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QUANTITATIVE ANALYSIS OF THE IMPLICATIONS OF COVID-19 ON GLOBAL AIRPORTS

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ABSTRACT

This research analyzes the status of the global aviation sector with the ongoing pandemic. This research is strategically divided to apply, IBM SPSS statistics, event study and also use the PEST analysis to discuss the impact the sector has suffered from the pandemic. Data for this research was filtered to mainly cover the period from January 2019. Covid-19 data is analyzed using the SPSS tool to prescriptively and descriptively analyze the cases. In the second part of the research covering the three different event periods, the study finds that investors and stakeholders reacted differently during each timeline. The results from this study found that airline stock returns are negatively impacted by declining during the three major events during the pandemic. The overall findings from this study suggest that there is a lot to be done if the various governments are to revive the sector that is already suffering a major setback.

KEYWORDS: Airline industry, Coronavirus, Data Analytics, Event Study, IBSS SPSS.

INTRODUCTION

Covid-19 is the newest global threat that has shaken economies worldwide. The airline industry is among the first to be hit due to the nature of the spread of the disease. Wuhan, China was the first place to report a case of the virus, which is known to be transmitted between people on 31st Dec 2019but its origin are being traced by global scientists. Despite the numerous trials and research, there has not been a confirmed treatment for the disease to date leading to panic and distress among global citizens. Various global governments have prohibited transport and movement between different countries. The global airline industry has received intense shaking tremendously disrupting its market value. It is because of the effects Covid-19 poses to the transport industry that motivates further research on the implications of the virus on the airline industry.

The world is constantly evolving and so is the air transportation system, which has enabled the fulfillment of global connectivity while satisfying globalization demands. Several factors such as pandemics, terrorist attacks, among others are some of the events that lead to changes in air transport over time [1]. Since 1945 to date, significant evolution has been observed whereby 3.5 billion annual trips come from commercial transport, over 40 % of these trips involve international travel [2]. Air movement is therefore important in ferrying people and cargo across various countries in turn contributing to global economic growth. The development and increased connectivity of air travel has made it easier to expedite the geographical spread of contagious or infectious diseases.

Various external threats are a risk to the aviation industry, which just like other industries, is not immune to threats and challenges. Threats such as natural disasters, disease outbreaks, recession, oil crises among others severely affect the global aviation industry leading to increased cancellations, travel bans as observed in many countries during the onset of Covid-19, closure of international borders, and aircraft grounding. Coronavirus is a case of external threats that have shaken air travel to date.

This study employs quantitative analysis to study the effect of Coronavirus on the global air industry. This research is an inclusion and contribution to the current literature on the pandemic of global air travel.

LITERATURE REVIEW

Passenger transportation using jet air was introduced in the late 1950s after Boeing 707 and Douglas DC-8 airlines were introduced. Going deep into history Englishman Graham Simons argues that there are prior trials in the jet transport age before 707. Simons presents a history of 707 and the introduction of jet transport [3]. The coronavirus pandemic is a major global pandemic although earlier in history there was an influenza pandemic that attacked the year 1918 [4]. Between 1957 and 1958 there were also less complex flu outbreaks, also between 1968 to 1970 that caused over a million global deaths [5], [6]. At that time air transport was not widespread therefore the effect on the sector was minimal.

The first outbreak to significantly shatter the activities of the aviation industry was witnessed in 2003. SARS outbreak in 2003 briefly affected the aviation industry, which was recovering from the September 2001 terrorist attack 9/11 [7]. The outbreak was not as bad since it accounted for at least 1,000 global deaths and was quickly contained. Another serious concern for the airline industry is the Ebola outbreak in 2014 [8], [9]. The disease affected air travel as the emphasis was put on preventing the virus from reaching the U.S from West Africa through flight.

It caused several flight cancellations and quarantine of suspected victims [10].

