China	58.1	70.9
Hong Kong	62.5	62.0
Indonesia	65.3	64.0
Israel	53.0	58.6
Japan	60.9	40.7
Singapore	61.0	49.8
Taiwan	40.6	32.7
Thailand	50.8	48.3
Colombia	66.1	69.1
Brazil	40.5	61.1
Canada	51.0	62.1
Mexico	56.1	56.6
US	61.1	59.3
UK	56.9	61.2

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4.1.2 Data Processing

In this section, we will discuss the processing conducted to the initial dataset in order to fix problems related to it. The closing prices of the firms were obtained from the Thompson Reuters dataset and the GRI index as well, whilst the rest of the covid-related data were derived from the OWID database. Since the pandemic data did not include missing values or any other issue that would cause problems to the analysis, we will only present the procedure related to the closing prices.

The initial dataset included 648 daily observations of 1131 firms in the tourism and leisure sector. The period span was 28/3/2019-20/9/2021. Firstly, we searched for missing values per date and per firm. There were found 40 stocks with at least 50% of the observations missing, so, assuming that they would not provide enough information, they were deleted from the dataset. Moreover, 26 stocks were not in numeric form, so we could not include them in the analysis, and were also deleted. Following that, we searched for “NA” (not available) values in the remaining data per date. We notice that the missing values occurred until 4/5/2020. However, there were 32 variables which did not provide values after 26/6/2019. These stocks were also excluded from the dataset. Finally, the remaining dataset include 1033 stocks.

For the purpose of the present analysis, the returns of the stocks were calculated using the equation:

$$R_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}})$$

,while $P_{i,t}$ and $P_{i,t-1}$ are the closing prices of firm i on days t and t − 1, respectively. For the rest of the missing values, we calculated them through the k-nn (k-nearest neighbors) algorithm, with k (number of neighbors) equal to five.

Returns of tourism and leisure stocks sustained a severe decline since the outbreak of the pandemic occurred. Figure 1 shows a time series plot of the returns of five stocks: “International.Meal.Company” (dark red), "Gamehost" (azure), "Aegean.Airlines"(steelblue),"Carnival"(brown) and “InterContinental.Hotels.Group” (green line). It is apparent that there was a severe decrease in the values of the returns during March of 2020, when the virus spread worldwide. In fact, during non-covid period, 57% of means of the returns were equal or below zero, while 88% of them got negative or zero values during the outbreak (5/3/2020-2/4/2020).The pandemic increased the volatility of the returns, especially at the first months of the outbreak.

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Figure 4.2: Time series plot of the returns of five stocks during 4/2019-9/2021

4.1.3 Diagnostic checks

When dealing with time series data, it is crucial to examine the existence of unit root in the data series. If so, the non-stationary process will affect the estimation of the model in this case, statistical inference should differ, in comparison with the modeling of stationary series. There are numerous unit root tests to conduct, however the Augmented Dickey-Fuller (ADF) test is one of the most popular.

Augmented Dickey-Fuller (ADF) test is an extension of Dickey-Fuller test, using differences of the variable. The null hypothesis of the test is the existence of a unit root (and so, the non-stationarity of the series) and the alternative hypothesis is that the series is stationary. As a result, under a 5% significance level, if the p-value of the test is below 0.05, there is enough evidence to reject the null hypothesis, and it is clear that the series is stationary. Otherwise, we conclude that the data is non-stationary. For the purpose of this research, all variables included in the models, per country, and the returns of each stock, were tested for stationarity via ADF test. The results (p-values) of the test for series of reported infections per million of population, victims, Gri and Stringency indices per country are presented in Table 4.3 (p-values are rounded to the second decimal place). Missing value of Montenegro is due to zero values of the time series.

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The results indicate that most of the series are non-stationary, as the p-values are greater than the critical value and, therefore, we cannot reject the null hypothesis that the series are growing non-stationary. In particular, approximately 43% of the countries show non-stationarity at the series of cases per million of population and 25% of them have non-stationary time series of reported deaths. In terms of the two indices, Gri has unit root in all countries included in the sample, whilst only Japan has stationary series of stringency index. This implies that it is needed to take the first differences of the variables and perform the ADF test again before we run the models.

Table 4.3: P-values extracted via ADF test per country for the 4 variables: cases per million of population, victims, Gri and Stringency indices.

Countries	Cases per million of population	Deaths	Gri Index	Stringency Index
Bosnia Herzegovina	0.05	0.09	0.73	0.22
Slovenia	0.55	0.61	0.52	0.42
Croatia	0.05	0.32	0.76	0.44
Montenegro	0.47	0.32	0.88	-
Malta	0.01	0.31	0.90	0.48
Italy	0.08	0.19	0.91	0.27
Greece	0.08	0.33	0.77	0.06
Morocco	0.04	0.84	0.75	0.22
France	0.02	0.02	0.81	0.69
Spain	0.01	0.09	0.83	0.43
Egypt	0.15	0.65	0.61	0.42
Turkey	0.01	0.01	0.95	0.32
Cyprus	0.01	0.02	0.59	0.52
China	0.01	0.01	0.76	0.50
Hong Kong	0.03	0.01	0.88	0.68
Indonesia	0.19	0.07	0.93	0.30
Israel	0.52	0.37	0.83	0.45
Japan	0.01	0.40	0.76	0.01
Singapore	0.69	0.92	0.88	0.83
Taiwan	0.01	0.36	0.44	0.41
Thailand	0.70	0.44	0.46	0.61
Colombia	0.40	0.66	0.66	0.54
Brazil	0.91	0.90	0.32	0.51
Canada	0.22	0.17	0.95	0.77
Mexico	0.20	0.61	0.73	0.68
US	0.43	0.61	0.77	0.27
UK	0.08	0.01	0.90	0.58

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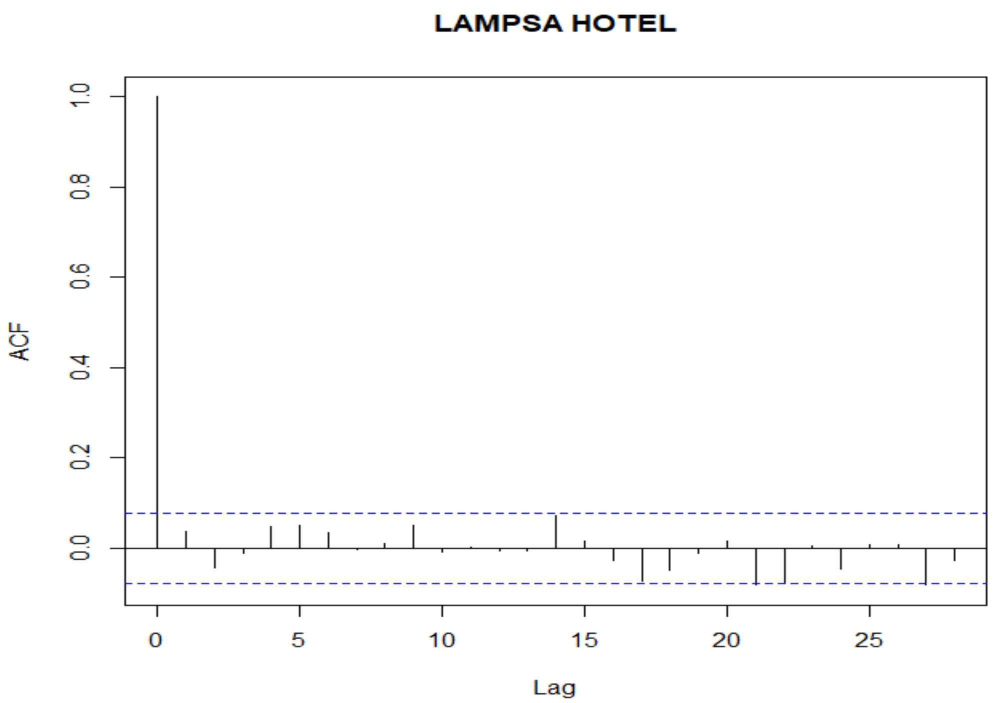
The results of the ADF test at the first differences of the four variables propose that the transformed series is now stationary, as p-values are all less than the critical level (0.05%) and, as a result, there is enough evidence to reject the null hypothesis. These results are also verified in the ACF and PCAF plots.

