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Martin Hrubý

COVID-19 and the Aviation Industry: Economic Impacts and Policy Responses

Master thesis

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Author: Martin Hrubý

Supervisor: Ing. Petr Balcar, M.Sc.

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Abstract

This thesis uses a combination of trend analysis and MACBETH/MABAC multiple criteria decision-making methods to assess the financial impact of the COVID-19 pandemic on the financial health of the aviation industry in 2020. It also examines the efficiency of government measures adopted to mitigate such impact by comparing the results with a hypothetical scenario where no government aid was provided in 2020. The findings show that the novel coronavirus pandemic significantly increased the probability of default across the studied airline sample and had a strong negative impact on profitability. Furthermore, the data indicates that government support improved the overall financial fitness of the studied sample and significantly reduced the probability of bankruptcy while having only a minimal effect on airline profitability. We analyze the mechanisms behind the identified trends and provide explanations that indicate room for improvement in future research.

Keywords

Aviation, Airlines, COVID-19, Government Support, MABAC, MACBETH, Financial Impacts

Range of thesis: 102,675 characters

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Costa Adeje, August 18, 2020 Martin Hrubý

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Master Thesis Proposal

Institute of Political Studies
Faculty of Social Sciences
Charles University in Prague

Date: 15.06.2017

Author:	**Martin Hruby**	Supervisor:	Ing. Petr Balcar, M.Sc.
E-mail:	martin.hruby@pelta.eu	E-mail:	balcar.petr86@gmail.com
Phone:	+421 908 054 124	Phone:	...
Specialization:	IEPS	Defense Planned:	September 2021

Proposed Topic:

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Topic Characteristics / Research Question(s):

Air travel constitutes an essential pillar of our modern globalized society connecting people, businesses, and even governments. The recent crisis triggered by the COVID-19 pandemic, resulting travel restrictions and slump in demand, has had an unprecedented impact on the aviation industry as a whole. Given the industry's strategic importance, governments around the world provided substantial amounts of funds to keep the industry afloat. This thesis aims to quantify the economic impact of the pandemic on this part of the economy and infer about the efficiency of government support in mitigating it.

Working hypotheses:

1. COVID-19 had a significant negative economic impact on the aviation industry.
2. Governments provided substantial amounts of aid to the aviation industry.
3. Relief measures provided by governments improved the financial health of airlines.

Methodology:

In the first part of the thesis, we will synthesize the existing body of knowledge on COVID-19 impact on the aviation industry and related government measures to understand the research context better. We will then use the framework developed by Kiraci (2019) to empirically analyze the financial mechanisms with which the novel coronavirus impacted the aviation industry and assess the effectiveness of state aid provided as a response to the crisis. The method combines traditional multi-varied trend analysis with MACBETH and MABAC multiple criteria decision-making methods to enable a holistic analysis of the financial fitness of an

airline. For the purposes of our research, we will use income statement, and balance sheet information gathered for time period of 2015 and 2020.

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Outline:

1. Introduction.
2. Literature review: characteristics of air transport industry, impacts of previous shocks, determinants of government support, government support provided as a response to COVID-19
3. Methodology and Data: Description of variables, Trend Analysis, MACBETH method, MABAC method
4. Results.
5. Discussion
6. Conclusion and recommendations.

References / Bibliography:

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1 Introduction

From the time, when the first scheduled passenger flight took off in 1914, the Aviation industry has come a long way. Widely regarded as the safest form of transportation, the air travel is an essential pillar of the modern globalized economy. It allows businesses to tap into foreign markets, employ people from all over the world as well and increase the efficiency of their operations. On the consumer side, it connects people with their relatives, allows them to study and work abroad and travel far and wide. For governments, air transport constitutes a strategic sector essential for economic growth and investment that quickly connects even the most remote parts of their territory and by doing so significantly contributes to country's development cohesion.

Since its inception, air transport has displayed a remarkable growth. Even though there were several recessions and "black swan" events in the past that caused a temporary slumps in demand, they were always relatively short-lived and followed by periods of strong expansion. Now, however, the sector is facing an unprecedented crisis. In late 2019, news about an unknown virus, discovered in Wuhan, China, started to appear. Few months later, the virus spread into most countries of the world, was labeled COVID-19 and declared a global pandemic by the World Health Organization. A surge of border closures and travel restrictions that followed caused air passenger numbers to plummet and the whole industry to practically come to a standstill with most of the world's fleet grounded. With airlines burning cash at unprecedented rates, governments around the world came to rescue and provided large amounts of government aid.

The goal of this thesis is to quantify the financial impact of COVID-19 health crisis on aviation industry and make conclusions about the effectiveness of government measures on its dampening. This chapter will provide an introduction to our study by first discussing the context and background of our research problem, its aims, importance and ultimately limitations.

Given the general importance of the industry, the impact of the novel coronavirus on aviation has been studied extensively in the recent months by international organizations (e.g., IATA 2020; ICAO, 2020; OECD, 2020), nation states (e.g., Congressional Research Service, 2020) as well as by individual

researchers (e.g., Suau-Sanchez et al., 2020; Amankwah-Amoah, 2020). However, the existing research focused mostly on describing operational performance of the industry as a whole and analysis of government support from the policy design perspective. As a result, the existing body of knowledge lacks understanding of the crisis impact on individual airlines and the relationship between government support and airline financial health.

Given this shortcoming, our research will aim to identify and comprehensively evaluate impact of COVID-19 on industry's financial performance and the efficiency of government measures in mitigating this impact. In order to achieve this, we set the following research objectives: firstly, to identify how COVID-19 pandemic impacted overall financial health of airlines worldwide; secondly, to understand what governments did to support the industry in unprecedently difficult times; and finally, to assess the effectiveness of the government measures in reducing the impact of the crisis. We will attempt to achieve the abovementioned objectives by answering following carefully constructed research questions.

RQ1: How did COVID-19 pandemic impact the impact the financial health of airlines around the world?

RQ2: What policy designs did governments use to provide relief to air travel industry during the crisis?

RQ3: Were the government measures successful in improving the financial performance of airlines?

Our research design uses modified framework originally developed by Kiraci (2019) to assess financial performance of airlines in the period of 2015-2020 as well as in a hypothetical absence of government measures. The method can be described as a combination of multi-aspect trend analysis and multiple criteria decision-making methods MACBETH and MABAC.

This study will contribute to the existing research by developing an approach that will help policymakers around the world assess the public

expenditures towards airline industry and develop better industry and company-specific policies.

The thesis is structured as follows. In chapter one, we introduced the context of our study, identified research objectives, questions and discussed possible value of our contribution. In chapter two, we will characterize aviation industry as a whole and provide evidence supporting its importance in today's world. Chapter three uses the existing body of knowledge to examine the impact of previous downturns on the industry. Furthermore, we will explain in detail how the novel coronavirus pandemic impacted the air transport industry throughout 2020 and how airlines reacted to the crisis environment. Theoretical determinants of government support and government aid provided around the world in 2020 are discussed as well. Next, we will introduce the research design and data used and explain the steps involved in our calculations. Results of trend analysis and MABAC method are presented in the following section. Finally, the two last sections are dedicated to discussion and summary of our findings as well as possible implications and limitations.

2 The Aviation Industry

According to Bowern and Rodrigue (2020), air transportation is defined as the "*movement of passengers and freight by any conveyance that can sustain flight.*" Therefore, the air transport industry can be defined as an aggregate of enterprises whose primary business activities are related to such movement of passengers and cargo. Air transportation could not operate independently and instead relies on a long list of upstream sectors, including aircraft manufacturers, airport operations, various support service providers and leasing companies (OECD, 2020). All the sectors are jointly referred to as the aviation industry. Thus, although the terms of aviation and air transport industry are used interchangeably even in academic literature, the latter constitutes de facto a subset of the more broader term. While military aviation is technically part of the aviation industry, we will not consider it for the purposes of this thesis.

Airlines constitute a foundation for the entire aviation ecosystem and directly influence the strategy and activity of other aviation sectors through shared ownership, as is often the case with airports or through demand in the case of airplane manufacturers, leasing companies, and service providers (OECD, 2020). Therefore, market forces impacting airlines are projected to the rest of the aviation industry through the abovementioned mechanisms. As such, we too will be using the two terms interchangeably and, for the sake of simplicity, narrow down the scope of analysis to airlines in later chapters of the thesis.

In 2019, 4.5 billion passengers boarded 46.8 million flights on 48,044 routes traveling together a staggering 8.68 trillion kilometers (ATAG, 2020). Air transport is viewed as a critical enabler of the modern globalized economy (OECD, 2020). "*As the only rapid global transportation network, it facilitates links between businesses, governments and people – enabling world trade, investment, tourism and travel among other key economic activities*." (IATA, 2020).

Air transport plays a crucial role in global trade by enabling access to international markets and "*facilitating globalization of production and supply chains*" (IATA, 2020). While 4-5 times more expensive than land and 12-16 times more expensive than sea transport, air freight provides the fastest way of moving goods, especially over longer distances, and guarantees more predictable delivery times. According to Oxford Economics (2008), studies show that improving

shipping schedules significantly impacts global trade growth. Medical supplies, perishable products, essential documents, and electronics are among commodities often shipped by air (Worldbank, 2009). Additionally, air transport significantly improves just-in-time production, which requires a timely supply of parts throughout different production phases and locations (Oxford Economics, 2008). In 2019, 61 million tons of cargo with a cumulative value of $6.5 trillion were transported by air (ATAG, 2020), representing around 35% of global trade by value but only less than 1 percent by volume (IATA, 2020), indicating a high unit value of goods transported this way.

Trade and investment are closely related, and the benefits mentioned above also impact domestic and foreign direct investment (Oxford Economics, 2008) and, in turn, expand the production capacity of an economy (IATA, 2020). This creates a key trigger for long-term economic growth. Analysis performed on EU countries jointly by IATA and Oxford Economics empirically proved a correlation between air connectivity and long-term productivity. Based on their findings, "*a 10% increase in the level of connectivity, relative to the GDP size, can increase long-run GDP by 1.1%"* (IATA,2020). Not only does air connectivity enable access to both international customers and suppliers, but as Bel and Fageda (2008) point out, it also constitutes an essential consideration criterion for the location of corporations' headquarters. In 2006, IATA conducted a survey in Chile, the Czech Republic, China, France, and the United States, during which they asked several hundred companies from different sectors of the economy about their perceived importance of air transport. Companies reported that, on average, 25 percent of their sales depend on the presence of a good air transport network, with technology companies reporting the highest dependency. Around 80 percent of respondents reported that air transportation directly impacts their production efficiency, and 70 percent reported that it allows them to tap into economies of scale in a way they would not be able otherwise (IATA, 2006). With the increased accessibility of air transport and an even more globalized economy, we can expect that the reported percentages would be significantly higher if the survey were conducted today. Having access to an extensive network of air connections also enhances specialization and allows for a more efficient allocation of resources (IATA, 2020).

Several industries rely on aviation to provide access to their prime customers, most notably tourism. World Tourism Organization (2020) estimates

that around 58 percent of all international travelers used air as the mode of transport in 2019, making it a critical direct enabler of international tourism. Air transport constitutes almost an exclusive access point in certain countries, such as the Philippines, where 98 percent of all tourists arrive by air (Zajac, 2016).

Beyond already mentioned benefits, air transportation allows for better access to education and helps to establish new and maintain existing social relationships in the present, increasingly interconnected world. According to OECD (2020), 4.6 million students were enrolled in a program abroad, and their number has been steadily growing for the past 20 years. Similarly, it allows corporations to access a broader pool of potential employees. Once abroad, air transport facilitates contact between migrants and their home country. Maintaining connections between a migrant and their relatives back home often results in a payment of remittances which often constitute an essential source of income, especially for developing countries (Oxford Economics, 2008).