The impact of the coronavirus pandemic has attracted the attention of various researchers globally. Elias discusses the impact of the virus on air travel and the lack of preparedness by the governments to tackle the situation [11]. The air transport industry is one of the most developed business sectors globally however a decreasing trend has since recently been noticed in the sector [12]. The articles discussed in this section relate to the question of the effect of coronavirus on the aviation industry. An area is still undergoing research, which will be done even after this study aiming to suggest possible strategies to the challenge such as government support among others [13].

RESEARCH METHODOLOGY

This research was facilitated by various literature and information, which is easy to achieve considering the pandemic, is a global threat still underway. Google Scholar, SPSS Analysis, Web of Science among other sources facilitated the research sources. Collection of data on air transport before, and during the pandemic was done, the articles majorly covering between 2017 to 2021. Older articles and information were collected to explain the development and evolution of the aviation industry. The event study methodology facilitated the quantitative research of this research after data analysis using the SPSS tool. It is possible to quantify market reaction to obtain various data types using the event study methodology [14].

This part of the research focuses on various events as the pandemic progresses. The virus was first reported in Wuhan, China but its origin are being traced by global scientists therefore the first event to be analyzed is when and where the disease was reported outside the area [15]. On 13th January 2020, Thailand was the first to report the first event outside China. Another event to be noted is the outbreak in Italy reported on 21st February 2020 [16]. Covid-19 brought in various special events; however, this research will only focus on three, the third event was when WHO declared the virus a global pandemic on 11th March 2020 after which Former US president Donald Trump banned travelers from 26 countries [17]. The goal of this methodology in the event period is to note the possibility of abnormal returns. The results pose time-

varying behaviors of the global airline industry stock market participants. A market model is employed to begin the study,

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + u_{i,t} (1)$$

In the formula, the daily stock returns (R_i) and stock market (m) at various periods are represented by $R_{i,t}$, and $R_{m,t}$.$U_{i,t}$ is independently and identically distributed representing the residual at time t of stock i. The next step is estimating the market model parameters during the 2019 estimation window. The irregular stock return i at time t is given as;

$$AR_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t} \dots\dots\dots (2)$$

The effect of the pandemic during the announcement of the 3 occurrences to the markets is captured by $AR_{i,t}$. A significant difference from zero implies deviation from the fair value of $AR_{i,t}$. The accumulated irregular stock return i at the time (t1) and (t2) is represented by CARi, (t1, t2). A test on CARi,(t1,t2) to see if there is a significant difference from zero is done to investigate

The deviation of market value from the fair value. A (-) or (+) CARi, (t_1, t_2) demonstrates goods price deviation from the expected value. The definition of cumulative stock return (i) from t1 to t2 is given as;

$$CAR_{i,(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_{i,t} \dots\dots\dots (3)$$

The study uses an event window timeline covering the first five days before the occurrence date to five days after a situation, given as [-5, +5]. The timeline is selected to cover the stock market efficiency. The choice of the timeline of this study is following the knowledge that a long occurrence period can alter the power of the statistic.

DATA COLLECTION AND ANALYSIS

This study first analyzes the effect of the pandemic on passenger traffic, world air traffic, and revenues in terms of operational regions, international passengers per region, domestic passengers traveling per route group. Data from this research is focused on the activities before and during the pandemic with the help of the ICAO database ranging from January 2019 to December 2020 [18]. Data analytics and visualization were done using SPSS, Google Analytics tool, and Excel data analytics.

The research is aimed at investigating the effect of coronavirus on the air transport industry, assessment of such a case depends on the analysis of the sector before and during the pandemic. PEST analysis is also a part of this research, adopting PEST analysis is important in analyzing the strategic management of any organization to nationally cover the success and impacts. The profitability of an industry can be externally gauged using the PEST analysis. It is an essential item that helps understand strategic risk by examining the various factors affecting an industry [19].

Data analytics is an important part of this research as it aims at discussing the impact of an ongoing pandemic. The goal is to examine any case of irregular returns within the suggested event periods. For the event study, data is collected from select firms in the air industry code (SIC 4512) under the travel and leisure label. Several countries only listed one airline firm as at the time of study. DataStream facilitates the stock prices and indices in local currencies.