Concerning the daily returns of the tourism firms, the results of the ADF test indicate that the series are stationary, as p-values are all less than the critical level (0.05%), and so, we can proceed with the analysis of them. The stationarity of the series is also confirmed from ACF and PACF plots.

Figure 4.3: ACF plot of time series of greek company's "LAMPSA HOTEL" daily returns



In particular, Figure 4.2 depicts the ACF plot of a greek hotel "Lampsa Hellenic Hotels S.A.", in which the stationarity of the series is apparent.

It is also crucial to examine the correlation between the regressors. Calculating the Pearson's correlation coefficient, we observed high correlation between variables "Casespermillion" and "Deaths", as long as "Stringency" and "Gri" in the majority of the countries. In particular, "Stringency" and "Gri" were highly correlated in all the countries, while "Casespermillion" and "Deaths" have a low or a moderate correlation

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only in Japan (0.24), Singapore (0.37), UK (0.48), Hong Kong (0.54), Cyprus (0.54), France (0.46) and Spain (0.48). Contrary to expectations, results indicate an extremely low correlation (0.01) in China, as it appears in Table 4.4.

Table 4.4: Pearson correlation coefficient between variables "Casespermillion", "Deaths", "Gri" and "Stringency" per country, rounded in the second decimal point.

Countries	Casespermillion and Deaths	Stringency and Gri indices	Casespermillion and Stringency	Casespermillion and Gri	Stringency and Deaths	Gri and Deaths
Bosnia Herzegovina	0.82	0.75	0.22	0.42	0.17	0.35
Slovenia	0.76	0.94	0.60	0.57	0.58	0.51
Croatia	0.80	0.85	0.27	0.32	0.38	0.36
Montenegro	0.78	-	-	0.59	-	0.48
Malta	0.60	0.84	0.38	0.51	0.31	0.37
Italy	0.74	0.96	0.52	0.53	0.60	0.56
Portugal	0.84	0.96	0.40	0.42	0.39	0.37
Greece	0.68	0.92	0.56	0.54	0.58	0.53
Morocco	0.82	0.96	0.28	0.34	0.34	0.40
France	0.46	0.92	0.47	0.46	0.61	0.53
Spain	0.48	0.94	0.45	0.51	0.57	0.53
Egypt	0.91	0.94	0.61	0.65	0.61	0.68
Turkey	0.82	0.91	0.45	0.45	0.61	0.61
Cyprus	0.54	0.88	0.30	0.38	0.32	0.35
China	0.01	0.83	0.10	-0.11	0.02	0.02
Hong Kong	0.54	0.90	0.39	0.43	0.29	0.30
Indonesia	0.89	0.94	0.43	0.45	0.39	0.41
Israel	0.76	0.79	0.43	0.45	0.53	0.44
Japan	0.24	0.84	0.45	0.33	0.57	0.51
Singapore	0.37	0.97	0.49	0.40	0.24	0.26
Taiwan	0.65	0.93	0.48	0.39	0.53	0.40
Thailand	0.58	0.92	0.20	0.36	0.31	0.29
Colombia	0.95	0.86	0.44	0.58	0.47	0.61
Brazil	0.92	0.94	0.66	0.62	0.62	0.60
Canada	0.60	0.97	0.61	0.50	0.56	0.53
Mexico	0.68	0.89	0.60	0.52	0.66	0.58
US	0.70	0.90	0.57	0.60	0.67	0.59
UK	0.48	0.94	0.42	0.49	0.55	0.45

The relationship between the other variables was found to be low or moderate in most of the countries.

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4.1.4 Models

In this section, we will present the models used for the analysis of this research. Taking into account both the existing literature, stepwise methods, multicollinearity and the correlations of the variables, we run 12 linear regression models. We use the following symbolism:

- “Returns” stand for the calculated daily returns of closing prices of tourism stocks, as presented in section 4.1.2
- “Casespermillion” stands for the daily reported cases per million of population of the country of origin under examination
- “Deaths” stands for the daily reported deaths of the country under examination
- “Stringency” stands for the Stringency index presented in section 4.1.1, and
- “Gri” stands for the Government Response Index presented in section 4.1.1

The dummy variables concerning the evolution of the pandemic presented in 4.1.1 were also included in the models. These are the following:

1) Returns ~ Casespermillion
2) Returns ~ Deaths
3) Returns ~ Stringency
4) Returns ~ Gri
5) Returns ~ ipandemic
6) Returns ~ Stringency*Casespermillion + Gri
7) Returns ~ Casespermillion + non_covid + spread + lock_1 + norm_1 + lock_2 + norm_2
8) Returns ~ Deaths + non_covid + spread + lock_1 + norm_1 + lock_2 + norm_2
9) Returns ~ Gri + ipandemic
10) Returns ~ Casespermillion + ipandemic
11) Returns ~ Deaths + ipandemic
12) Returns ~ Stringency*Deaths + Gri

4.2 Results

The results of the analysis will be presented as follows. The analysis described above is conducted for a time period around five significant events related to the pandemic: the date when the first covid-19 case was reported (31/12/2019), the moment when the virus started to spread worldwide (we consider the date 5/3/2020), the announcement of the first and second lockdown implemented to each of the countries, and the date when FDA approved the first COVID-19 vaccine, which has been known as the Pfizer-BioNTech COVID-19 Vaccine (21/12/2020).

Firstly, for each stock included in the sample, we check for zero values in the period March 2019-September 2021, and in each of the time span described before. For each case, if the percentage of zero values is greater than 60%, the particular stock is excluded from the sample, as it is considered that it does not provide enough information to the analysis. In particular, stocks originated from Cyprus, Bosnia Herzegovina, Montenegro, Morocco and Slovenia were excluded from the sample for that reason.

Following, for the firms of each country, we run “SURE” models (each of the 12 linear models mentioned before), to see how well they could describe the data, and the correlations between each country’s firms. We run the 12 models for a time span of ten and thirty days after these five events, aiming to capture the effect they had on tourism stocks of each country. Moreover, we conduct the same procedure for OLS (Ordinary Least Squares) estimates. In cases when SURE method could not provide satisfactory results, OLS output will be presented. We use adjusted R^2 as a criterion for the effectiveness of the models. Also, regression assumptions are tested for each of the linear models. Shapiro-Wilk’s test is used for checking normality, Breusch-Pagan test for heteroscedasticity and Durbin-Watson test for autocorrelation over the residuals of the regression. Diagnostic plots are also created. We use the following symbols for p-values: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%, - means that the p-value is not statistically significant.
The results will be presented for each of the countries included in the sample.

Brazil

The sample obtained includes nine Brazilian stocks. The 80% of the return values of one of them were equal to zero, so we did not include it in the analysis. For

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the rest eight stocks, we found that only model 1 (Returns ~ Casespermillion, including the intercept) on the period 5/3/2020-19/3/2020 fitted some of the eight stocks, through SURE estimates, with a mean of the adjusted R^2 to be equal to 0.43. The results ($R_{it} = \beta_{i1} + \beta_{i2} \cdot Casespermillion_t + \varepsilon_{it}, i = 1, \ldots, 8$) are presented in Table 4.5 below. Standard errors will be written in the parentheses.