In 2020, Air Transport Action Group (ATAG) (2020) tried to quantify the importance of air transport in the economy using input-output methods on 2018 data. According to their findings, the aviation industry contributed $3.5 trillion to the world's GDP, which translates to around 4,1% participation and would position it in the 17th place in terms of GDP if it were a country. Within this amount, ATAG identified four distinct subsectors based on their relationship with air transport. Direct channel, including operational expenditures of carriers, airports, other on-airport services, and navigation services providers, contributed $961.3 billion. According to the authors, $816.4 billion came from the indirect channel that could be defined as "*the aviation sector's procurement of inputs of goods and services from other businesses in the economy*." Wages to aviation industry employees spent in the economy, labeled as the aviation-induced channel, amounted to $692.8 billion, and finally, $1 trillion was generated in tourism enabled by air transport. The same analysis estimated that the aviation industry supported around 87.7 million jobs in 2018, including again direct, indirect, aviation-induced, and tourism catalytic sectors. ATAG claims that aviation jobs have 4.3 times higher productivity than other jobs in terms of gross value added (GVA). Additionally, based on Oxford Economics (2008) estimates, every job created within air transport triggers creation of more than one job along its supply chain.

The sector's importance in the economy stems from more than just direct economic effects. Oxford Economics (2008) states that aviation "*diffuses the knowledge gained from investment in research and development and multiplies the effects of innovation across economies*."

Several countries depend on air transport as it is often the only way of connecting remote areas such as islands. Air transport, in those cases, constitutes a key determinant of economic and social cohesion as well as development convergence (OECD, 2020). Furthermore, accessibility can play a crucial role in preventing the outflow of the skilled labor force (Airports Council International, 2004). Fare prices for routes connecting important peripheries are often subject to government regulation and even subsidies. In the European Union, "public service obligations" (PSOs) have been imposed on various air routes. PSO mechanism is usually used if a route is viewed as a necessary peripheral connection but is unlikely to be commercially viable. In such case, the government may give exclusive access rights to a single airline and provide compensations for losses incurred while operating a PSO (European Commission, 2021). In Spain, for example, PSO agreements have been in place since 1998 on interisland connections (Martin-Cejas, 2021).

3 Literature Review

3.1 Impacts of Previous Economic Shocks on Aviation Industry

The last ten years in the air travel industry before the COVID-19 pandemic had been characterized by strong expansion driven by passenger and cargo demand growth, with an average year-on-year growth in passenger demand of 6.3 percent[1], making it one of the best decades in industry's history (Kearney, 2020). Even before, despite several disruptive events, the industry had been growing steadily year on year.

Before 2020, according to (Franke, John, 2011), there were only two instances in history when air traffic reported negative growth: First Gulf War in 1991 and the period between 2001 and 2003 when the terrorist attacks on World Trade Center in September 2001, known as 9/11 event, were followed by the outbreak of Severe Acute Respiratory Syndrome (SARS). As the authors point out, 2001 was a particularly challenging year for aviation. A joint effect of lingering economic downturn triggered by the burst of the "dot.com" market bubble three years before and the events of 9/11 resulted in what was, at the time, regarded as the worst airline crisis in history (Franke, John, 2011). Five months after the attacks, demand for air travel was 31 percent below the previous year (CNBC, 2020) , and several airlines struggled to remain afloat. It took four years for the demand to return to pre-crisis levels due to a double dip triggered by the SARS epidemic in 2003. According to Suau-Sanchez et al. (2020), prior to COVID-19, the SARS outbreak was the most significant disease-related disruption in aviation history and arguably one that most closely resembled the situation around the pandemic. According to WHO, SARS is a respiratory disease caused by a virus, that in approximately 10-20 percent of cases, requires hospitalization and potentially also mechanical ventilation (WHO, 2003). Ultimately, the virus infected 8000 people across 37 countries and resulted in a little less than 800 deaths, with victims concentrated mainly in China (OliverWyman, 2021). Monthly revenue passenger kilometers (RPKs) in May 2003, which was the worst month of the crisis, were 35 percent lower than the same month of the previous year (Suau-Sanchez et al. 2020). World Health Organization announced containment of the virus in July of the same

[1] Own calculations based on Statista data

year (OliverWyman, 2021). While traditional full-service carriers struggled to remain operational, low-cost carriers gained significant market share in the short-haul segment with a new unbundling business model (Apex Aero, 2020).

The financial crisis of 2008 represented another significant slowdown for the industry. Financial uncertainty prompted many people to think twice about their planned vacations and corporations to reevaluate the necessity of their upcoming business trips, resulting in a slump in demand for air travel. Airlines reacted by significant reductions in the workforce. Overall, passenger traffic fell by 2.1 percent in 2009, translating to a loss of $85 billion across the industry (IATA, 2010). While previous "black-swan" events caught the industry by surprise, the 2008 recession was, to some degree, anticipated and therefore resulted in fewer causalities.

Several other comparatively minor downturns have disrupted air travel in the past. Notably, there were two more disease-related "black-swan" events. The swine influenza (H1N1) outbreak of 2009 caused the first pandemic in over forty years (Clegg, 2010). Originating in Mexico in June, the disease quickly spread to the rest of the world, prompting WHO to declare a global pandemic just three months after the start of the outbreak. The pandemic lasted for a year and is estimated to have infected somewhere between 11 and 21 percent of the population at that time, causing 284,000 deaths (Roos, 2011). The economic impact of the pandemic on the air transport sector was especially noticeable in Mexican passenger traffic which recorded a 30 percent decrease in the immediate aftermath of the outbreak. (IATA, 2016).

The second event was triggered by an outbreak of the Ebola virus in Western Africa. Ebola virus causes a severe and often fatal illness and had been around for a while when the outbreak started in 2014. The Earliest records of the virus in Africa date to 1975, when it was first discovered in countries of Sudan and the Democratic Republic of Congo in an area surrounding the Ebola River (Amankwah-Amoah, 2016). All previous outbreaks of the virus were localized in remote populations. The index patient of the Ebola outbreak was identified in December 2013 in Guinea, and the virus quickly spread to the country's capital of Conakry. In August of the following year, as the virus spread to nine more countries in Western Africa, WHO labeled the situation as a Public Health Emergency of International Concern – a title reserved for situations that could potentially escalate to become an international threat (WHO, 2014). After resulting in more than 11,000 casualties

over the span of two and a half years, the outbreak officially ended in June 2016. According to estimations published by (Huber et al., 2018), the economic cost of the outbreak in Africa amounts up to $32.6 billion in lost gross domestic product and severely impacted air travel in the region.

It is important to note that disease outbreaks, in general, are especially disruptive for the industry as air travel is viewed as a significant transmission pathway (Sun et al., 2020). Airplanes aid the spread of diseases by facilitating spread between different geographical areas and allowing transmission of disease among passengers on board (Clegg, 2010). Not only do pandemics and epidemics cause a slump in customer demand but also prompt governments to establish travel restrictions that further impact air travel

In 2010, an eruption of the Eyjafjallajokull volcano in Iceland disrupted air travel in Europe. As a large cloud of volcanic ash traveled across European airspace during a period of eight days, approximately 48 percent of the regional air traffic was grounded for concerns over engine safety (Petursdottir, Reichardt, 2020), causing the most extensive civil aviation disruption in Europe since the Second World War (Oxford Economics, 2010). The total economic impact of the event on the air travel industry was estimated at €1.3 billion.

Overall, past periods of depressed demand led only to relatively minor decreases, followed by periods of accelerated expansion (Kearney, 2020). Based on the data collected from the Second oil shock (1979), Gulf War (1990), dot.com bubble and 9/11 (2000), and global financial crisis (2007), IATA (2015) estimated that one year following a disruptive event, 75 percent of the traffic impact persists with a reduction to slightly over 50 percent in year two and 20 percent in year five. IATA attributes this resilience to decreasing air travel costs (1.7 percent year-on-year on average since 1970) coupled upward trend in disposable income and living standards that allows more people to afford traveling by air.

3.2 Covid-19 and Aviation Industry

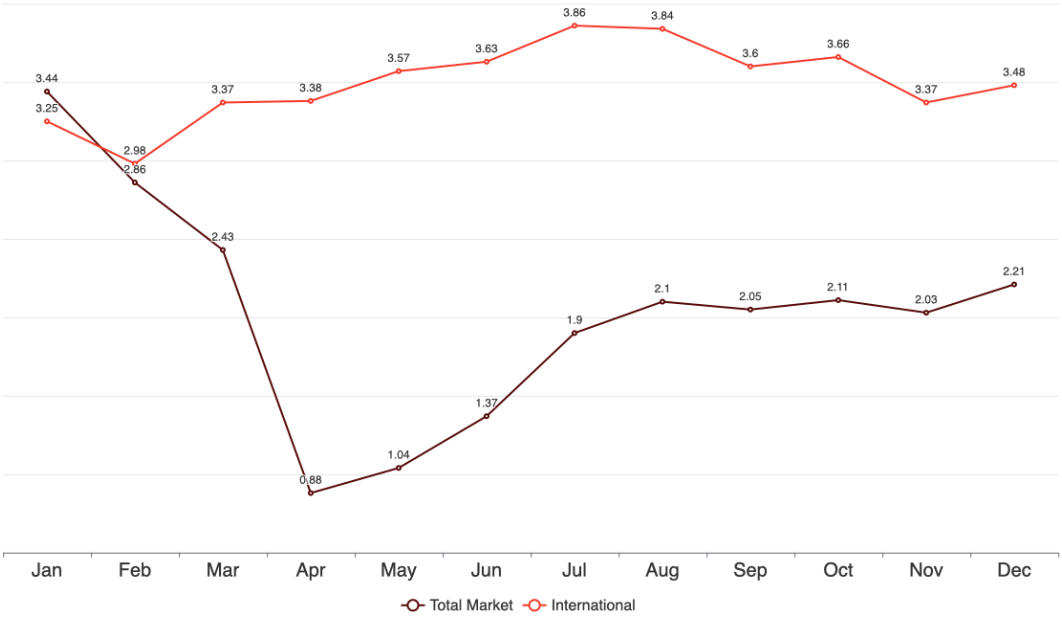
Early in December 2019, reports of severe pneumonia cases with seemingly unknown origin started to emerge around the city of Wuhan in China. Weeks later, using the samples taken from infected individuals, Chinese scientists managed to isolate a new virus strain belonging to the family of coronaviruses. (Cucinotta, Venelli, 2020). On January 30, 2020, the Emergency Committee of WHO labeled

the novel coronavirus a "Public Health Emergency of International Concern" (Velavan, Meyer, 2020) and a few days later officially named it COVID-19 to reflect the year when it first appeared as well as the viral family (WHO, 2020). During this time, cases started to emerge all over China, rest of Asia and even reached Europe and the United States. Despite the best efforts to contain the new disease, on March 17, WHO declared the situation a global pandemic. Mazareanu (2020) attributes the rapid spread of the disease to human hypermobility resulting from increased globalization as well as the Wuhan's accessibility during the outbreak. The position of Wuhan as an important air and rail hub, coupled with the increased traffic caused by the Chinese New Year, facilitated the rapid spread of the virus across the country and to the rest of the world (T Wu et al., 2020). As a response to the growing international concerns and an attempt to stop the spread of the virus, more than 130 countries had introduced a form of travel restriction by late April 2020 (Devi, 2020). Travel restrictions adopted throughout 2020 took different forms, including complete border closures, travel bans to certain areas, screenings or quarantine upon arrival. Such restrictions drastically reduced human mobility around the world, and the resulting negative impacts affected industries across the entire economy. Despite the launch of several ongoing vaccination schemes in 2020 and growing population protection, the emergence of new, potentially more contagious variants of the virus keeps nation-states from completely lifting the containment measures (Airlines for Europe, 2021).

The drop in customer demand for international transport due to infection concerns and an environment characterized by ever-changing travel restrictions meant that air transport was among the hardest-hit industries. The sector finished the year 2020 with a total amount of commercial flights 42 percent[2] below the previous year and right around the 1999 levels. As visible in figure 1, the number of flights reached the lowest point in April, then made a significant rebound during the summer months, taking advantage of the partially lifted travel restrictions, and stagnated again from August onwards. In December, we saw a slight increase in the volume that can be attributed to the holiday season.