IBM SPSS Statistics

The IBM SPSS Statistics is an important tool when analyzing predictive and descriptive analyses including those coming from data from the coronavirus pandemic. The tool covers a powerful command syntax language making it possible to

perform behind the scenes. With the command syntax from this tool, programing is flexible, new data or problems are easily adapted, and instructions for future outcomes are saved. The coronavirus statistics and research website is an important part of this research since it has highly useful information that helped this research, it contains exact dates.

The excel data files for this research are not an SPSS Statistics file (*.sav) therefore the application must first receive the file as an import. The file is a .csv data therefore command syntax is another way of reading the data into SPSS statistics. For the application to receive the file, the command syntax is used as follows; In the SPSS Statistics, a new syntax Editor session is opened then File is selected, new then Syntax See figure 1

```
PRESERVE.
 SET DECIMAL DOT.

 GET DATA  /TYPE=TXT
   /FILE="/<path>/Covid_data.csv"
   /ENCODING='UTF8'
   /DELIMITERS=","
   /QUALIFIER='"'
   /ARRANGEMENT=DELIMITED
   /FIRSTCASE=2
   /DATATYPEMIN PERCENTAGE=95.0
   /VARIABLES=
   date AUTO
   location AUTO
   new_cases AUTO
   new_deaths AUTO
   total_cases AUTO
   total_deaths AUTO
   /MAP.
 RESTORE.
 CACHE.
 EXECUTE.
 DATASET NAME DataSet1 WINDOW=FRONT.
```

Figure1: SPSS Statistics, a New Syntax Editor Session is Opened then File is Selected.

The path on the file subcommand is changed to reference, directory where the covid_data.csv or 2020_01_01 JobId1904530_Data file is located on the system. The file is a simple is structure containing several variables such as departure airport, arrival airport, location variable, new daily cases, and total recorded cases among others. This part of the research aims to analyze the number of cases recorded in different locations daily. The date variable information is converted into an SPSS statistics recognizable format because of a mismatch with the date variable in the data file.The replacement syntax is as follows in figure 2

```
COMPUTE date=REPLACE(date,'-','/').
 EXECUTE.
 ALTER TYPE date (A10 = SDATE10).
 VARIABLE LEVEL date (ORDINAL).
 VARIABLE LABELS date 'Date'
     /location 'Location'
     /new_cases 'New Cases'
     /new_deaths 'New Deaths'
     /total_cases 'Total Cases'
     /total_deaths 'Total Deaths'.
 FORMATS new_cases TO total_deaths (F8.0).
```

Figure 2: The Replacement Syntax.

FINDINGS AND DISCUSSIONS

Regional Effects of Covid-19 on International Passenger Traffic

The pandemic highly disrupted operations within the aviation industry. A percentage air traffic reduction of 57.35 was suffered in the Middle East locale, with Africa following with a 53.56% reduction. A 52.61 % reduction was recorded in Europe, Latin America, and the Caribbean suffering a 48.4 % reduction. Flight operations in the Asia-Pacific region were most disrupted with a reduction in flights by 4,913,303 from 2019. Europe and North America also recorded a reduction in flight operations from 2019 by 4,766,279 and 3,211,278 respectively. The discussions in this section can be explained using figure 3 below, which shows the effects of Novel Covid-19 on Civil Aviation. [18].

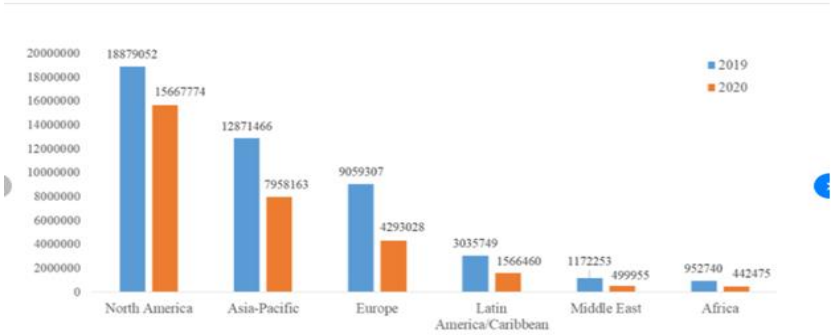

Figure 3: Effect of Pandemic on Flight Activities Regionally, January 2019 to December 2020.