Table 4.5: Results of SURE model Returns ~ Casespermillion on Brazilian stocks

Stocks	$\boldsymbol{\beta_{i1}}$	$\boldsymbol{\beta_{i2}}$	**Adjusted R^2**
Azul PN	-0.17(**) (0.05)	0.48(*) (0.14)	0.48
BK BRA.OPEAS.ARTR.ON.Travel&Leisure	-0.08(**) (0.02)	0.30(**) (0.07)	0.60
Companhia de Locacao das Americas Car rental	-0.10(*) (0.03)	0.29(*) (0.09)	0.44
CVC BRA.OPD.E ACDV. ON. Travel & Leisure	-0.14(*) (0.05)	0.42(*) (0.14)	0.48
Gol Intelligent Airlines S.A.	-0.16(**) (0.04)	0.38(*) (0.13)	0.48
Hotels Orthon PN	-0.05(**) (0.014)	0.06(*) (0.04)	0.20
International Meal Company	-0.13(**) (0.03)	0.30(**) (0.08)	0.50
T4F Entretenimento S.A.	-0.09(**) (0.02)	0.15 (0.07)	0.30

Note: (*) signif. at 5% (**) signif at 1%

It is evident that “BK BRA.OPEAS.ARTR.ON.Travel&Leisure” and “International Meal Company” fit the model the best among the rest of the stocks, while Casespermillion of the population has a positive effect on the returns. Moreover, strong correlation is observed between the residuals of the equations (Table 4.6).

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Specifically, “Gol Intelligent Airlines S.A.” has a correlation of 0.95 with “Azul PN”, indicating the interconnection and the economic shock spread to the firms. “Companhia de Locacao das Americas Car rental”, “CVC BRA.OPD.E ACDV. ON. Travel & Leisure” and “Gol Intelligent Airlines S.A.” seem to have the highest correlations among the rest of the firms. “Hotels Orthon PN” and “T4F Entretenimento S.A.” have the lowest correlations, as expected since model did not fit adequately the their returns (R^2=20 and 30 respectively)

For the rest of the time periods (ten and thirty days) of the events related to pandemic, the R^2 of the models were extremely low, showing no relationship between returns and regressors.

Table 4.6: Correlation matrix of residuals of Brazilian SURE equations

Stocks	Azul PN	BK BRA.OPEAS. ARTR.ON.Travel&Leisure	Companhia de Locacao das Americas Car rental	CVC BRA.OPD.E ACDV. ON. Travel & Leisure	Gol Intelligent Airlines S.A.	Hotels Orthon PN	Internati-onal Meal Company	T4F Entretenimento S.A.
Azul PN	1.00	0.74	**0.90**	**0.93**	**0.94**	0.42	0.55	0.58
BK BRA.OPEAS.ARTR.ON.Travel&Leisure	0.74	1.00	**0.90**	0.78	0.78	0.29	0.69	0.74
Companhia de Locacao das Americas Car rental	**0.90**	**0.90**	1.00	**0.86**	**0.89**	0.31	0.70	0.69
CVC BRA.OPD.E ACDV. ON. Travel & Leisure	**0.93**	0.78	**0.86**	1.00	**0.90**	0.16	0.62	0.58
Gol Intelligent Airlines S.A.	**0.95**	0.78	**0.89**	**0.90**	1.00	0.26	0.64	0.66
Hotels Orthon PN	0.42	0.19	0.31	0.16	0.26	1.00	-0.31	0.26
International Meal Company	0.55	0.69	0.70	0.62	0.64	-0.31	1.00	0.37
T4F Entretenimento S.A.	0.58	0.74	0.69	0.58	0.66	0.26	0.37	1.00

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Canada

The sample obtained includes 39 Canadian stocks. However, 15 of them include at least 60% of zero values, so we check for each of the time period examined for firms with zero values that could cause problem to the analysis and do not provide any information.

For a 10-days period after the first reported case (31/12/2019), there are 19 stocks with 60% zero values or more, so they will be excluded from the analysis in the particular time period. For the rest of the 20 firms, the models did not seem to fit the data. For the period 31/12/2019-31/1/2020 (30-days period), there are 9 stocks with the majority of their values equal to zero, so the firms examined are now 30. Again, none of the models fit the dataset. The same procedure was conducted for each of the examined time spans. SURE models, however, seem not to fit well the dataset, as the R^2 was very low.

Even though SURE models did not provide efficient results for the time periods under examination, we resulted in some satisfactory findings through OLS estimators. As before, we exclude 13 stocks from the dataset, as they do not provide enough information. For the period 17/3/2020-27/3/2020, when the first quarantine took place in Canada, model 12 (Returns ~ Stringency*Deaths + Gri) fitted well the returns of a part of the firms. Some of them are presented in Table 4.7($R_{it} = \beta_{i1} + \beta_{i2} \cdot Stringency_t + \beta_{i3} \cdot Deaths_t + \beta_{i4} \cdot Gri_t + \beta_{i5} \cdot StringencyDeaths_t + \varepsilon_{it}$, $i = 1, \dots, 5$).

Results of the tests of regression assumptions for each of the stocks are presented in Table 4.8. Assumptions are fulfilled at a 5% significance level, except for "Aegis Brands" which seems to violate the normality assumption. Moreover, it is noted that the mean of the adjusted R^2 of all stocks equals to 0.33, while, running the same model for the 30-days period (17/3/2020-17/4/2020), we find mean of R^2 equal to 0.22.

China

The sample obtained includes 17 Chinese stocks, with only a few zero values. So, the whole sample was used for the analysis. The majority of the SURE and OLS

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models did not provide good results for the time periods examined, and for that reason, they are not presented.

Table 4.7: OLS Results of Returns ~ Stringency*Deaths + Gri on Canadian stocks

Stocks	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	Adjusted R^2
Aegis Brands	0.07 (0.05)	-0.03 (0.05)	-0.03(*) (0.009)	-0.008 (0.008)	0.007 (0.01)	0.50
Bragg Gaming Group	0.02 (0.02)	-0.06(*) (0.02)	-0.003 (0.003)	-0.004 (0.003)	-0.015(*) (0.004)	0.54
Evergreen Gaming Corporation	0.01 (0.014)	-0.052(*) (0.01)	-0.0005 (0.002)	0.002 (0.002)	0.009(*) (0.003)	0.92
Keg Royalties Income Fund	0.09 (0.03)	0.02 (0.03)	0.015 (0.006)	-0.029(*) (0.006)	-0.008 (0.008)	0.76
Victory Squares Technologies	0.19(*) (0.05)	0.04 (0.05)	-0.03(*) (0.01)	-0.0007 (0.01)	-0.016 (0.013)	0.80

Note: (*) signif. at 5% (**) signif at 1%

Table 4.8: P-values of diagnostic tests for regression assumptions on Canadian stocks

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
Aegis Brands	0.04	0.40	0.17
Bragg Gaming Group	0.56	0.21	0.34
Evergreen Gaming Corporation	0.93	0.15	0.51
Keg Royalties Income Fund	0.23	0.84	0.16
Victory Squares Technologies	0.08	0.42	0.93

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Colombia

Colombia's dataset only contained one stock and, therefore, we could not conduct a SURE analysis. However, OLS estimators on model 6 (Returns ~ Stringency*Casespermillion + Gri) through short period of spread (5/3/2020-19/3/2020), gave satisfactory results. The results, as seen in Table 4.9, indicate that Casespermillion has a vital role for these data, too. Regression assumptions are fulfilled, too (p-values for Shapiro test: 0.55, Breusch-Pagan: 0.48, Durbin-Watson: 0.26).

Croatia

The initial sample obtained includes 20 stocks from Croatia. However, most of them (17) included at least 60% of zero values, and so, they could not contribute to the analysis. For the rest of the firms, we run SURE and OLS models but none of them fitted well.

Table 4.9: Results of OLS model Returns ~ Stringency*Casespermillion + Gri on Colombian stock. Adjusted R^2 equals to 0.50.