[2] Own calculations based on data form Flightradar24

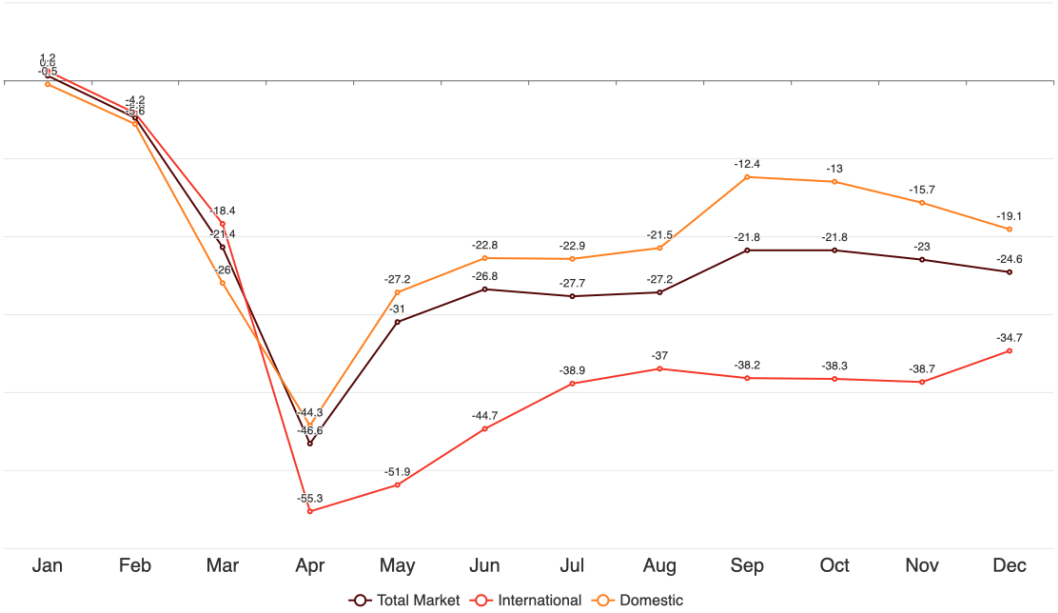
Figure 1: Total Number of commercial flights per month (2019 and 2020)



Source: Own representation of data from Flightradar24

In order to fully understand the magnitude of impact that the pandemic had on the industry in 2020, it is crucial to take a look beyond the absolute number of commercial flights. Passenger load factor (PLF) is an important metric commonly used in air transportation, representing airlines' capacity utilization (Statista, 2021). Figure 2 depicts the evolution of this indicator throughout 2020 in relation to the previous year. As was the case with the absolute number of commercial flights, the lowest PLF was recorded in April, with carriers flying with only 42 percent average capacity utilization presenting a stark contrast with 80 percent in the first month of the year. This represents a significant decline of more than 55 percent when compared to the same month in 2019. With travel restrictions targeting largely international travel, the load factor of domestic flights outperformed the international flights by a substantial margin.

Figure 2: Airline Passenger Load Factor % year-on-year change vs. 2019



Source: Own representation of data from IATA Economics (2021)

The disproportionally greater impact of the pandemic on international travel also affected the industry's performance across different geographical regions. Europe, Africa, and the Middle East, where international travel contributes to between 65 and 80 percent to the overall traffic, fared much worse than the North America and Asia-Pacific, with 16 and 30 percent of domestic travel respectively (ICAO, 2020).

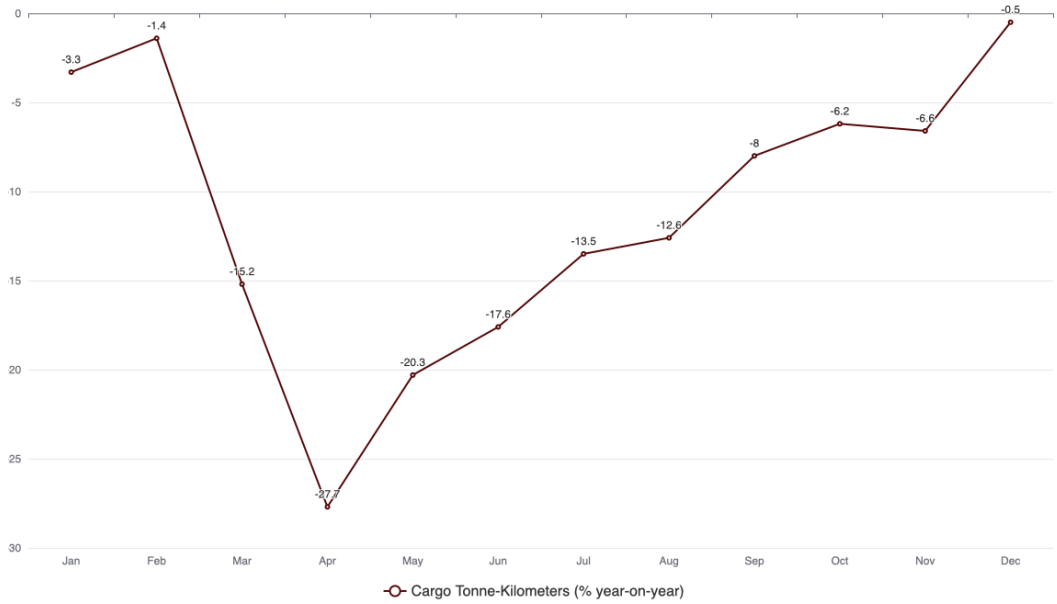
Another segment that was hit especially hard by the health crisis was business travel. According to Stalnaker et al. (2021), 75 percent of companies around the world completely suspended domestic business travel and 93 percent international business travel. Travel bans, constrained budgets, teleconferencing technology, and employee safety concerns were among the main drivers impacting suspension decisions (IATA, 2020). Overall, the business travel sector decreased by 85 percent in 2020, a number especially painful for the air travel industry as it is its most profitable segment. Events in the past have triggered decreases in corporate travel, but none of them to this extent. For example, the 9/11 terrorist attacks and the great recession resulted in 11 and 8 percent decreases, respectively (Pwc, 2020).

The relative absence of both international and business segments created significant financial pressure across the industry, with full-service carriers suffering the most. During the past event-triggered demand slumps, low-cost airlines proved

to possess an advantage over traditional full-service carriers due to lower operational costs while exhibiting comparable decreases in revenue generated per seat per mile flown. This does not seem to be the case for the COVID-19 crisis. According to Stalnaker et al. (2021), low-cost airlines have gained a revenue advantage as well as they are less dependent on business travel customers. In a normal year, corporate travelers represent only around 12 percent of passengers but can contribute to up to 75 percent of revenue on certain connections (PwC, 2020) and generate more than half of total revenues for a full-service airline in a normal year (Stalnaker et al., 2021). The decline of international and business travel forces full-service carriers to compete with their low-cost counterparts over domestic travelers, generally characterized by high price elasticity. This could create additional pressure on the already low margins in the industry, especially for full-service carriers.

Impacts of the pandemic on air freight were less dramatic, and airlines used this sector to partially offset their losses. Cargo tonne-kilometers (CTKs) represents one of the most commonly used performance indicators in the air cargo sector and reflects one metric tonne of revenue-generating freight transported over the distance of one kilometer (Eurostat). Figure 3 displays the evolution of this indicator with respect to the year 2019. While also experiencing the initial decline as demonstrated by April performance when global CTKs were around 28 percent below the previous year, the second half of the year brought about a significant rebound mainly due to the partial lifting of restrictions at the end of the second quarter and boom in e-commerce. The trend reversal was also influenced by the worldwide need to promptly distribute medical supplies such as face masks and vaccines (Albers, Rundshagen, 2020), as well as the decision of many passenger-oriented airlines to run cargo-only flights in the absence of passenger demand (Vinod, 2020). December's cargo tonne-kilometers were only 0.5 percent below the previous year. Overall, full-year cargo performance was 10.6 percent below 2019 levels. (OECD, 2021).

Figure 3:Cargo Tonne-Kilometers % year-on-year evolution (2020)



Source: Own representation of data from IATA Economics (2021)

The magnitude of the impact of the COVID-19 pandemic on the industry can also be seen when looking at the proportional relationship between GDP and passenger growth. (KPMG, 2021) Before the crisis, the industry boasted a worldwide GDP multiplier of 1.5x, which means that for each one percent of GDP growth, the number of passengers would grow by 1.5 percent on average (KfW, IPE Bank, 2016). At the end of 2020, however, global GDP was estimated to have contracted by less than 5 percent (KPMG, 2021), while the number of passengers recorded a year-on-year decline of more than 61 percent (Statista, 2021).

The absence of revenues throughout 2020 put cash flow management in the spotlight of the entire industry as an essential precondition for liquidity and, ultimately, survival (Vinod, 2020). In March 2020, an analysis done by IATA (2020) showed that 75 percent of their airline sample only had three months-worth of cash and cash equivalents to cover their expenses with a median of two months. Managing the cash flow of an airline became particularly difficult during the COVID-19 pandemic due to an increased number of flight cancellations. A significant proportion of cash held by an airline is composed of "unflown" revenue, i.e. cash collected for flights that have not yet departed (McKinsey, 2021). The increasing number of border closures in the second quarter of 2020 resulted in many planned flights being canceled and customers demanding refunds. While airlines

tried to mitigate the impact on their cash flow by providing travel credit, local customer protection laws in many cases forced carriers to issue such refunds, negatively impacting cash flow. According to Forbes (2020), only in United States, airlines issued $10 billion in vouchers in the first half of 2020.

Dramatic reduction in traffic volumes also forced carriers into the withdrawal of airplanes from service to reduce variable costs. At the peak of the crisis in April 2020, 62 percent of the world's passenger jet fleet was grounded (Cirium, 2020), leaving skies the emptiest they had been in the last 26 years (Time, 2020). Furthermore, many airlines stopped operations on routes with low profitability. Based on estimations of IATA (2021), the number of city pairs served worldwide was 33 percent below the previous year at the end of October 2020. While not in use, an aircraft still needs intensive and costly routine maintenance to keep it operational for future use. Nesting wildlife, corrosion, dust, or even landing gear tire deterioration are all among the problems that needed constant attention (Cirium, 2020).

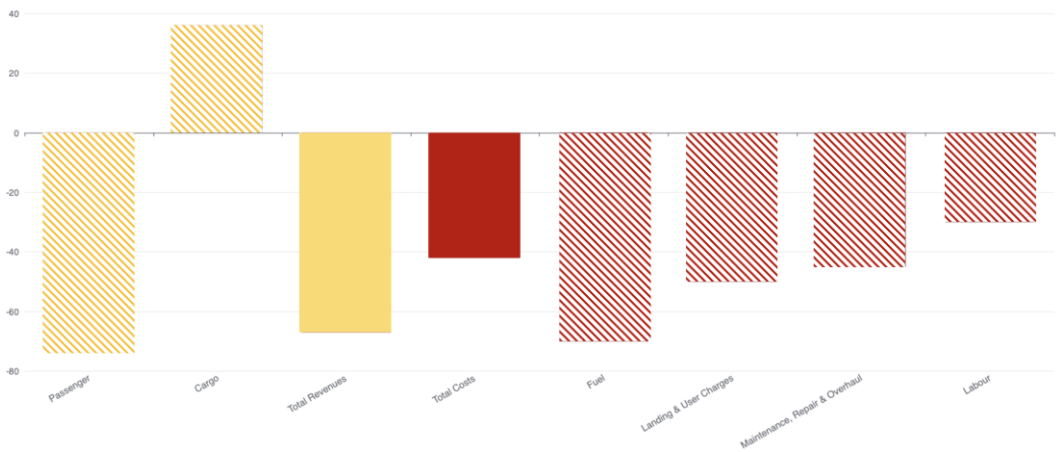
Furthermore, the unprecedented number of airplanes on the ground meant that carriers had to find a solution to a rising logistical problem of where to park them. Many carriers ran out of space in their own storage sites and had to resort to external providers instead, further increasing their expenditures. Many airports across the globe used their main operational areas, including runways, as storage spaces (Serrano & Kazda, 2021). Despite running maintenance and storage costs, IATA (2020) estimates that by the end of the second quarter of 2020, Airlines managed to reduce their variable costs by up to 70 percent. Grounding of the world fleet had negative repercussions on aerospace manufacturers that together reported a 55 percent reduction in production when compared against 2019, the worst result ever reported (OliverWyman, 2021). Further variable costs reductions were achieved naturally due to low oil prices throughout 2020. On average, fuel represents 25 percent of an airline's operating costs.