Regional Effects of Covid-19 on Domestic Passenger Traffic

The number of domestic passengers that were observed during the pandemic posed a severe decline as compared to the number of passengers in 2019. In 2020, 30% of the world's local travelers were from China after overtaking North America that had less than forty million local travelers. Europe recorded 159 million domestic passengers while 123 million travelers were recorded in Pacific South East Asia, 75 million travelers were noted in S. America, S. W Asia recorded 73 million passengers with N. Asia noting 63million; 33 million passengers were recorded in Central America or the Caribbean.

Africa and Middle Eastern routes recorded the least figure of local travelers. The information on the effect of the virus on domestic passenger traffic can be further explained using the figure 4 below.

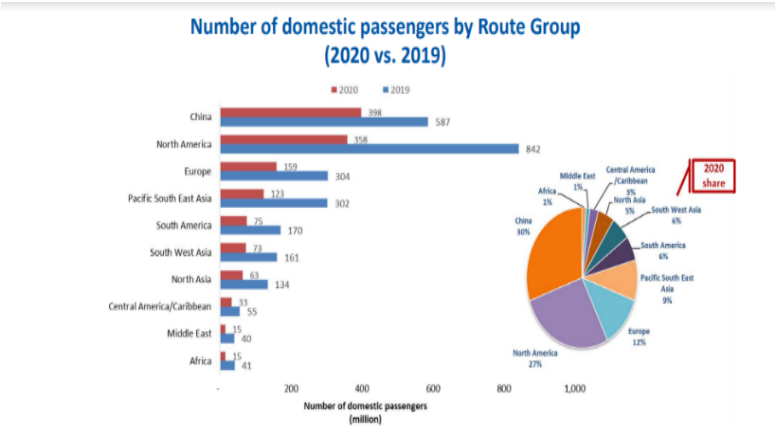

Figure 4: Number of Domestic Passengers per Route Group (Millions) [18].

Regional Effects of Covid-19 on Domestic Passenger Traffic

ICAO recorded that the pandemic led to low passenger traffic. The Asia-Pacific region suffered a severe loss of 120billion USD and a negative 921 million passengers. The European region followed the Asia-Pacific region suffering a 100billion USD loss and a negative of 769 million passengers. North America suffered an 88 billion USD loss in revenue following a reduction of 599 million passengers.

Middle East region covering a 132 million-passenger reduction suffered a 22 billion USD loss, Africa region ranks lowest on the loss sector since it was observed to have less number of passengers. Africa suffered a 14 billion USD loss in revenue following 78 million reductions in passengers during 2020 as described by the diagram below [18].

Effect of Covid-19 on International Passenger Traffic

The number of passengers that traveled in 2019 when compared to those that traveled in 2020 within the same regions shows a sharp decline in numbers. Travelers around the European and Asia/Pacific region contributed 70% of the international traffic in 2020 while travelers from the Middle East, North America, Africa, and the Caribbean contributed 30 % as shown in the figure 5 below.

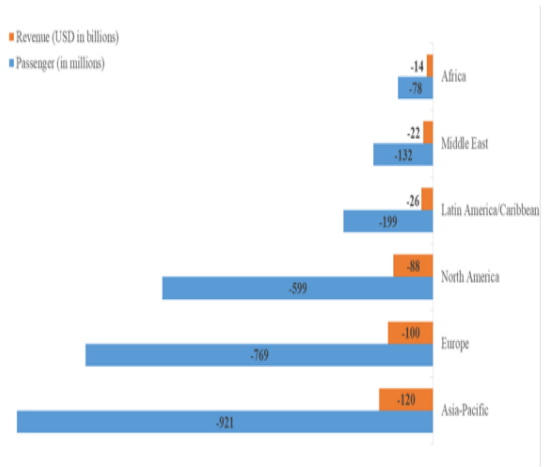

Figure 5: Effect of the Virus on Traveler Traffic and Revenue [18].