Regressors	Estimate	Std. Error	Pr(>|t|)
Intercept	-0.08	0.04	-
Stringency	0.022	0.02	-
Casespermillion	0.58	0.22	*
Gri	1.60	1.12	-
Stringency*Casespermillion	0.25	0.22	-

Note: (*) signif. at 5% (**) signif at 1%

Egypt

The dataset includes 13 Egyptian tourism stocks. However, six of them have at least 60% of zero values, and so, we excluded them from the sample. Using the rest 6 stocks, we run SURE models and found models 5 (Returns ~ ipandemic), 10 (Returns ~ Casespermillion + ipandemic) and 11 (Returns ~ Deaths + ipandemic) to have the largest mean R^2 among the 12 models in total during the first days of the spread of the virus. Specifically, returns of three of the stocks, “Sharm Dreams Resort”, "REMCO" Tourism Villages Construction Company and “Golden Coast El Sokhna Company”

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were well described really well from the aforementioned models, as the results in Table 4.10 indicate.

Table 4.10: Adjusted R^2 of SURE models 5, 10 and 11 for three Egyptian stocks.

Stocks	R^2 (Model 5)	R^2(Model10)	R^2(Model 11)
Golden Coast El Sokhna Company	0.69	0.70	0.75
"REMCO" Tourism Villages Construction Company	0.72	0.75	0.68
Sharm Dreams Resort	0.85	0.85	0.81

Variable “ipandemic” is statistically significant for all 3 stocks in each of the three models, with a coefficient of estimate around -0.1. However, only model 11 fulfills the regression assumptions for all of the stocks, as shown in Table 4.11. “Sharm Dreams Resort” fits model 11 in the better way among the rest of the stocks.

Table 4.11: P-values of diagnostic tests for regression assumptions on Egyptian stocks for model 11.

Stocks	Shapiro-Wilk’s test	Breusch-Pagan test	Durbin-Watson test
Golden Coast El Sokhna Company	0.72	0.53	0.10
"REMCO" Tourism Villages Construction Company	0.22	0.35	0.07
Sharm Dreams Resort	0.14	0.22	0.20

Residuals of “Sharm Dreams Resort” also has the highest correlation with the majority of the firms (Pearson’s correlation is higher than 0.68 with four out of five stocks). SURE estimates of the regressions of the stocks are shown in Table 4.12 ($R_{it} = \beta_{i1} + \beta_{i2} \cdot Deaths_t + \beta_{i3} \cdot ipandemic_t + \ \varepsilon_{it},\ i = 1, \dots, 3$).The only statistical significant variable is “ipandemic”, while the coefficient estimate for “Sharm Dreams Resort” is equal to -0.1. Due to the logarithm of the dependent variable “Returns”, we conclude that if “ipandemic” increases by one, if other variables are constant, return value will decrease by 10%.

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Table 4.12: Returns ~ Deaths + ipandemic on Egyptian stocks

Stocks	β_{i1}	β_{i2}	β_{i3}
Golden Coast El Sokhna Company	0.03(*) (0.01)	-0.02 (0.01)	-0.1(***) (0.02)
"REMCO" Tourism Villages Construction Company	0.004 (0.013)	-0.009 (0.01)	-0.09(**) (0.02)
Sharm Dreams Resort	-0.007 (0.009)	-0.0005 (0.007)	-0.1(***) (0.01)

Note: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%

France

The initial sample consisted of 24 French stocks, with 13 of them including at least 60% of zero values. For each of the time periods examined, we choose to use firms with non-zero values. Even though SURE estimates did not provide satisfactory results, OLS estimates of model 6 (Returns ~ Stringency*Casespermillion + Gri) for the period 5/3/2020-17/3/2020 of the spread of the virus, were quite efficient. The results of the four stocks with the higher R^2 are presented in Table 4.13 below. Coefficients of estimates for ΄Air France–KLM΄ are presented above. In particular, exponentiating the coefficients because of the log-transformation of the dependent variable, we conclude that , holding the other variables constant, increasing the Casespermillion per 1 unit, will decrease the returns by 8.9%. It is interesting that increasing the Casespermillion*Stringency per 1 unit, will decrease the returns by only 1%, meaning that the Stringency and restriction measures manage to lessen the negative effect of the pandemic on the returns of the stocks. Overall, Casespermillion seems to have a vital role to all the French stocks. Results of regression tests are presented in Table 4.14 , too.

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Table 4.13: Results of OLS model Returns ~ Stringency*Casespermillion + Gri on French stocks.

Stocks	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	Adjusted R^2
Air France–KLM	-0.06(*) (0.02)	-0.009 (0.004)	0.009(*) (0.002)	0.01 (0.008)	-0.001(*) (0.0002)	0.61
Société des Bains de Mer	-0.03(*) (0.009)	-0.008(*) (0.002)	0.004(*) (0.001)	0.006 (0.004)	-0.0008(**) 0.0001	0.82
Bernard Loiseau SA	-0.0004 (0.004)	-0.002 (0.001)	-0.002(*) 0.0006	0.002 (0.002)	-0.00004 (0.00007)	0.62
Pierre and Vacances Sevilla	-0.08(***) (0.009)	-0.01(**) (0.002)	0.003(*) (0.001)	0.02(**) (0.004)	-0.0009(***) (0.0001)	0.79

Note: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%

Table 4.14: P-values of diagnostic tests for regression assumptions on French stocks for model 6.

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
Air France–KLM	0.14	0.76	0.98
Société des Bains de Mer	0.93	0.30	0.39
Bernard Loiseau SA	0.67	0.44	0.25
Pierre and Vacances Sevilla	0.18	0.82	0.97

Greece

Greek tourism companies (8) included in the dataset, consisted of 0.77-0.81% zero values, and for that reason, were excluded from the sample. Most of the models did not seem to fit well the data, however model 2 (Returns ~ Deaths) applied on period 6/11/2020-18/11/2020 of the second quarantine implemented from the

government, was found to have better results. In particular, using SURE modeling on 5 non-zero Greek stocks, we obtained R^2 ranging from 0.01-0.86, meaning that there are some firms with returns well described by the particular model, and others not be fitting well (Table 4.15- $R_{it} = \beta_{i1} + \beta_{i2} \cdot Deaths_t + \varepsilon_{it},\ i = 1, \dots, 3$).
"Kyriakoulis shipping", specifically, had a 0.86 adjusted R^2, whilst regressor "Deaths" being statistically significant at a 1% critical level, and its coefficient of SURE estimate being equal to 0.003. "Aegean Airlines" had a 0.54 adjusted R^2, while Deaths was statistically significant at a 5% critical level, and its coefficient of SURE estimate being equal to 0.004. Residuals of "Aegean Airlines" were highly correlated (0.62) with those of "OPAP". However, the rest of the firms do not seem to be strongly related.

Table 4.15: SURE estimates of Returns ~ Deaths for Greek stocks

Stocks	β_{i1}	β_{i2}	**Adjusted** R^2
Aegean Airlines	0.04 (0.02)	0.004(*) (0.001)	0.54
Football Prognostics	0.01 (0.01)	0.002(*) 0.0007	0.46
Kiriakoulis Shipping	0.007 (0.005)	0.003(***) (0.0003)	0.86

Note: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%

<u>Hong Kong</u>

Dataset contains 113 stocks originated from Hong Kong. 15 of them contained at least 60% of zero values, so they were excluded from the initial sample. For a 30-days period after the first reported case (31/12/2019-31/1/2020), 45 of them had many zero values, so we did not consider them in the sample. Similarly to other countries too, the models implicated for the days after the first reported covid case, do not fit well the returns (for Hong Kong's firms R^2 range from 0.01-0.30) indicating that this event did not affect the stocks' behavior. Unfortunately, none of the models for the time periods under examination fit the data adequately.