IATA (2020) estimates that approximately 50 percent of airline costs are fixed or semi-fixed, making it difficult to promptly react to slumps in demand. The next step shared among carriers to further reduce cash burn was short-term operational retrenchments (Albers, Rundshagen, 2020). Many airlines tried to reduce their expenditures by staff reductions either through layoffs or by taking advantage of furlough schemes provided by governments (GrantThorton, 2020).

However, staff reductions in the air travel industry only provide temporary relief and are generally associated with potential problems with operational flexibility in the future. The industry is characterized by a high proportion of skilled jobs that additionally require constant recertifications in order to comply with various safety requirements. Despite this, IATA's estimates (2021) show a cut of more than one million jobs among airlines in 2020, and according to ATAG (2021), the total loss of jobs across the entire supply chain could amount to 4.8 million.

IATA (2021), in their "*Airline Financial Monitor*," reported that carriers at the end of 2020 managed to reduce their total costs by an impressive 42 percent with sizeable reductions throughout variable and semi-variable cost items (as seen in figure 4). However, even if coupled with good cargo performance, this figure was still not enough to offset the drastic decrease in passenger revenue that had dropped to 2000 levels at $372 billion (IATA, 2021) and meant that the cash burn would continue. The net cash flow from operating activities across the industry at the end of the fourth quarter was -46.3 percent of revenues, with Europe being impacted the most at -58.3 percent, followed by North America (-47.6 percent), Latin America (-25 percent), and Asia-Pacific (-19.9 percent) (IATA, 2021).

Figure 4: Airline operating revenues and cost changes in 2020 vs. 2019



Source: IATA Economics (2021)

Overall, the year 2020 resulted in the worst global airline performance ever recorded, with a net loss of $126.4 billion, representing a staggering 575 percent decline from the previous year's $42.2 billion (IATA, 2021). A split of financial

results per region is displayed in Table 1 below, indicating that Latin America has incurred the most significant loss compared to 2019 while North America fared better than everyone else. This steep decline meant that already low industry margins practically evaporated and reached -33.9 percent for the full year.

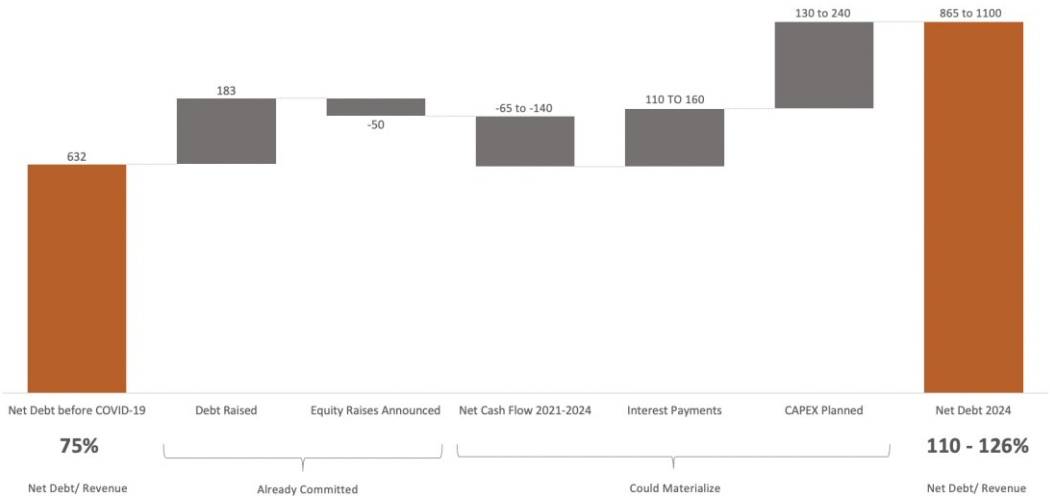
Table 1: Evolution of airline financial results by region and year (2015-2020)

Region	2015	2016	2017	2018	2019	2020
North America	21.7	17	17.8	14.5	17.4	-35.1
Europe	7.1	8.8	8.9	9.1	6.5	-34.5
Asia-pacific	7.5	7.4	10.5	6.1	4.9	-35
Middle east	2.1	1.3	0.1	-1.5	-1.5	-7.9
Latin America	-1.6	0.4	0.5	-0.8	-0.7	-11.9
Africa	-0.8	-0.4	-0.2	-0.1	-0.3	-2.0
Worldwide	36	34.2	37.6	27.3	26.4	-126.4

Source: IATA Economics (2021)

According to Centre for Aviation (2021), 33 airlines ceased operations during the year, with the highest number of failures being located in North America (11) and Europe (9). Most airlines, however, managed to survive the crisis so far, which can be attributed mainly to the amount of government support that was provided throughout 2020. Airlines also raised substantial amounts of debt and equity on their own, thanks to the robust stock market and low interest rates (Centre for Aviation, 2021). McKinsey (2021) estimates that the industry collectively accumulated $180 billion of debt and $50 billions of equity by November 2020. They warn that if no measures are taken, low predicted cash flow coupled with interest payments and increased capital expenditures associated with capacity restoration could mean that debt outgrows revenues by 2024 (see figure 5). This would significantly increase leverage in an already highly leveraged industry and lead to a significant increase of ticket prices (McKinsey, 2021).

Figure 5: Airline industry financing need and net debt (figures in $ billion)



Source: McKinsey (2021)

According to the forecast done by McKinsey (2021), 2019 levels of revenue passenger kilometers are not expected before 2024. They predict that business travel recovery will trail behind leisure and visiting friends and relatives (VFR) bookings and will only reach 80 percent of 2019 levels by 2024. Stalnaker et al. (2021) attributes this trend to teleworking skills acquired by employees during the curfew periods and technology investments made by companies around the world to enable it. Based on a survey conducted by McKinsey in early 2021, we can expect a significant reduction of business trips related to internal meetings, conferences, and events as companies will try to reduce travel only to meetings with customers and supply chain partners.

3.3 Determinants of Government Support

Before the COVID-19 pandemic, most government interventions in the aviation sector focused on airplane manufacturers. Ensuring airplane safety and tackling the potential lack of investment in innovation, research and development due to the existence of significant economies of scale were among the top priorities. Growing environmental concerns were also translated into a number of regulations aimed at accelerating the transition to more environmentally friendly airplanes (OECD, 2020). Additionally, governments and international bodies often stepped in to

enhance the safety and security of passengers, especially in the period following the 9/11 attacks.

Since the onset of the crisis, air transport has been to a varying extend affected by several general measures aimed at reducing the negative social impact of the pandemic on the economy as a whole (OECD, 2021). However, this sector, in particular, has received a lot of targeted attention from policymakers all over the world as well. This one and the following part of the thesis will focus on understanding the main drivers behind this trend. While doing so, we will draw upon works of Abate et al. (2020) extensively as they presented one of the very few comprehensive theoretical assessments of the pandemic-related government relief measures.

According to Abate et al. (2020), the evidence from the months following the outbreak of the COVID-19 pandemic suggests that governments, in general, tend to give a high priority to protecting the air transport industry in order to conserve both direct economic activity and jobs in aviation as well as in sectors that are either in aviation industry's supply chain or are to a varying degree enabled by it such as tourism. Zhang and Graham (2020) suggest that, from the perspective of policymakers, air connectivity has strong spillover effects on economic growth. Furthermore, OECD (2020) adds that passenger and cargo transportation can be considered a public utility associated with significant potential adverse effects on the economy and society as a whole in its absence. Additionally, they argue that the competitiveness of the national business sector could, to a large extent, depend on the survival of a national carrier and the presence of at least one international hub airport. Many of the presented arguments could apply to different sectors of the economy as well and therefore an argument could me made against targeted government measures. Public policies aimed at achieving more general policy goals such as promotion of healthy business environment and competitive landscape could provide a viable solution (OECD, 2020). However, presence of strong economies of scale meant that replacement of a failed carrier could pose significant challenge.

While air transport plays undoubtedly an essential role in every country's economy and its support should therefore be well justified, it is important to note that such support without careful consideration can pose a serious threat to both the

industry's dynamics and the broader policy goals such as sustainability or efficiency improvements.

Abate et al. (2020) found several variables that have a statistically significant correlation with the willingness of governments to provide coronavirus-related aid to the aviation industry. Among the country-specific variables with positive correlation in regards to both the willingness of governments to provide coronavirus related aid and the amount of resources allocated were: country's wealth, the number of domestic carriers, the magnitude of the financial impact of the pandemic, country's dependency on international markets and sector's relative importance in the economy. Kearney (2020) added two additional variables of airline size and financial health, focusing more on the problem of aid allocation rather than whether the support would be provided at all. Their contribution is purely theoretical and lacks empirical evidence.

3.4 Classification of Support Measures and Their Potential Implications

In their paper titled *Government support to airlines in the aftermath of the COVID-19 pandemic*, Abate et al. (2020) mention two distinct forms a state aid can take in relation to the aviation industry: selective subsidies to carriers and other companies across the aviation supply chain or interventions that prevent the market entry of potential competitors. In order to better understand the relief measures taken as a response to the COVID-19 health crisis, they further classified them into seven subcategories: "*government-backed commercial loans and government guarantees; recapitalization through state equity; flight subsidies, nationalization; deferral and/or waiver of taxes and charges; grants; and private equity*." (Abate et al. 2020). From their point of view, while all the abovementioned support types will undoubtedly increase the involvement of the public sector in the aviation industry in the short- to medium-term, it is the nationalization and recapitalization that are most likely to result in extended government presence due to their impact on corporate structure.

It would mean a reversal in the mainstream industry trend that has been at least until now characterized by privatization and deregulation. Both processes have been associated with increased competition, better airline financial performance, lower customer prices, and higher flight frequency (Czerny, Lang, 2019). While

Abate et al. (2020) see the increased presence of the public sector as a possible hindrance in progress made in the areas mentioned above, in McKinsey (2021), they view it more as an opportunity for airlines to work closely with one of their key stakeholders. They argue that join efforts with governments could improve cooperation in areas such as labor flexibility, foreign capital caps, cash-on-hand requirements, or carbon emission standards. Additionally, it is crucial to delve into the potential impact of governments' involvement in the aviation industry's environmental impact – a topic that has been gaining more and more attention in recent years. While the commercial operations across the industry only produce around two percent of the global human-induced CO2 emissions, the rapid expansion of the industry in recent years resulted in a 30 percent increase in CO2 production between 2013 and 2019 with an average yearly increase of 4.5 percent (International Council on Clean Transportation, 2020) making it an important policy consideration.

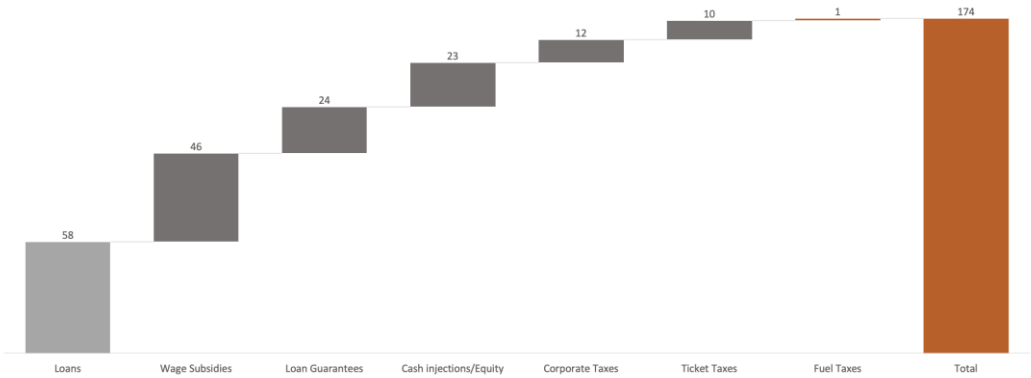
While the involvement of government support provides much-needed resources to the industry, it inhibits airlines' strategic and operational decision-making power. Conditions attached to many government support measures show the intention of policymakers to use the crisis to steer the industry towards a greener, more efficient future. However, Albers and Rundshagen (2020) argue that those conditions could potentially yield counterproductive results, especially in the case of multi-national airline groups that have received government funding from several governments, with each one attaching its strings. This could potentially put the airline in a position where it is facing competing legally and politically enforceable requirements.