PEST Analysis

The global pandemic situation has posed economic setbacks following the declining profits and margins and increased operating costs. This study involved PEST analysis to help in the quantitative analysis of the aviation industry with the pandemic in the course. The findings are then presented in the study.

Political analysis –The airline industry has suffered a major shakedown as several authorities have imposed tough conditions to curb the spread of the disease. Several states have restricted travel daily regarding the number of daily reported cases. Governments have prioritized the safety of their citizens. Various governments have offered economic support to their airlines for example Europe funded some airlines such as Air-France with 7B euros, British Airways 9.37B euros, and Lufthansa with 9B euros [20].Government support was extended to several airlines such as 600M euros for EasyJet, 12.7B euros for Norwegian Air, 600M euros for Ryanair, and 500M euros for Virgin Atlantic [21].

Economic analysis –When addressing the effect of the virus on the global aviation sector, the first factor to be considered is likely the economic impact the pandemic has posed to the industry. Closure of borders and travel restrictions

is an economic disaster in the airline industry, the total number of travelers was also significantly decreased. In 2020 there was a 100B USD setback in revenue in Europe by the airline sector with the United States recording an estimated 88 billion USD loss in revenue. The loss in the Asia-Pacific region was estimated at 120 billion US dollars [22].

Social analysis –Apart from the association between family, relatives, friends, neighbors, co-workers among others, there exist several ties among countries. Inter-state relations may also be represented by the proper treatment of tourists in the neighboring countries. Many people fear traveling due to the pandemic, tourism is therefore also greatly impacted [23]. The pandemic has reduced relationships at all levels from the society to inter-state levels. It is during the pandemic that increased cases of mental health problems, has been reported [24], [25]. Various governments put in place measures such as lockdown and curfew to protect their people however, instead of promoting healthcare this issue has raised mental health concerns even as WHO advises on mental health awareness [26].The analysis by WHO is to enable identification of the problems, risks and discuss solutions using technology.

Event Study

This part of the research was mainly concerned with the three events mentioned in the methodology section. The event window period [-5, +5] posed cumulative abnormal returns which are discussed in averages in this section with the aid of a table diagram. Stock prices in the global airline industry suffered negative impacts from all the events despite global stock traders underestimating the effect of the first event. The event posed minimal negative impact thus not attracting the attention of global markets. In the second event, Italy had a severe impact.

The table .1 below presents the situation experienced in different countries during three-occurrence timelines for 3 general occurrences based on specific states. Most cases present a negative mean and middle value on the cumulative irregular return especially during the event date and five days post-event [0, +5]. Parametric and nonparametric tests are employed for mean and middle values equality. The t-test is an emphasis on the nonparametric tests providing the same results with higher statistical significance. The results are presented in three phases pre-event, during the event, and after the event. During the period [-5, 0], event 2 presents the most significant results.

Negative abnormal returns are witnessed in U. S, India, South Korea, and Thailand. Five days prior occurrences 1 and 3 witness a close difference from zero in mean and middle equality tests implying an under-reaction phenomenon. Explanations from this finding include traders expecting the disease to spread to particular regions [27].In addition, investors do not anticipate that lockdown policy in different states will shatter the performance of cross-country airlines, generally underestimating the effects of the pandemic on worldwide economic situations. The pre-event window period allowed the investors to take the information into account therefore the occurrence date for any of the occurrences does not pose abnormal results.

Event 3 exposed Australia, China, and Canada's stock markets to significant negative returns. As discussed earlier in the PEST analysis on government remedies [28], Asia-based airline stock is not asaffected as the other airline stocks. Korea Development Bank following aided airlines with cash setbacks following a directive from the South Korean government in February 2020 while the same year in March the authority provided the capital [29], [30]. The table.1 below presents cumulative irregular returns during the different event timelines in individual countries.