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Indonesia

Dataset contained 30 Indonesian stocks, with 11 out of them to have at least 60% of their values equal to zero. Model 3 (Returns ~ Stringency) implicated in 10-days period after the approval of Pfizer vaccine from FDA fitted some of the stocks quite well through OLS estimates. For instance, R^2 for "Blue Bird Group transportation company" was equal to 0.66, with Stringency being statistically significant at a 1% critical level (p-value of Shapiro test: 0.22, Breusch-Pagan test: 0.26, Durbin-Watson test: 0.50). The coefficient of estimate was equal to 0.02. Similarly, returns of "Fast Food Indonesia" were fitted at a 79% from model 3, with Stringency being again statistically significant at a 1% critical level and its coefficient of estimate equal to 0.03 (p-value of Shapiro test: 0.05, Breusch-Pagan test: 0.34, Durbin-Watson test: 0.09). The rest of the SURE and OLS models reached low or moderate R^2 and for that reason, they are not being mentioned.

Table 4.16: OLS estimates of Returns ~ Stringency for Indonesian stocks

Stocks	$\boldsymbol{\beta_{i1}}$	$\boldsymbol{\beta_{i2}}$	**Adjusted R^2**
Bluebird Group	-0.03(*) (0.009)	0.02(**) (0.005)	0.66
Fast Food Indonesia	-0.02 (0.01)	0.034(***) (0.006)	0.79
Asia Pacific	-0.01 (0.02)	0.03(*) (0.01)	0.48

Note: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%

Israel

Applying the regression analysis to the 7 non- zero valued stocks in the sample originating from Israel, we found adequate results for models 6 (Returns ~ Stringency*Casespermillion + Gri) and 12 (Returns ~ Stringency*Deaths + Gri) for the next days after the announcement of the first quarantine in Israel. In particular, both models provided moderate to high R^2 via OLS estimates for 10- days and 30-days period after the event. Results of model 12 are presented in Table 4.17 below

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($R_{it} = \beta_{i1} + \beta_{i2} \cdot Stringency_t + \beta_{i3} \cdot Deaths_t + \beta_{i4} \cdot Gri_t + \beta_{i5} \cdot Stringency * Deaths_t + \varepsilon_{it}$, $i = 1, \ldots, 5$). Also, qqplot of the residuals of the regression is depicted in Figure 3.

Against expectations, 30-days period provided equally good results with 10-days period, indicating that the economic shock had longevity. Similar values were obtained for model 6 as well, with Gri being the statistical significant regressor for most of the firms.

Italy

10 Italian stocks were used for the purpose of this research. Conducting a regression analysis for each of the time span described before and each of the 12 models, we resulted only in low or moderate values for adjusted R^2. In particular, models 5 (Returns ~ ipandemic), 9 (Returns ~ Gri + ipandemic), 10 (Returns ~ Casespermillion + ipandemic) and 11 (Returns ~ Deaths + ipandemic) seem to lead to better results through SURE or OLS estimators, however the values of R^2 are still moderate, ranging from 0.10-0.47.

Table 4.17: Results of OLS model Returns ~ Stringency*Deaths + Gri on Israelian stocks

Stocks	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	Adjusted R^2
Dan Hotels	0.0001 (0.006)	0.01 (0.002)	0.004 (0.001)	0.004(*) (0.001)	-0.0004 (0.001)	0.65
El Al Airlines	-0.02 (0.009)	0.003 (0.003)	0.001 (0.002)	0.009(**) (0.002)	-0.003 (0.002)	0.76
Fattal Holdings (1998) holding company	-0.02 (0.03)	0.025 (0.01)	0.01 (0.008)	0.02(*) (0.007)	0.004 (0.007)	0.61
Holmes Place International	0.001 (0.005)	0.004 (0.002)	-0.0008 (0.001)	-0.001 (0.001)	0.005(**) (0.001)	0.76
Knafaim Holdings	0.005 (0.009)	-0.007 (0.003)	0.0003 (0.002)	0.01(**) (0.002)	-0.002 (0.002)	0.75

Note: (*) signif. at 5% (**) signif at 1%

Japan

The initial sample consisted of 164 Japanese stocks. Most of them were not fitted well by the models, nevertheless five of them did achieve a satisfying R^2 for model 1 (Returns~ Casespermillion) during the first days of the first lockdown in Japan (19/3/2020-30/3/2020), as presented in Table 4.18. Regression hypotheses are satisfied for each of these stocks, except for the normality hypothesis of "Fields" company.

Mexico

Mexico's dataset consisted of 10 firms, 4 out of which had at least 60% zero values. We apply the models for each of the time periods, however none of them seemed to describe well enough the behavior of the stocks (R^2 between 0.01-0.34).

Table 4.18: OLS Results of Returns~ Casespermillion for period (19/3/2020-30/3/2020) for six Japanese stocks.

Stocks	$\boldsymbol{\beta_{i1}}$	$\boldsymbol{\beta_{i2}}$	**Adjusted R^2**
Shinki Bus	-0.009 (0.007)	0.23(**) (0.05)	0.77
Natty Swanky holdings	-0.05(*) (0.01)	0.48(**) (0.12)	0.64
Japan Airlines	-0.004 (0.007)	0.17(*) (0.05)	0.60
Fujita Corporation	-0.0001 (0.01)	0.32(*) (0.08)	0.62
Fields	-0.01 (0.009)	0.34(**) (0.06)	0.78
AB hotel	-0.01 (0.01)	**0.30(*)** (0.09)	0.60

Note: (*) signif. at 5% (**) signif at 1%

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Portugal

Dataset contained 6 Portugal stocks, however four of them had a lot of zero values, and for that reason they were excluded from the sample. Running the models for the rest two firms, we found that during second quarantine, at a 30-days period (15/1/2021-17/2/2021), model 12 (Returns ~ Stringency*Deaths + Gri) could moderately describe the dataset. In details, adjusted R^2 were equal to 0.65 and 0.24 for "Ibersol Sgps" and "Sport Lisboa e Benfica" respectively. Stringency, Gri and Stringency*Deaths were statistically significant for the first firm, while only Gri had a negative coefficient (p-value of Shapiro test: 0.75, Breusch-Pagan test: 0.07, Durbin-Watson test: 0.85). The rest of the models applied for the others time periods only gave low values of R^2.

Singapore

Dataset contained 39 stocks originated from Singapore. However, none of the 12 models could provide satisfactory results for each of the time periods examined.

Spain

Returns of Spanish stocks seem to be fitted well by quite a few of the models, especially during the initial period of the first quarantine in Spain (13/3/2020-24/3/2020). Using five Spanish firms as a sample, we found model 6 (Returns ~ Stringency*Casespermillion + Gri) to have the highest R^2. Results (rounded in second decimal point) are presented in Table 4.19 below. As seen in Table 4.19 ($R_{it} = \beta_{i1} + \beta_{i2} \cdot Stringency_t + \beta_{i3} \cdot Deaths_t + \beta_{i4} \cdot Gri_t + \beta_{i5} \cdot Stringency * Deaths_t + \varepsilon_{it},\ i = 1,\ldots,5$), "eDreams ODIGEO travelling company" and "Intl Con Airline" the firms with the highest R^2, meaning that the variance of the returns is well described by the models. In particular, Stringency index seems to affect positively the returns of the first, as it is statistically significant and its coefficient equals to 0.1. Gri index, on the other hand, affects inversely the behavior of the returns of "Intl Con Airline", as its coefficient is negative. Model 12 (Returns ~ Stringency*Deaths + Gri) also described well the data, reaching similar values. For instance, "Intl Con Airline" has R^2 equal to 0.96, and all the variables are statistically significant. The coefficients of Gri and Deaths are equal to -0.05 and -0.04 respectively. It is important to note that, applying the models for the 30-days period after the beginning of the first quarantine in Spain,

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the values of R^2 are severely declined. The comparison of the values is presented in Table 20.