3.5 Government Support Provided as a Response to Covid-19

According to McKinsey (2021), an estimated $174 billions of government support were provided to the industry (figure 6) which equals to approximately 50 percent of the total revenues of that year. The largest number of government relief transactions consisted of state loans ($58 billion) followed by different forms of wage subsidies ($46 billion) that together comprised more than half of all the support provided worldwide. State guarantees on debt provision and equity injections were also among prevalent types of government support contributing together around $47 billion. Rest of the government support was comprised of

various reductions and waivers of state-imposed taxes and fees, such as landing fees or fuel taxes.

Figure 6: Government aid provided to airlines during COVID-19 pandemic (in $ billion)



Source: McKinsey (2021)

As for the allocation of relief measures between private and state-owned carriers, a study conducted by OECD (2020) among the member states confirms the findings of Abate et al. as (2020) as out of 69 identified schemes and interventions, 41 targeted privately-owned carriers while only 28 state-owned enterprises. The study, however, identified a great deal of disparity when it comes to the type of support provided between the two groups as out of 9 direct cash injections, 8 were allocated to state-owned carriers or carriers where state owned a significant portion of shares (OECD, 2020).

Overall, levels of government support to airlines in response to the COVID-19 health crisis have been impressive, but they vary significantly across regions. The following part of the thesis will examine the regional characteristics of government aids provided.

3.5.1 Government Support in Europe

European policymakers were the most direct among the regions in providing support to the industry. It is important to point out that government support in European Union is undern normal circumstances strictly regulated or prohibited altogether in accordance with the Single Market rules (OECD, 2021). However, in May 2020, European Commission adopted a temporary framework lifting some of the regulations and allowing member-states to provide liquidity to businesses

impacted by the COVID-19 pandemic under certain specified rules (European Commission, 2020). Additionally, governments were allowed to provide conditional support to further broader objectives, such as digitalization or emission reduction (OECD, 2021).

Between April and June 2020, Air France-KLM Group received funding from both the Dutch and French governments totaling €10.4 billion. The package comprises a state-backed loan, direct shareholder's loan, and a five-year revolving credit facility. As a part of the agreement, the group agreed to commit to specific environmental goals as well as dividend payment interruption until the loans are fully repaid. In April 2021, France announced a rescue plan that included an additional €4 billion recapitalizations of the group (Bloomberg, 2021). As a part of the agreement, the group agreed to commit to specific environmental goals as well as dividend payment interruption until the loans are fully repaid. Both governments provided loans to smaller carriers as well (OECD, 2021).

United Kingdom provided furlough payment schemes to airlines under the Job Retention Scheme (CJRS) and enabled larger companies to access the "Covid Corporate Financing Facility" (CCFF). This scheme was designed to provide liquidity through the purchase of short-term debt. According to KPMG (2021), among airlines that used CCFF to obtain funds this way were EasyJet (£600 million), British Airways (£300 million), Wizzair (£300 million), and Ryanair (£600 million). VAT deferrals and Coronavirus Business Interruption Loan Scheme (CBILS) were also made available to combat the crisis (UK Parliament, 2020).

Germany was among the countries with the most complex relief schemes centered around the "Economic Stabilization Fund" (WSF), established to provide broader financial support to companies affected by the COVID-19 pandemic (KPMG, 2021). Such support could take the form of loans, convertible debt, or equity capital. German development bank KfW acted as a supplementary loan provider (OECD,2021). In the case of the national flag carrier Lufthansa, a €6 billion support package was provided through WSF comprised of a €3 billion government-backed loan and €6 billion recapitalization package (KPMG, 2021). As was the case with Air France-KLM, the package came with several conditions, including dividend payment and buyback limits and the sale of slots at several German airports. Besides Lufthansa, the two primary beneficiaries of government

support for aviation industry support were TUI and a low-cost airline Condor, receiving together €80 million.

The government of Switzerland provided funding to local subsidiaries of German Lufthansa together with Belgium and Austria. Additionally, Swiss International and Edelweiss Air used 85 percent loan guarantees worth €1.4 billion. The guarantee will last until 2025 and the carriers will be able to request up to two one-year extensions (OECD, 2020).

In Sweden, government has established a loan guarantee scheme targeting aviation industry with a total value of approximately €500 million. Around 30 percent of the total amount was dedicated to SAS as a part of a larger relief package that also included recapitalization and issuance of new equity. Both Swedish and Danish governments participated in the recapitalization and increased their stake in the carrier form 14.3 percent to 21.8 percent each (Reuters, 2020).

Norway was last among European countries that provided more significant support to the sector. Similar to Sweden, a loan guarantee program was put in place with a total value of approximately €574 million and available to all carriers with a national license. Norwegian Air was allocated approximately half of this amount, and SAS 25 percent (OECD, 2021).

3.5.2 Government Support in Asia and Pacific

Compared to Europe, Asian governments' willingness to help air travel industry to stay afloat varied dramatically between countries. In March 2020, Singapore Airlines managed to secure a state equity injection amounting to around $3.5 billion together with an additional $6.8 billion in convertible bonds. (McKell Institute, 2020) Additionally, in February 2021, Singapore state announced that it would allocate around $640 million "OneAviation Support Package" from their 2021 budget to help struggling airlines navigate through the crisis and maintain Singapore's position as a major global aviation hub in the future. Alongside this package, subsidies, pilot recertification assistance as well as a long list of cost relief initiatives revolving around rebates on various fees were provided (Civil Aviation Authority of Singapore, 2021).

In China, the first months of the pandemic were characterized by government measures aimed at reducing the costs of struggling airlines and airports. In February 2020, Airlines were made exempt from the "Civil Aviation

Development Fund" fees entirely and various other fees partially. Furthermore, Civil Aviation Administration of China (CAAC) provided airlines with more operational flexibility in areas such as on-time-performance, scheduling changes, or airport slot allocation. Czerny (2021) concludes that while the cost-reduction-centered policies helped airlines survive the initial impact of the pandemic, a substantial cash injection will be needed in the future.

Japan approached the crisis more comprehensively and provided the struggling industry with a set of direct and indirect relief measures, including loans to airlines amounting to 4.1 billion euros, tax reductions, payment exceptions, and employment support (OECD, 2021). Japan's largest aviation holding company ANA Holdings, that owns Nippon airways among other companies in the aviation supply chain, managed to secure $3.8 billion

India has shown a relative unwillingness to provide support to airlines. The government has modified fare caps and floors and permitted airlines to borrow up to $27 million under the "Emergency Credit Line Guarantee Scheme" (Business Line, 2021).

The South Korean government provided relief aid worth approximately $78 billion to smaller and medium-sized carriers through two state-owned banks. Additionally, the two banks agreed provide $971 million to the nation's flagship carrier Korean Air. The liquidity injection is planned to be composed of loans, securities acquisition, and bonds without a maturity date (Reuters, 2020).

In April, 2020 Australia established "Australian Airline Financial Relief Package" program aimed at sustaining domestic airline industry. A total amount of $285 million was allocated (Australian Government, 2020) out of which €200 million went to Quantas, country's largest carrier.

3.5.3 Government Support in North America

The United States was very generous and prompt to act in supporting its aviation sector. In March 2020, Payroll Support Program defined in Coronavirus Aid, Relief and Economic Security Act (CARES) authorized the US Treasury Department to allocate a $32 billion aid package to help preserve employment within the industry and compensate the workers. Additionally, in December of the same year, a $45 billion transportation stimulus was approved, out of which $15

billion were allocated to further stabilize aviation industry employment (KPMG, 2021).

On the other hand, Canada, United States' northern neighbor, was not so quick in providing relief measures to their depressed Aviation Industry. Air Canada received around €554 million through "Canada Emergency Wage Subsidy" in 2020. However, it took Canadian authorities more than a year to reach a deal with Air Canada for the provision of a much-needed targeted financial support. In April 2021 Canadian government committed itself to provide Air Canada with several low-interest loans totaling up to $5.4 billion. Additionally, the government will purchase $500 million worth of stock. Both measures are part of a more extensive program to provide relief to critical local businesses and came with several conditions. The carrier has agreed to restart service on temporarily suspended routes, introduce caps on executive compensations, pause share buybacks, dividend payments, protect jobs, and provide refunds to pandemic-related cancellations (CBC Canada, 2021).

3.5.4 Government Support in Latin America

Latin America was a region that received the least amount of government aid throughout 2020 (IATA, 2020). Despite the fact that aviation industry contributed more than $167 billion to the GDP and supported more than 7 million jobs across Latin America and Caribbean in 2019 government support provided in the region constituted only around 1 percent of industry's 2019 revenues. This amount was comprised mostly of $1.2 million credit line and tax relief scheme provided by Colombian government. The lack of funding was reflected in bankruptcy filings of region's two most prominent airlines LATAM and Avianca (Centre for Aviation, 2020).

3.5.5 Government Support in Middle East and Africa

In Israel, after an unsuccessful attempt of El Al airline to raise funds through issuance of a new stock, Israeli government stepped in, as "buyer of last resort" and acquired shares worth approximately $150 million (14.4 percent stake in the company). Additionally, $250 million government-backed loan was made available to the carrier.

Government of Dubai – owner of Emirates, the flag carrier of United Arab Emirates put an equity injection of $2 billion to save the company after reporting its biggest annual loss in history and later in early 2021 extended the package by another $1.1 billion. Qatar Airways, another state-owned carrier from the region, received similar relief measure worth $3 billion from the government. According to Reuters (2021), both airlines found themselves in a particularly difficult position due to the lack of domestic market that most airlines used to offset their losses.

According to the report from IATA (2021), several African airlines managed to secure a relief package worth $2.04 billion. The aid was primarily comprised of direct loans, equity financing, and capital injections. Additionally, institutions such as International Monetary Fund, African Development Bank, African Export Import Bank, and African Union agreed to provide more than $30 billion to air transport and tourism sectors across the continent. An investigation by IATA suggests that as of March 2021, most of the funds are still pending to reach airlines and other recipients in the air transport supply chain. An essential contributor to the pressure squeezing the local air transport industry is the $601 million of airline funds that are currently being blocked from repatriation across 17 African countries. The amount comprises ticket sales made in local currencies that are being held due to the lack of foreign exchange (AirInsight, 2021). The practice of blocking airlines' funds seems to be a recurrent topic in several African countries and one that could significantly affect company's decision whether to serve such markets in the future. This could hinder the recovery speed of the economy in the post-crisis period as air connectivity is an essential factor of economic growth. The Release of the $601 million would immediately improve the situation in affected markets as well.

4 Methodology and Data

In this thesis, we evaluate financial impacts of the COVID-19 pandemic on a sample of selected airlines and the effectiveness of government support measures on mitigating such impacts using the framework developed by Kiraci, (2019). We find this method well suited for our research as it was originally applied to a similar research problem. Kiraci used the framework to assess financial impacts of 2008 financial crisis on air transport industry. The method combines several standard approaches for financial performance evaluation such as calculation of debt, liquidity, profitability, risk ratios and trend analysis with methods used in multiple criteria decision-making (MCDM). The result is a robust framework that allows researcher to assess financial health of a company from a more traditional atomistic way, focusing on different financial aspects at first, and then follow by a more comprehensive analysis provided by MCDM methods.

4.1 Data

For the purposes of our research, we chose a sample of 12 of the world's major airlines that were carefully selected to represent different geographical areas as well as different business models that are widely used within the industry (table 2). The levels of government support provided to each of the airlines was another important consideration criterion. We gathered both balance sheet and income statement information for each carrier in our sample for time period of 2015 to 2020, using S&P Global Market Intelligence data. In order to get more insight into financial processes that impacted 2020 performance of our sample, we used annual reports that are publicly available. The annual reports were also used to gather information on government support measures and their impacts on both balance sheet and income statement indicators. All government measures that were taken into consideration and their financial implications are outlined in the appendix. Financial information of government support disclosed in other currency than EUR were converted using average foreign exchange rates for 2020 provided by European Central Bank.