Table 1: Cumulative Irregular Returns During the Different event Timelines in Individual Countries

Market	Timeline	Occurrence 1 (13th January 2020)			Occurrence 2 (21st February 2020)			Occurrence 3 (11th March 2020)		
Pre-event										
		Mean	**Middle value**	**t-test**	**Mean**	**Middle Value**	**t-test**	**Mean**	**Middle Value**	**t-test**
Australia	[-5, 0]	-2.41	-2.40	-2.440a	-0.29	-0.47	-0.249	-17.84	-14.57	-2.836
Canada	[-5, 0]	0.97	-0.10	0.617	−3.41	−2.77	−1.366	−4.63	−6.23	−1.947
China	[-5, 0]	0.99	-0.10	1.109	1.64	0.25	0.883	7.07	6.15	4.393
India	[-5, 0]	8.16	2.02	1.023	2.91	1.10	1.405	−2.86	−0.30	−0.892
S. Korea	[-5, 0]	-3.24	-4.23	-1.540	−4.62	−6.07	−2.172	−1.55	0.51	−0.345
U. S	[-5, 0]	-3.29	-1.89	-1.776	-3.12	-3.45	-6.436	−0.54	−2.50	−0.179
On-event										
Australia	[0, 0]	0.67	0.38	1.553	0.26	0.34	0.273	−4.20	−4.83	−4.172
Canada	[0, 0]	0.53	0.48	1.472	−1.38	−0.52	−1.628	−3.77	−4.36	−3.143
China	[0, 0]	−0.13	−0.40	−0.263	−1.15	−1.66	−1.863	3.59	2.63	3.533
India	[0, 0]	0.57	0.07	0.399	0.13	0.00	0.778	−3.06	−3.99	−2.938
S. Korea	[0, 0]	−0.50	−0.70	−0.874	−0.13	−0.36	−0.171	−0.20	0.95	−0.175
U. S	[0, 0]	−0.91	−0.69	−2.658	0.38	0.25	1.254	−1.45	−0.72	−1.303
Post-event										
Australia	[0, +5]	−0.48	−1.96	−0.263	−8.78	−6.27	−2.089	−25.10	−28.87	−3.441
Canada	[0, +5]	0.05	−0.12	0.040	−5.66	−5.79	−2.215	−36.89	−49.95	−3.311
China	[0, +5]	−2.75	−4.76	−1.545	−2.86	−3.60	−1.323	−2.79	−2.36	−1.544
India	[0, +5]	0.57	1.73	0.319	−0.86	−0.93	−0.337	−6.71	−5.44	−0.870
S. Korea	[0, +5]	−2.38	−3.95	−2.108	5.31	3.62	0.957	−8.24	−3.15	−1.947
U.S	[0, +5]	−3.27	1.07	−0.706	-10.62	-10.69	−8.436	−32.42	−38.53	−3.285

Event 3 directly affects the U.S, therefore, posing a dramatic impact on the global airline industry. The results presented in this finding are robust such that the estimation window is varied following the year 2019's second half data. The periods between [-5, 0] to [-1, 0] and from [0, 1] to [0, +5] allow the redefinition of pre-event and post-event windows respectively.

RESEARCH SUMMARY

In summary, the Coronavirus pandemic has disrupted the economies of various sectors globally. This research investigates the impact the global airlines have faced from the pandemic. To effectively cover the topic, the research has employed comprehensive means to discuss the issue. An event study is the main methodology that has facilitated the study, in addition to event study, IBM SPSS, PEST analysis; EXCEL tools have facilitated the study.Like every other sector, the airline industry was not prepared for such a pandemic and was one of the most hit sectors. According to the findings, world passenger traffic suffered a negative 60 %, which is like no other in the airline industry. Moreover, the pandemic is still ongoing therefore; various state governments should consider ways of helping in the revival of the sector.

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