Table 4.19: OLS Results of model Returns ~ Stringency*Casespermillion + Gri on Spanish stocks

Stocks	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	Adjusted R^2
Codere Gaming Company	-0.02 (0.04)	0.02 (0.01)	-0.0001 (0.0002)	-0.01 (0.01)	0.00008 (0.0001)	0.67
eDreams ODIGEO travelling company	-0.004 (0.03)	0.01 (0.01)	-0.0001 (0.0002)	-0.02 (0.01)	0.0005 (0.0001)	0.82
Intl Con Airline	0.08(*) (0.02)	0.02(*) (0.005)	-0.0004(*) (0.00008)	-0.05(**) 0.007	0.0003(*) (0.00008)	0.87
Meliá Hotels International	0.11 (0.06)	0.03 (0.02)	-0.0002 (0.0003)	-0.05 (0.03)	0.0003 (0.0003)	0.57
NH Hotel Group	0.075 (0.05)	0.02 (0.01)	-0.0005 (0.0003)	-0.04 (0.02)	0.0005 (0.0002)	0.24

Note: (*) signif. at 5% (**) signif at 1%

Table 4.20: Adjusted R^2 of model 12 for periods 13/3/2020-24/3/2020 (first column) and 13/3/2020-15/4/2020 (second column) on Spanish stocks

Stocks	Adjusted R^2 for period 13/3/2020-24/3/2020	Adjusted R^2 for period 13/3/2020-15/4/2020
Codere Gaming Company	0.67	0.64
eDreams ODIGEO travelling company	0.82	0.23
Intl Con Airline	0.87	0.46
Meliá Hotels International	0.57	0.23
NH Hotel Group	0.24	0.10

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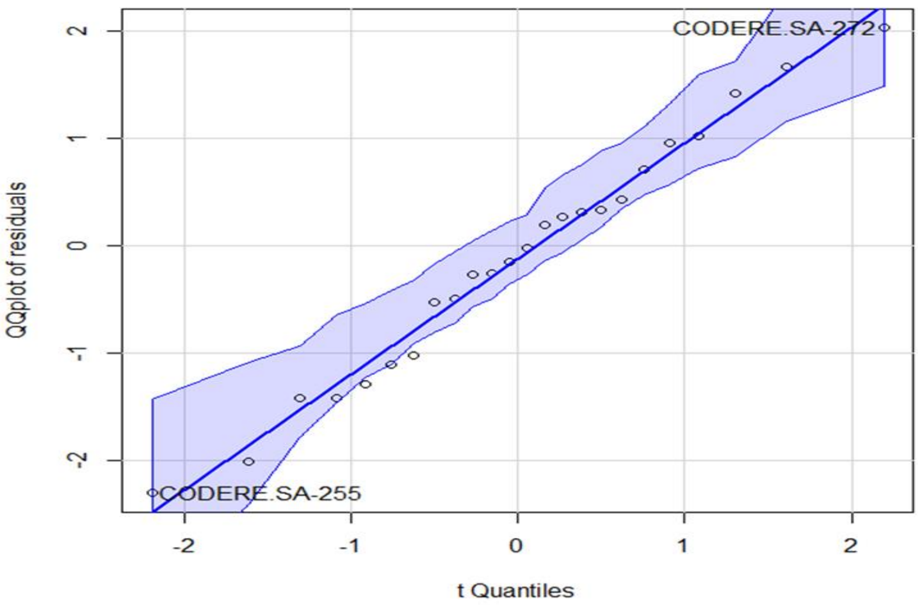
"Codere Gaming Company" fits both models quite well. In addition, its residuals fulfill the model assumptions for 10 and 30-days periods (Figure 3).

Figure 4.4: QQplot of residuals for model 12 (30-days period),Codere Gaming Company



The results of the diagnostic tests for 10-days-model are provided in Table 4.21. As we can see, the assumptions are violated only for "eDreams ODIGEO travelling company".

Table 4.21: P-values of diagnostic tests for regression assumptions on Spanish stocks for model 12.

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
Codere Gaming Company	0.93	0.67	0.95
eDreams ODIGEO travelling company	0.01	0.72	0.03
Intl Con Airline	0.44	0.22	0.71
Meliá Hotels International	0.49	0.49	0.57
NH Hotel Group	0.38	0.15	0.37

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Taiwan

Most of the models failed to describe the dataset adequately enough for the time periods examined. Nonetheless, for model 10 (Returns~ Casespermillion + ipandemic), the returns of six of Taiwan's stocks during the spread of the virus (5/3/2020-16/3/2020) achieved R^2 ranging from 0.65 to 0.78. The coefficient of OLS estimates of "ipandemic" was negative for all eight of them, meaning the existence of the pandemic caused a decline in stocks' returns (Table 4.22:$R_{it} = \beta_{i1} + \beta_{i2} \cdot Casespermillion_t + \beta_{i3} \cdot ipandemic_t + \varepsilon_{it}$, $i = 1, \ldots, 6$). The rest 32 of the firms only gave low R^2. The model assumptions are met, too (Table 4.23).

Thailand

During the first days after the approval of the Pfizer vaccine from FDA (21/12/2020-31/12/2020), returns of a part of the 19 Thailand's stocks, were well enough interpreted from models 3 and 4 (Returns~ Stringency and Returns~ Gri) through OLS estimates.

Table 4.22: Results of model 10 Returns~ Casespermillion + ipandemic for six of Taiwan's firms

Stocks	β_{i1}	β_{i2}	β_{i3}	**Adjusted R^2**
EVA Airways Corporation	-0.008 (0.009)	0.02 (0.03)	-0.07(*) (0.01)	0.67
First Hotels	-0.009 (0.005)	0.08(**) 0.01	-0.04(**) (0.008)	0.79
Phoenix Tours International, Inc	-0.009 (0.008)	-0.0007 (0.02)	-0.07(***) (0.01)	0.75
Power Wind Health Industry Incorporated	-0.01 (0.01)	0.02 (0.02)	-0.7(**) 0.01	0.65
Taiwan Taxi Company	-0.009 (0.006)	0.07(**) (0.01)	-0.04(**) (0.009)	0.77
Wowprime Corp	-0.003 (0.008)	0.04 (0.02)	-0.055(**) 0.01	0.68

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Table 4.23: P-values of diagnostic tests for regression assumptions on Taiwan's stocks for model 10.

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
EVA Airways Corporation	0.30	0.41	0.55
First Hotels	0.54	0.54	0.86
Phoenix Tours International, Inc	0.86	0.19	0.54
Power Wind Health Industry Incorporated	0.77	0.12	0.51
Taiwan Taxi Company	0.73	0.68	0.87
Wowprime Corp	0.94	0.43	0.68

Tests for model assumption of model 3 are presented in Table 4.25 below. The two indices were found statistically significant for the majority of the firms, and the coefficients of their estimates were negative (Table 4.24: $R_{it} = \beta_{i1} + \beta_{i2} \cdot Stringency_t + \varepsilon_{it},\ \ i = 1, \dots ,5$) meaning that in the particular time period, the increase of restriction measures affected inversely the returns of the stocks. For instance, increasing the Stringency Index by one unit, will decrease the values of the returns by 5%.

For the rest of the time periods, the results were inadequate, and for that reason, they are not presented.

Turkey

The sample consisted of 17 Turkish firms, nevertheless, none of the models implemented at any time period gave satisfying results. The largest R^2 observed was that of "Altın Yunus Hotel & Spa" firm by model 5 (Returns ~ ipandemic) on a 30-days period of spread (5/3/2020-6/4/2020), and was equal to 0.55 "Ipandemic" was found statistically significant, with its coefficient of SURE estimate equal to 0.15.

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Table 4.24: OLS Results of model Returns~ Stringency on Thailand's firms

Stocks	β_{i1}	β_{i2}	Adjusted R^2
MK Restaurant Group Public Company	-0.004 (0.005)	-0.05(**) (0.001)	0.77
Krungthai Car Rent and Lease Public Company Limited	-0.000001 (0.002)	-0.003(**) (0.0006)	0.73
BTS Group Holdings	-0.003 (0.004)	-0.006(***) 0.0009	0.84
Oishi Group Public Company Limited	0.001 (0.004)	-0.003(**) (0.0009)	0.62
Raja Ferry Port	-0.004 (0.003)	-0.004(***) (0.0006)	0.82

Note: (*) signif. at 5% (**) signif at 1% (***) signif at 0.1%

Table 4.25: P-values of diagnostic tests for regression assumptions on Thailand's stocks for model 3.