Table 2: Airline Sample

Airline	CODE
Air Canada	AC
Air France - KLM	AF/KL
China Southern Airlines	CZ
Delta Air Lines	DL
Ryanair	FR
IAG	IAG
LATAM Airlines	LA
Lufthansa	LH
Qantas	QF
Singapore Airlines	SQ
Turkish Airlines	TK
Southwest Airlines	WN

4.2 Description of the Variables

Risk, debt, profitability and liquidity criteria that will be examined are detailed in the table 3 below. It is important to note, that due to budget constrains of our research, we were not able to obtain license for MACBETH software that is necessary to use the method. In order to overcome this constraint, we decided to work with the same set of indicators used in Kiraci's original paper (2019) as we consider them relevant for our research as well.

Table 3: Research Criteria

Criteria type	Code	Criteria description
Risk	C1	Altman Z-Score
	C2	Springate S-Score

Debt	C3	Total Liabilities / Total Assets
	C4	Short-term Liabilities / Total Assets
Profitability	C5	Gross Profit / Total Assets
	C6	Operating Income / Total Assets
Liquidity	C7	Current Assets / Current Liabilities
	C8	Working Capital / Total Assets

4.2.1 Risk Criteria

Altman Z-Score:

Altman Z-Score Model, developed in 1968 by Edward I. Altman and constitutes one of the most well-known quantitative methods of predicting business bankruptcy. Christopoulos et al. (2009) defines the model as *"a set of financial ratios in a multivariate context, based on a multiple discriminated model, for the firms where a single measure is unlikely to predict the complexity of their decision making or the scope of their entire activities."* The model in its original form was used to predict failures and track financial performance in the air transport industry as early as in the 1980s (Gritta et al 2008). However, increasing utilization of leasing to finance assets in the sector made the model less dependable. Additionally, in 1983, Altman developed a modified version of the model better suited for non-manufacturing industries. For abovementioned reasons, we will use the following version of the formula:

$$Z' = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

where:

X_1 = working capital / total assets (liquidity ratio)

X_2 = retained earnings / total assets (profitability ratio)

X_3 = earnings before interest and taxes / total assets (profitability ratio)

X_4 = book value of equity / total liabilities (leverage ratio)

The resulting Z score can be interpreted based reference intervals. If the score is equal to 1.1 or lower, it indicates high probability of financial failure in the near term. Results falling in the interval between 1.1 and 2.6 that Altman referred to as the "gray zone", indicate that the result is not statistically significant to make conclusion. Z score of 2.6 or higher indicate low risk of bankruptcy. As Gritta et al (2008) point out, model can also be used to compare relative financial strength of a company.

Springate S-score model

Gordon Springate developed his S-score model in 1978 by modifying Altman's procedure (Huo, 2006). Using stepwise discriminant analysis, he selected four out of 19 appropriate financial rations that provided best indication of company's financial health (Pakdaman, 2018). During a test conducted on 40 companies, his model achieved 92.5 percent success rate in predicting bankruptcy (Hantono, 2019). Springate model was used in the past to evaluate financial health in aviation industry (e.g. Abdullah et al., 2020; Kiraci, 2019; Dhamelia, 2021). Formula for calculating Springate S-score takes the following form:

$$Z = 1.03A + 3.07B + 0.66C + 0.4D$$

where:

A = working capital / total assets

B = earnings before interest and taxes / total assets

C = earnings before taxes / current liabilities

D= revenue / total assets

The final S-score is contrasted with a critical value of 0.862. If s-score is lower than this reference value, it indicates risk of bankruptcy while results higher than 0.862 indicate good financial health (Kiraci, 2019).

4.2.2 Debt Criteria

Studies of capital structure differences between different industries have shown that air transport is one of the most leveraged sectors (Oum et al. 2000). Given the

industry's susceptibility to external shocks, monitoring leverage ratios of an airline and their evolution over time constitutes an important precondition for successful navigation through periods of recession. In accordance with the framework outlined by Kiraci, we will use total liabilities to total assets and short-term liabilities to total assets ratios to measure leverage of out statistical sample.

4.2.3 Profitability Criteria

Profitability ratios provide an insight on company's capacity to generate profit relative to items such as assets or revenues. Gross profit on total assets and operating income on total assets ratios were used by Kiraci (2019). With airplane fleet generating most of airline's revenue, both metrics are particularly appropriate for the measuring profitability in air transport industry.

4.2.4 Liquidity Criteria

Liquidity measures the ability of an enterprise to repay its short-term financial obligations without resorting to external capital. According to International Financial Reporting Standards, it is measured by evaluating components of assets and liabilities of a company (Breuer et al. 2012). While liquidity in general constitutes an important criterion for assessing the financial health of a company, severe cash burn triggered by the COVID-19 pandemic across the entire air transport industry has further reinforced the rationales behind its usage. In our paper, we will be using current assets over current liabilities and working capital over total assets ratios to assess liquidity levels across our airline sample.

4.3 Method

Following the method outlined by Kiraci (2019), three distinct methods will be used to quantify the impact of COVID-19 on airline companies and evaluate the effectiveness of government support provided. Firstly, we will employ the Trend Analysis method to study the evolution of risk, debt, profitability and liquidity ratios in the period between 2015 and 2020. We will also calculate an alternative hypothetical scenario 2020' that will assume no government aid provided and compare it to the real results of 2020. The state support impacts will be isolated using information included in annual reports and outlined in the appendix.

As the next step, we will use MACBETH method analysis conducted by Kiraci (2019) to assess the relative importance of our ratios on airline financial performance and assign them weights that will be used as an input for our subsequent analysis.

MABAC MCDM method will be utilized as a last step of our research. In this step, we will use weights calculated using MACBETH method to holistically compare financial performance between airlines in our sample during different years as well as their performance airlines across the entire time series.

4.3.1 Trend Analysis

The main purpose of the trend analysis method is to track changes and identify patterns in the evolution of financial data over time. In this method, percentual changes of an indicator are calculated by comparing its value in a year that is being analyzed against the previous year. The formula we will use is displayed below. We will record values computed using this method in heatmaps charts for a better visual representation. Furthermore, we will analyze each ratio group separately i.e., risk, profitability, liquidity and debt.

$$Percentage\ change = \frac{indicator\ value\ in\ year\ x}{indicator\ value\ in\ year\ x - 1}$$

4.3.2 MACBETH Method

MACBETH method presents an interactive approach to multiple-criteria decision-making that was developed by Bana e Costa, Vansnick and Do Corte (2003). The main difference between MACBETH and other multiple-criteria decision analyses (MCDA) is, according to its authors "*that it requires only qualitative judgements about differences of values to help a decision maker, or a decision-advising group, quantify the relative attractiveness of options*" (Bana e Costa et al., 2003). As Bana e Costa & Vasnick (1999) point out, assessing ordinal preference for different criteria is not particularly challenging but it might not yield sufficient information for the decisionmaker. In practice, it is often necessary to know not only that one variant is more attractive than the other but also by how

much. The method is based on conducting pairwise comparisons between different criteria using a 6-point sematic scale.

Besides air transport industry in Kiraci (2019), the MABAC method has been used successfully in various evaluation contexts such as finance (Ensslin et al., 2000; Santos et al. 2011; Mastorakis; 2012), supply chain management (Bruna et al., 2011; Vernadat et al., 2013) or project resource allocation in public sector (Ferreira et al., 2008; Montmain et al., 2009).

The process of the MACBETH method is outlined below (Kundakci & Işık, 2015; Kundakci, 2016; Kiraci, 2019; Bana e Costa & Vansnick, 1999):

Step 1. Decision criteria are determined and used to build a value tree.

Step 2. Ordinal importance scores for each criterion are identified. Minimum two references are needed – upper reference level with a score of 100 and lower reference level with a score of 0. It is important to point out that upper level does not constitute the best performance and likewise lower level does not constitute the worst performance.

Step 3. Criteria are arranged in an *mxm* square matrix from left to right, based on their predicted importance. M represents the number of alternatives

Step 4. Criteria are used in pairwise comparisons based on differences in their attractiveness. MACBETH sematic scale assigns numerical value to each comparison based on perceived relative importance.

Table 4:MACBETH Sematic Scale

Sematic scale	Equivalent numerical scale	Explanation
Neutral	0	No difference between alternatives
Very weak	1	An alternative is very weakly attractive over another
Weak	2	An alternative is weakly attractive over another
Moderate	3	An alternative is moderately attractive over another

Strong	4	An alternative is strongly attractive over another
Very strong	5	An alternative is very strangely attractive over another
Extreme	6	An alternative is extremely attractive over another

Source: Bana e Costa & Vansnick, (1999)

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Step 5. Evaluations done in step 4 are checked for consistency using the M-MACBETH software. If inconsistencies are detected, the software will suggest possible modifications in order to achieve consistent result.

Step 6. Judgements retrieved from step 4 and checked for consistency in step 5 are transformed to a numerical scale using linear programming.

Step 7. Weighted scores that illustrate the overall attractiveness of individual criteria are computed and ranked using additional aggregation model.

4.3.3 MABAC Method

Developed by Pamucar & Cirovic at University of Defense in Belgrade (2015), Multi-Attribute Border Approximation Area Comparison (MABAC) method is a powerful and reliable tool designed to handle complex decision-making problems (Wang et. Al, 2020). MABAC method is based around measuring *"distance of criteria functions from each of alternative border approximation areas."* (Xu et al., 2019). MABAC method improves accuracy of the final ranking by calculating values of potential gains and losses (Xu et al., 2019).

The individual steps of MABAC method are outlined below (Bozanic et al., 2016; Kiraci, 2019):

Step 1. Initial decision matrix (X) is set up as seen in the formula 1. The matrix contains all criteria and alternatives to be evaluated. Alternatives are defined by the

vectors $A_i = (x_{i1}, x_{i2}, \dots, x_{in})$ where x_{ij} is the alternative $i = 1,2, \dots, m$ value of criterion $j = 1,2, \dots, n$.

$$X = \begin{array}{c} \\ A_1 \\ A_2 \\ \cdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{array} \quad (1)$$

Step 2. All units in the decision matrix (*X*) are standardized using linear normalization procedure and the results are recorded in normalized decision matrix (*N*).

$$N = \begin{array}{c} \\ A_1 \\ A_2 \\ \cdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ t_{21} & t_{22} & \cdots & t_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{m1} & t_{m2} & \cdots & t_{mn} \end{bmatrix} \end{array} \quad (2)$$

Individual values of the normalized matrix are calculated by applying expression (3) for benefit criteria and expression (4) for cost criteria.

$$t_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \quad (3)$$

$$t_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \quad (4)$$

Where x_{ij} is a value of the decision matrix (*X*), x_i^+ represents maximum value of a studied criterion among different alternatives and x_i^- represents minimum value of a studied criterion among the alternatives.

Step 3. Weighted matrix (*V*) is set up by combining normalized matrix (*N*) and relative weights representing levels of importance of each criterion w_i.

$$V = \begin{array}{c} \\ A_1 \\ A_2 \\ \cdots \\ A_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} w_1(t_{11}+1) & w_1(t_{12}+1) & \cdots & w_1(t_{1n}+1) \\ w_1(t_{21}+1) & w_1(t_{22}+1) & \cdots & w_1(t_{2n}+1) \\ \cdots & \cdots & \cdots & \cdots \\ w_1(t_{m1}+1) & w_1(t_{m2}+1) & \cdots & w_1(t_{mn}+1) \end{bmatrix} \end{array} \quad (5)$$

Step 4. Border approximate area (BAA) matrix (*G*) is determined by calculating border approximate areas for each criterion using the formula (6)

$$g_i = \left(\prod_{j=1}^{m} v_{ij} \right)^{\frac{1}{m}} \quad (6)$$

where v_{ij} is an element of the weighted matrix (*V*) and *m* represents total number of alternatives.