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
MK Restaurant Group Public Company	0.31	0.46	0.97
Krungthai Car Rent and Lease Public Company Limited	0.25	0.50	0.34
BTS Group Holdings	0.05	0.56	0.88
Oishi Group Public Company Limited	0.10	0.54	0.55
Raja Ferry Port	0.19	0.33	0.90

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UK

During the time periods of the spread of covid (5/3/2020-19/3/2020) and of the second quarantine in United Kingdom (5/11/20-16/11/2020), UK's returns were interpreted most effectively by the models, among the rest of the time periods under examination. In particular, for model 12 (Returns~ Stringency*Deaths + Gri) at the first days of spread, we found that 41% of the stocks gave R^2 equal or higher than 0.60 through OLS estimates. Some of the results are presented in Table 4.26 below ($R_{it} = \beta_{i1} + \beta_{i2} \cdot Stringency_t + \beta_{i3} \cdot Deaths_t + \beta_{i4} \cdot Gri_t + \beta_{i5} \times Stringency * Deaths_t + \varepsilon_{it},\ i = 1, \ldots, 5$).Results of diagnostic tests are presented in Table 4.27 below.

For the rest of the time periods under examination, models resulted in low or moderate R^2 indicating that the models could not interpret the variance of the data effectively

Table 4.26: OLS Results of model Returns ~ Stringency*Deaths + Gri on English stocks

Stocks	β_{i1}	β_{i2}	β_{i3}	β_{i4}	β_{i5}	Adjusted R^2
YNGN | Complete Young & Co.'s Brewery PLC N.V.	-0.02 (0.02)	-0.01 (0.007)	-0.01(*) (0.004)	0.003 (0.005)	0.001 (0.0007)	0.70
Wizz Air Holdings	-0.01 (0.02)	0.02 (0.008)	0.008 (0.005)	-0.02(*) (0.006)	-0.003(*) (0.0008)	0.71
Sportech PLC	-0.03 (0.02)	-0.01 (0.007)	0.001 (0.004)	0.002 (0.005)	-0.003(*) (0.0007)	0.91
Revolution Bars Group	-0.006 (0.03)	-0.04(*) (0.01)	0.003 (0.008)	-0.01 (0.009)	-0.00004 (0.001)	0.72
The Rank Group	-0.016 (0.02)	0.003 (0.006)	-0.005 (0.004)	-0.02(*) (0.005)	-0.0001 (0.0007)	0.88

Note: (*) signif. at 5% (**) signif at 1%

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US

US dataset consisted of 271 firms, out of which 100 had at least 60% of zero values. Model 1 (Returns~ Casespermillion) on first days of second lockdown implemented in US (15/10/2020-26/11/2020) gave satisfying interpretation for some of the firms, as its R^2 values ranged from 0.01 to 0.72. Results of five stocks are presented in Table 4.28.

Table 4.27: P-values of diagnostic tests for regression assumptions on English stocks for model 12.

Stocks	Shapiro-Wilk's test	Breusch-Pagan test	Durbin-Watson test
YNGN | Complete Young & Co.'s Brewery PLC N.V.	0.11	0.40	0.24
Wizz Air Holdings	0.38	0.31	0.59
Sportech PLC	0.34	0.85	0.59
Revolution Bars Group	0.19	0.49	0.70
The Rank Group	0.07	0.72	0.31

For instance, "Southwest Airlines" returns gave a 0.72 R^2, while the coefficient of the statistically significant variable "Casespermillion" was equal to 0.007. The model assumptions are fulfilled (p-value for Shapiro-Wilk's test: 0.40, Breusch-Pagan test: 0.85, Durbin-Watson test: 0.26). "Hilton Worldwide Holdings Inc" also resulted in 0.69 R^2 with variable "Casespermillion" being statistically significant and its coefficient equal to 0.008. However, normality assumption is violated for the particular regression (p-value of Shapiro-Wilk's Test: 0.04). Overall, most of the models did not achieve to describe well the data.

Overall, six of the countries were excluded from the sample due to the existence of zero-values and eight of them were not fitted well enough by the models neither through OLS nor SURE estimates. However, three countries provided satisfactory results through SURE models, and eleven though OLS estimates (Figure 5).

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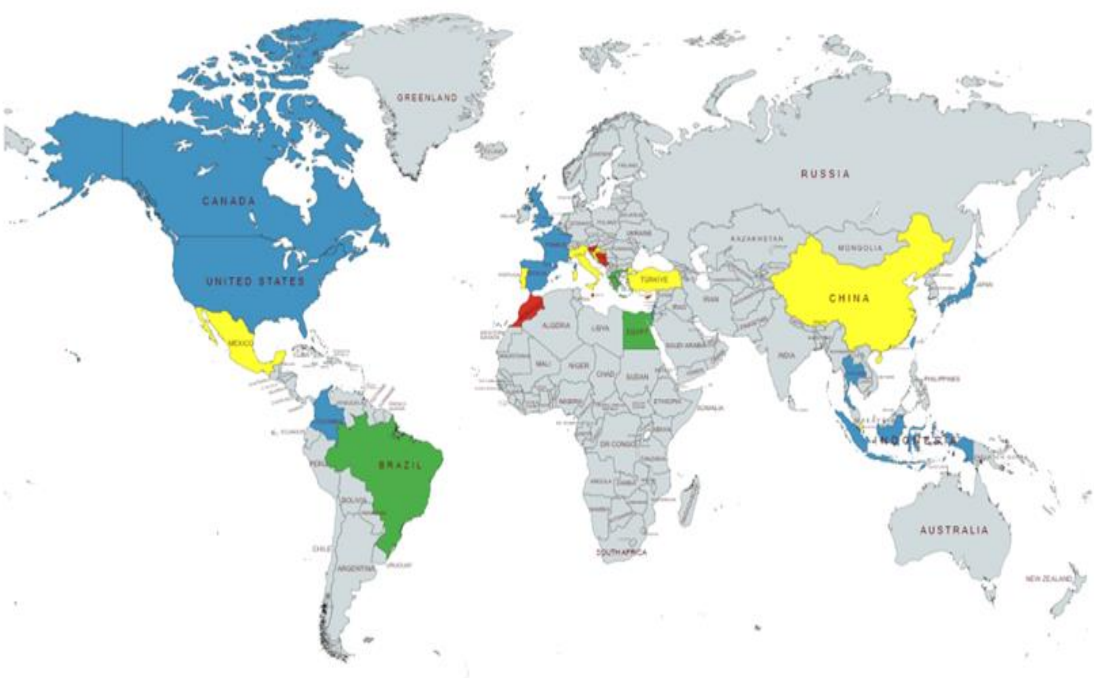
Table 4.28: OLS estimates of Returns~ Casespermillion on US' stocks

Stocks	β_{i1}	β_{i2}	Adjusted R^2
Yatra Online	0.02 (0.01)	0.002(*) (0.0006)	0.62
One Group Hospitality	-0.01 (0.008)	0.001(**) (0.0002)	0.70
Playags	-0.01 (0.007)	0.0009(**) (0.0002)	0.62
Skywest	0.001 (0.007)	0.001(**) (0.0002)	0.70
Southwest Airlines	0.004 (0.005)	0.0007(**) (0.0001)	0.72

Note: (*) signif. at 5% (**) signif at 1%

Figure 4.5: Summary of results per country (OLS: Blue, SURE: green, low R^2: yellow and excluded from the sample: red colour)



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CHAPTER 5

CONCLUSIONS

Coronavirus outbreak triggered global recession in the tourism sector in 2020. Governments imposed restriction measures, lockdowns and fiscal policies in order to limit the consequences of the pandemic. In this thesis, we estimated the impact of pandemic-related variables, such as daily reported deaths, cases per million of population in each country , stringency and GRI indices, to the returns of firms in the tourism sector, through twelve regression models . The results (section 4) indicated that the models interpreted adequately the variance of the data of 14 countries in the sample, while for the most of these countries, it seems that the impact of the variables used was intense on a 10-days period after the event, and was diminished after 30 days. This brevity implies that the repercussions of Covid-19 pandemic were that of an economic shock. In addition, the results suggest that the models fitted the data most effectively the first days of the spread of the virus (5/3/2020-16/3/2020) and the days after the announcement of the first quarantine at most of the countries worldwide, meaning that the particular time periods, the development of the pandemic has been crucial to for the economic growth in the tourism sector. In fact, reported cases and stringency index were found to be statistically significant most frequently, which, in line with the existing literature, reflects the essential need for social distancing measures and fiscal policies implemented by governments. Moreover, this implies that the spread of Covid-19 and the panic evoked by that affected most the investors, rather than the victims of the pandemic.

This intensifies the necessity of support given to tourism firms in order to stabilize their economy after the coronavirus pandemic and the need for further research about measures employed by governments to mitigate the economic damage of a potential crisis. In particular, researchers could discuss which measures have been the most effective in reducing the spread of a virus, the panic triggered by that to the investors, and the economic consequences. Moreover, they could examine economic strategies aiming to make the behavior of tourism stocks more resistant to crises.

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BIBLIOGRAPHY

Alam, Md. Samsul, Paramati, Sudharshan Reddy (2016), The impact of tourism on income inequality in developing economies: Does Kuznets curve hypothesis exist?, *Annals of Tourism Research*

Amine Ben Amar , Fateh Belaid, Adel Ben Youssef, Benjamin Chiao, Khaled Guesmi (2021), The unprecedented reaction of equity and commodity markets to COVID-19, *Finance Research Letters*

Assaf, A., & Scuderi, R. (2020): COVID-19 and the recovery of the tourism industry. *Tourism Economics, 26(5), 731–733.*

Christian D.; Wang, Qingwei (2008), The Economic Impact of Olympic Games: Evidence from Stock Markets, *ZEW Discussion Papers, No. 08-060, Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim*

Dlawar Mahdi Hadi, Salih Katircioglu & Cahit Adaoglu (2020) The vulnerability of tourism firms' stocks to the terrorist incidents, *Current Issues in Tourism*

Eleas Tzavalis (2008), Econometrics, *AUEB Publishing*

Emawtee Bissoondoyal-Bheenick, Hung Do, Xiaolu Hu, Angel Zhong (2021) Learning from SARS: Return and volatility connectedness in COVID-19, *Finance Research Letters, Volume 41*

Engelhardt, Bryan; Matheson, Victor; Yen, Alex; and Chisholm, Max (2018), The Economic Impact of Olympic Games: Effects of Host Country Announcements on Stock Market Returns, *Economics Department Working Papers. Paper 178*

Frank Agbola, Tarik Dogru and Ulrich Gunte (2020), Tourism Demand: Emerging Theoretical and Empirical Issues, *Tourim Economics*

Gagan Deep Sharma, Asha Thomas, Justin Paul (2021): Reviving tourism industry post-COVID-19: A resilience-based framework, *Tourism Management Perspectives, Volume 37,100786, ISSN 2211-9736,*

Georgios Christou (2011), Introduction to Econometrics, *Gutemberg Publishing*

Giray Gozgor, Marco Chi Keung Lau, Yan Zeng, Cheng Yan, and Zhibin Lin (2021), The Impact of Geopolitical Risks on Tourism Supply in Developing Economies: The Moderating Role of Social Globalization**,** *Journal of Travel Research*

G.K., Chetan Kumar and K.B., Rangappa and S., Suchitra (2022): Normative analysis of the impact of Covid-19 on prominent sectors of Indian economy by using ARCH Model, *Theoretical and Applied Economics , Vol. 29, No. No. 2 / 2022 (631), Summer (20 June 2022): pp. 151-164.*

Godwell Nhamo, Kaitano Dube, and David Chikodzi, (2020), COVID-19 and the Stock Market: Impacts on Tourism-Related Companies, *Springer Link*

Habibi, Zohal, Hamed Habibi, and Mohammad Aqa Mohammadi (2022), The Potential Impact of COVID-19 on the Chinese GDP, Trade, and Economy. *Economies 10:73*

Huayu Shen, Mengyao Fu, Hongyu Pan, Zhongfu Yu & Yongquan Chen (2020) , The Impact of the COVID-19 Pandemic on Firm Performance, *Emerging Markets Finance and Trade*

Kevin Moran, Dalibor Stevanovic, Adam Kader Touré (2022), Macroeconomic uncertainty and the COVID-19 pandemic: Measure and impacts on the Canadian economy, *Canadian Journal of Economics*

Lina Zhong, Sunny Sun, Rob Law & Xiaonan Li (2021), Tourism crisis management: evidence from COVID-19, *Current Issues in Tourism, 24:19, 2671-2682*

 https://doi.org/10.26219/heal.aueb.6012

Loukia Meligkotsidou, Elias Tzavalis & Ioannis D. Vrontos (2012), A Bayesian panel data framework for examining the economic growth convergence hypothesis: do the G7countries converge?, *Journal of Applied Statistics, 39:9, 1975-1990*

Loukia Meligkotsidou & Ioannis D. Vrontos (2012), Detecting structural breaks in multivariate financial time series: evidence from hedge fund investment strategies, *Journal of Statistical Computation and Simulation, DOI:10.1080/00949655.2012.740671*

Loukia Meligkotsidou, Ioannis D. Vrontos (2008), Detecting structural breaks and identifying risk factors in hedge fund returns:A Bayesian approach, *Journal of Banking & Finance, Volume 32, Issue 11,Pages 2471-2481,ISSN 0378-4266,*

Marinko Skare , Domingo Riberio Soriano, Małgorzata Porada-Rochon´ (2021), Impact of COVID-19 on the travel and tourism industry ,*Technological Forecasting & Social Change*

Ming-Hsiang Chena , Woo Gon Kimb , Hyun Jeong Kim (2005), The impact of macroeconomic and non-macroeconomic forces on hotel stock returns, *International Journal of Hospitality Management*

Nashirah Abu Bakar , Sofian Rosbi (2020), Effect of Coronavirus disease (COVID-19) to tourism industry, *International Journal of Advanced Engineering Research and Science (IJAERS)*

Omair Haroon, Syed Aun R. Rizvi (2020), COVID-19: Media coverage and financial markets behavior—A sectoral inquiry, *Journal of Behavioral and Experimental Finance*

Rutynskyi, Mykhailo; Kushniruk, Halyna (2020), The impact of quarantine due to COVID-19 pandemic on the tourism industry in Lviv (Ukraine*), Problems and Perspectives in Management; Sumy Vol. 18, Iss. 2*

https://doi.org/10.26219/heal.aueb.6012

Sofia Dimeli (2013), Contemporary methods of analyzing time series, *AUEB Publishing*

Thankom G. Arun, Peterson K. OziliB (2020), Spillover of COVID-19: impact on the Global Economy, *SSRN Electronic Journal*

Wenmin Wu , Chien-Chiang Lee, Wenwu Xing and Shan-Ju Ho (2021) , The impact of the COVID-19 outbreak on Chinese-listed tourism stocks, *Financial Innovation*

Zopiatis, Anastasios; Savva, Christos S.; Lambertides, Neophytos; McAleer, Michael (2017) : Tourism Stocks in Times of Crises: An Econometric Investigation of Unexpected Non-macroeconomic Factors, *Tinbergen Institute Discussion Paper, No. 17-052/III, Tinbergen Institute, Amsterdam and Rotterdam*