Based on the results from previous calculation, BAA matrix (*G*) is expressed in the $n\ x\ 1$ configuration with *n* representing the number of criteria used in the decision-making process.

$$G = \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ [g_1 \quad g_2 \quad \cdots \quad g_n] \end{array} \quad (7)$$

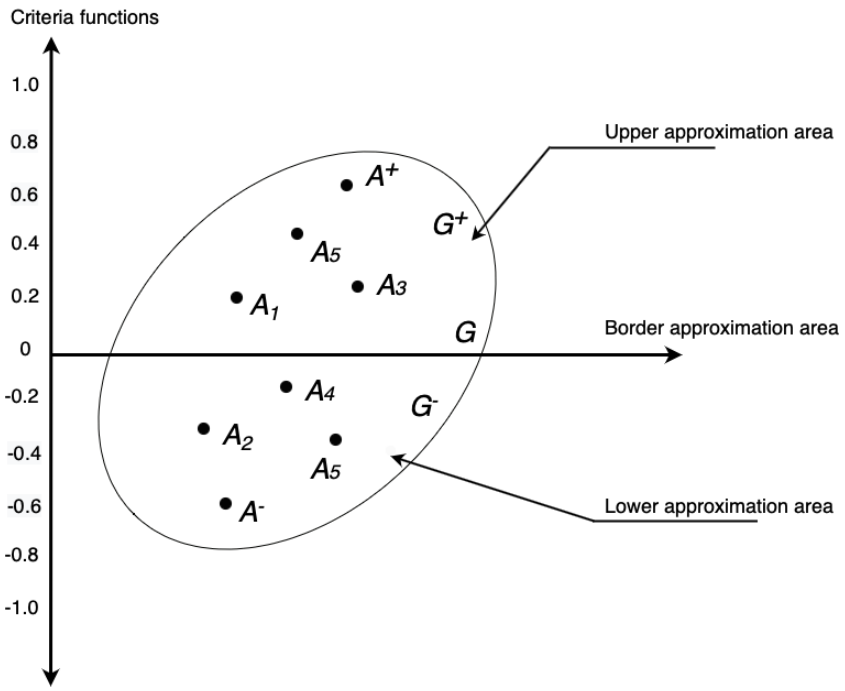
Step 5. Alternative distance (q_{ij}) of weighted matrix (*V*) elements from the border approximate area (*G*) is calculated and set up as a matrix (*Q*). The distance is calculated as a difference between elements of the weighted matrix and the BAA values.

$$Q = \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} v_{11}-g_1 & x_{12}-g_2 & \cdots & v_{1n}-g_n \\ v_{21}-g_1 & v_{11}-g_2 & \cdots & v_{2n}-g_n \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1}-g_1 & v_{m1}-g_2 & \cdots & v_{mn}-g_n \end{bmatrix} \end{array} \quad (8)$$

Alternative q_{ij} can be located in the border approximate area (*G*), upper approximate area (G^+) or lower approximate area (G^-). Ideal alternative (A^+)

belongs to the upper approximate area while sub-optimal alternative (A^-) belongs to the lower approximate area as show in the figure 7.

Figure 7: Visualization of Border (G), Upper (G^+) and Lower (G^-) Border Approximation Area



Source: Bozanic et al.(2016)

The position of the alternative (A_i) is determined using the equation (9).

$$A_i \in \begin{cases} G^+ & if \quad q_{ij} > 0 \\ G & if \quad q_{ij} = 0 \\ G^- & if \quad q_{ij} < 0 \end{cases} \tag{9}$$

An alternative is evaluated as the best if it lies in the upper approximation area (G^+) by as many criteria as possible. At the same time, the higher the value of $g_i \in G^+$, the closer an alternative is to the ideal and the lower the $g_i \in G^-$, the closer it is to the opposite end.

Step 6. During the final step of the method, a sum of criteria distances of different alternatives to the border approximation area matrix are summed up and criteria

functions (S_i) are determined equation (10). Alternative with the highest value of criterion function represents the optimal alternative.

$$S_i = \sum_{j=1}^{n} q_{ij}, \quad j = 1,2, \dots, n, \quad i = 1,2, \dots, m \qquad (10)$$

where again, m and n represent the number of of criteria and alternatives respectively.

5 Results

5.1 Trend Analysis

Examining the evolution of both Altman Z-Score and Springate S-Score in table 3, we observe a significant increase in the probability of default in 2020' in the absence of government support across the entire airline sample when compared with 2019. Furthermore, based on the differences of scores between 2020 and 2020' we can infer that government support played an important role in reducing the risk of default by 50 percent on average when excluding airlines that did not receive any support. However, despite the efforts of governments, the bankruptcy probability remained high in 2020 compared to 2019 with only one notable exception recorded in C1 for Singapore airlines that can be explained by a cumulative effect of excessive amounts of government support coupled with major decrease in both short- and long-term fuel hedging.

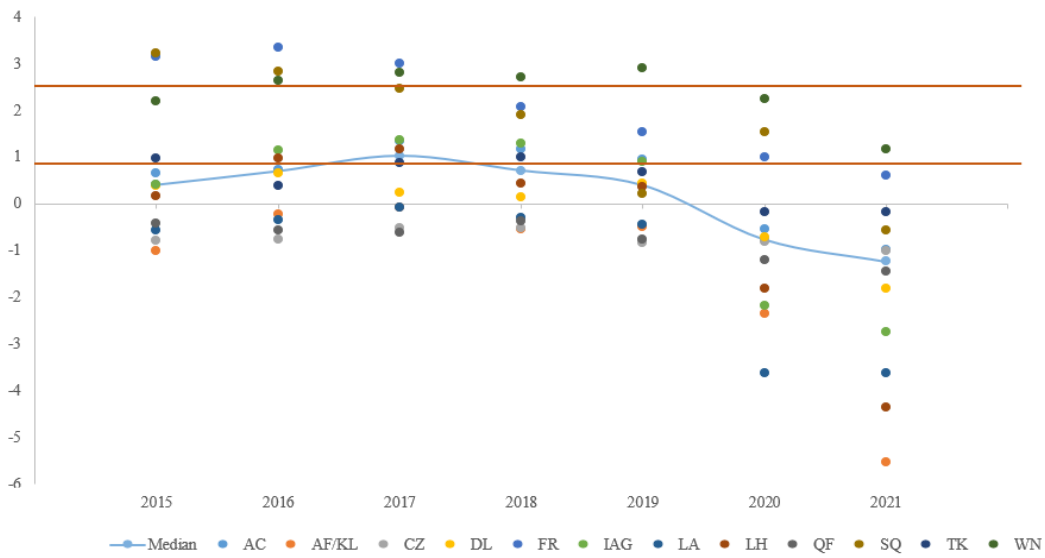
Table 5: Evolution of Airline Risk Indicators

Airline	Indicator	2015	2016	2017	2018	2019	2020	2020'
AC	C1	2,81	0,12	0,81	-0,12	-0,20	-1,59	-2,04
	C2	0,18	-0,05	-0,01	-0,25	0,01	-2,23	-2,59
AF/KL	C1	0,24	0,78	0,63	-5,58	0,07	-3,63	-9,87
	C2	0,54	0,56	-0,09	-0,16	-0,09	-3,24	-4,69
CZ	C1	-1,56	0,01	0,32	0,00	-0,59	0,04	-0,21
	C2	0,15	-0,16	0,17	-0,36	-0,45	-4,88	-6,24
DL	C1	1,87	0,69	-0,65	-0,45	2,32	-2,69	-5,24
	C2	0,59	0,02	-0,20	-0,14	0,13	-2,50	-3,29
FR	C1	0,01	0,06	-0,11	-0,30	-0,27	-0,35	-0,61
	C2	0,31	-0,02	-0,06	-0,41	-0,21	-1,78	-2,02
IAG	C1	6,06	1,75	0,19	-0,06	-0,30	-3,43	-4,04
	C2	0,25	0,35	0,02	0,06	-0,26	-2,40	-2,63
LA	C1	-2,92	0,36	0,75	-2,40	-0,46	-7,29	-7,29
	C2	-0,52	0,52	0,59	0,01	-0,32	-6,86	-6,86
LH	C1	3,69	5,06	0,20	-0,64	-0,15	-6,05	-13,08
	C2	0,27	0,36	0,06	-0,29	-0,25	-2,95	-4,10
QF	C1	0,66	-0,36	-0,07	0,39	-1,07	-0,57	-0,89
	C2	3,19	0,18	-0,14	0,05	-0,27	-1,25	-1,49
SQ	C1	0,05	-0,12	-0,12	-0,23	-0,89	6,30	-3,75
	C2	0,21	-0,26	0,51	-0,35	-1,00	-420,53	-693,19
TK	C1	0,21	-0,61	1,31	0,13	-0,31	-1,26	-1,26
	C2	0,01	-0,84	2,87	0,43	-0,32	-1,31	-1,31

WN	C1	0,14	0,20	0,07	-0,04	0,07	-0,23	-0,60
	C2	0,28	0,00	-0,10	-0,12	-0,07	-1,61	-2,36

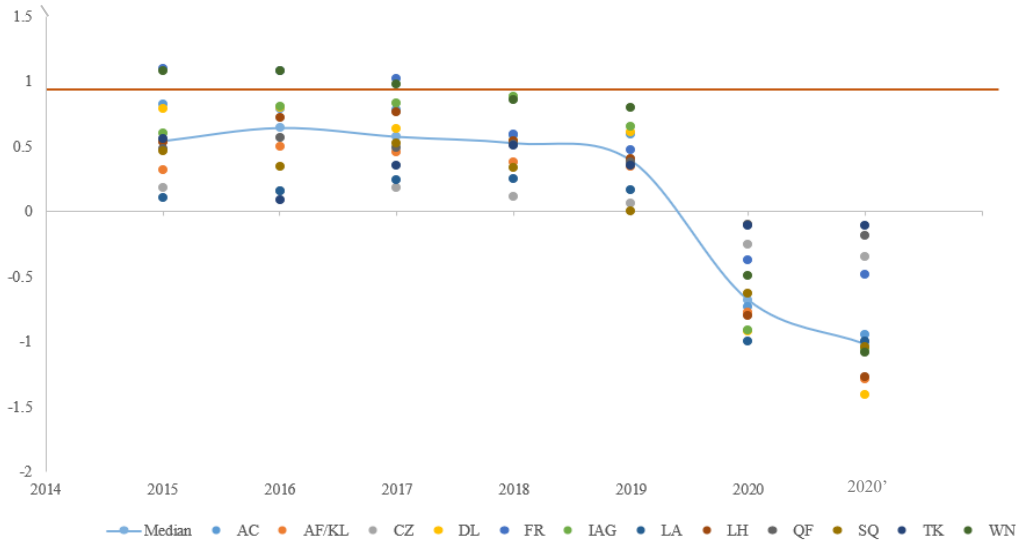
Distribution of Altman Z-Score throughout the studied time series, indicates that according to the framework, more than half of the airlines were already in a significant risk of default before the COVID-19 pandemic as they are positioned below the lower reference boundary (figure 8). This number increased significantly in 2020 and would have been even greater should no government support be provided as seen in 2020'. Furthermore, we can observe a correlation between the values of the Altman Z-Score and the amounts of government aid provided. Lufthansa, Air France-KLM and IAG who scored the lowest in 2020' all ranked among airlines with largest volumes of government aid received. There were two notable exceptions to this relationship; Singapore airlines received the largest amount of governments support (EUR 9.9 billion) despite not ranking among the worst performers and LATAM Airlines that did not receive any support despite exhibiting high bankruptcy probability. Altman Z-Score results for LATAM Airlines proved to be very accurate as the airline filed for bankruptcy protection in July 2020 (Aerotime, 2021). This indicates that government aid helped airlines with the similar or lower scores to avoid bankruptcy.

Figure 8: Evolution of Altman Z-Score



When examining the evolution of Springate S-Score, we can see that even more carriers were at the risk of bankruptcy before the pandemic. This can be attributed to the fact that the methodology puts greater emphasis on profitability which is notoriously low for the entire industry. The only two carriers from our sample that were exhibiting good financial health in the pre-crisis period according to the framework were Southwest Airlines and Ryanair, both of which employ low-cost business model that yields higher profit. COVID-19 impact on Springate S-Score observed in 2020' was more uniform than the one observed in Altman Z-Score. The uniformity can be attributed to the greater emphasis on profitability which plummeted across the entire industry as a direct result of decrease in traffic. A correlation between the values of the score and the amounts of government support provided can be observed again as all of the six worst performers of 2020' (Delta Airlines, Air France-KLM, Lufthansa, Southwest Airlines, IAG and Singapore Airlines) were among the top six recipients of government aid. Comparison between 2020' and 2020 shows the important role the government support played in mitigating the impacts of the crisis. Similar to previous indicator, LATAM Airlines reached the lowest score in 2020 when government supports are taken into consideration indicating viability of the indicator to predict business failures.

Figure 9: Evolution of Springate S-Score



In the period from 2015 to 2019 both debt indicators showed relatively stable trend except for few outliers such as Singapore Airlines in 2019 where we can observe around 30 percent increase for both total liabilities to total assets (C3) and short-term liabilities to total assets (C4) ratios (table 4). 2020' data shows different behavior between the two indicators. C3 grew across the entire sample with a single exception of Ryanair. This trend can be explained by the decrease in total assets triggered by cash outflow. On the other hand, C4 performance varied between the airlines because of different ways airlines approached cash sourcing during the crisis. Government support caused slight decrease in both ratios for recipient airlines. Part of the relief aid given to airlines was realized through equity, grants and waivers. Such support triggers increase in assets through cash without impacting the total liabilities and so decreases the C3 debt ratio. The rest of the government support was provided mostly through long-term debt financing increasing total assets while keeping current liabilities stable. As a result, C4 ratio improved.

Table 6: Evolution of Airline Debt Indicators

Airline	Indicator	2015	2016	2017	2018	2019	2020	2020'
AC	C3	-0,10	-0,08	-0,12	0,05	-0,01	0,12	0,15
	C4	-0,12	0,00	-0,02	-0,10	0,08	-0,12	-0,09
AF/KL	C3	-0,04	-0,05	-0,03	0,02	-0,02	0,27	0,34
	C4	0,01	-0,14	-0,09	0,04	-0,01	-0,05	0,29
CZ	C3	-0,04	-0,01	-0,02	-0,05	0,10	-0,01	0,00
	C4	0,23	-0,04	-0,06	0,06	-0,08	-0,06	-0,04
DL	C3	-0,05	-0,04	0,01	0,01	-0,01	0,28	0,37
	C4	0,06	-0,10	0,19	-0,13	0,02	-0,29	-0,23
FR	C3	0,02	-0,07	0,01	-0,05	0,10	-0,07	-0,09
	C4	0,09	-0,16	0,10	0,12	0,21	-0,23	-0,18
IAG	C3	-0,04	-0,01	-0,06	0,02	0,06	0,18	0,20
	C4	-0,03	-0,15	0,09	0,06	-0,09	0,06	0,09
LA	C3	0,07	-0,07	-0,01	0,07	0,03	0,36	0,36
	C4	0,10	0,04	-0,04	-0,05	0,12	0,45	0,45
LH	C3	-0,06	-0,03	-0,06	0,01	0,01	0,27	0,49
	C4	0,06	-0,17	0,11	0,20	-0,12	-0,01	0,26
QF	C3	-0,04	0,00	-0,01	-0,01	0,08	0,08	0,10
	C4	-0,02	-0,01	-0,02	-0,01	0,08	-0,06	-0,04
SQ	C3	-0,02	0,01	0,07	0,13	0,29	-0,20	0,08
	C4	-0,02	-0,06	0,00	-0,05	0,35	-0,53	-0,41
TK	C3	-0,01	0,03	-0,03	0,01	0,01	0,09	0,09

	C4	-0,12	0,03	-0,03	0,06	-0,03	0,05	0,05
WN	C3	0,00	-0,03	-0,03	0,01	-0,01	0,20	0,28
	C4	0,16	-0,15	-0,07	0,10	0,15	-0,37	-0,30

Profitability indicators gross profit on total assets (C5) and operating income on total assets (C6) show that the entire sample experienced significant decline in profitability during 2020. This decline can be explained by both the significant decrease in passenger demand overall and the COVID-19 impact on the most profitable air travel segments of international and business travel. Additionally, the small differences between 2020' and 2020 indicate that government aid did not improve airline profitability. This shows that the objective of state support schemes was not to absorb the losses incurred but to ensure the future viability of the industry by providing short-term cash inflow through a debt structure with long-term deadlines that can once industry recovers from cash shortage.

Table 7: Evolution of Airline Profitability Indicators

Airline	Indicator	2015	2016	2017	2018	2019	2020	2020'
AC	C5	0,12	-0,07	-0,08	-0,01	-0,10	-1,13	-1,14
	C6	0,32	0,72	0,11	-0,65	1,53	-3,00	-3,47
AF/KL	C5	0,14	0,17	0,01	-0,03	-0,08	-1,10	-1,13
	C6	0,38	1,64	-0,51	0,62	-0,31	-9,87	-13,03
CZ	C5	0,55	-0,15	-0,22	-0,15	0,00	-1,12	-1,12
	C6	0,75	0,12	0,07	-0,42	0,09	-1,86	-2,30
DL	C5	0,16	-0,01	-0,02	-0,14	0,05	-1,36	-1,39
	C6	3,51	-0,09	-0,16	-0,17	0,11	-3,02	-3,84
FR	C5	0,43	0,01	0,09	-0,22	0,00	-1,03	-1,03
	C6	0,86	-0,19	0,06	-0,44	-0,35	-2,73	-2,99
IAG	C5	0,02	0,10	0,06	0,06	-0,12	-1,17	-1,19
	C6	0,65	0,31	0,03	0,34	-0,39	-3,97	-4,31
LA	C5	-0,04	-0,09	0,10	-0,09	-0,05	-1,37	-1,37
	C6	-1,17	10,52	0,19	0,23	-0,27	-10,10	-10,10
LH	C5	0,13	0,14	0,08	-0,06	-0,18	-1,14	-1,18
	C6	5,98	0,08	0,34	-0,17	-0,35	-5,41	-6,99
QF	C5	0,37	0,21	-0,05	0,01	-0,07	-0,28	-0,27
	C6	1,26	0,67	-0,19	0,04	-0,13	-2,75	-3,02
SQ	C5	0,09	0,00	0,14	-0,19	-0,12	-0,94	-0,93
	C6	1,08	-0,49	2,46	-0,51	-1,05	-89,59	-127,04

TK	C5	-0,12	-0,57	1,16	0,09	-0,28	-0,83	-0,83
	C6	0,14	-0,97	4,58	3,05	-0,30	-1,88	-1,88
WN	C5	0,21	-0,07	-0,08	-0,05	-0,02	-1,20	-1,22
	C6	0,72	-0,10	-0,13	-0,07	-0,06	-2,00	-2,81

Despite our expectations, Table 6 shows an ambiguous impact of the COVID-19 crisis on liquidity ratios of airlines in absence of government restrictions. While contra-intuitive at first, some carriers, notably the ones located in North America, managed to improve liquidity in the crisis environment. This was possible due to the low-interest rates and robust stock market that allowed them to source substantial amounts of capital through long-term debt (Centre for Aviation, 2021). 2020 figures indicate that governments were successful in mitigating the impacts of the pandemic and improving the liquidity of our sample with exception of IAG who used reductions in their trade receivables to cover significant part of their cash needs in addition to the government support. This structural change, however, provided cash without impacting current assets and therefore distorting the ratios used.

Table 8: Evolution of Airline Liquidity Indicators

Airline	Indicator	2015	2016	2017	2018	2019	2020	2020'
AC	C7	0,10	-0,09	0,08	0,05	-0,13	0,26	0,13
	C8	5,07	-1,23	4,27	0,72	-1,33	6,68	3,56
AF/KL	C7	0,04	0,19	0,00	-0,16	0,07	0,24	-0,75
	C8	0,05	0,42	0,10	-0,53	0,13	0,53	-2,30
CZ	C7	-0,57	-0,09	0,26	0,12	-0,39	1,32	1,02
	C8	-0,97	0,01	0,12	-0,02	-0,06	0,32	0,25
DL	C7	-0,05	-0,05	-0,16	-0,17	0,20	1,68	0,76
	C8	-0,12	0,05	-0,37	0,02	0,09	1,11	0,64
FR	C7	-0,17	0,09	-0,21	-0,24	-0,12	0,20	-0,06
	C8	-0,34	0,09	-0,56	-1,35	-2,11	0,92	-0,04
IAG	C7	0,06	0,31	-0,04	-0,09	-0,03	-0,23	-0,39
	C8	0,20	1,20	-0,86	-16,24	-0,17	-2,03	-3,47
LA	C7	-0,20	0,16	0,10	-0,14	0,05	-0,27	-0,27
	C8	-0,45	0,13	0,17	-0,19	-0,05	-0,99	-0,99
LH	C7	-0,04	0,29	-0,06	-0,25	0,07	-0,03	-0,84
	C8	-0,21	0,78	-0,91	-2,24	0,24	-0,06	-2,79
QF	C7	0,03	-0,27	-0,11	0,09	-0,03	0,28	0,20
	C8	0,08	-0,55	-0,08	0,08	-0,11	0,29	0,21
SQ	C7	-0,04	-0,13	-0,17	-0,01	-0,41	2,85	-0,25

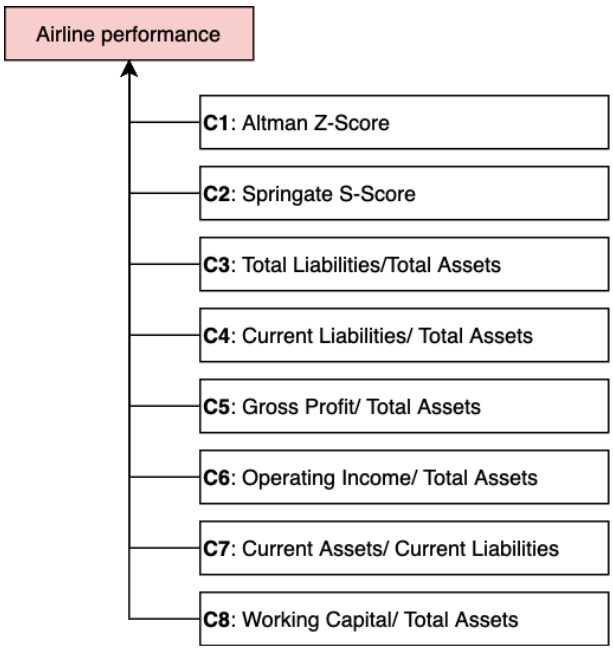
	C8	-0,50	-2,85	-1,59	0,00	-1,97	1,58	0,30
TK	C7	0,05	-0,02	0,06	0,03	-0,08	-0,19	-0,19
	C8	0,28	-0,10	0,25	0,11	-0,48	-0,85	-0,85
WN	C7	-0,18	0,21	0,07	-0,09	0,05	2,03	1,32
	C8	-0,57	0,37	0,19	-0,34	-0,05	2,93	2,15

5.2 MACBETH Method Results

This section of the paper will present MACBETH approach results presented in Kiraci (2019) that will later be used as an input for our subsequent analysis. Kiraci applied MACBETH method to determine significance levels of financial indicators used for airline performance evaluation in the context of the 2008 financial crisis. The method follows steps outlined in previous sections of the thesis and the results are explained below.

Two academic experts on air transport industry were asked to evaluate the decision criteria. The resulting MACBETH value tree is displayed on the figure 10.

Figure 10: MACBETH Value Tree



Source: Kiraci (2019)

In the following step, pairwise comparisons were conducted using consensus method and recorded in a comparison matrix using the MACBETH

software (figure 11) and the sematic scale outlined in table 3. Furthermore, judgement consistency check was performed.

Figure 11: MACBETH Criteria Weight Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
C1	Neutral	Neutral	V. Weak	Weak	Weak	Weak	Weak	Weak
C2	Neutral	Neutral	V. Weak	Weak	Weak	Weak	V.weak-Weak	Weak
C3			Neutral	Weak	Weak-mod.	Weak	Weak	Weak-mod.
C4				Neutral	weak	Weak-mod.	Weak	Weak-mod.
C5					Neutral	Weak-mod.	Weak	Weak
C6						Neutral	Weak	Weak
C7							Neutral	Weak
C8								Neutral

Source: Kiraci (2019)

The resulting criteria weights calculated by Kiraci (2019) are presented in the table 9. The highest weights were attributed to both Altman Z-Score and Springate S-Score while working capital over total assets criterion was found to be the least efficient.

Table 9: MACBETH Criteria Weights

Criterion	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
Weight	20.00	20.00	18.33	15.00	11.67	8.33	5.00	1.67

Source: Kiraci (2019)

5.3 MABAC Method Results

This part of the thesis will examine the performance of our airline sample in the 2015-2020 time series and under the theoretical absence of government support in 2020 using the MABAC method and criteria weights calculated by Kiraci (2020) as described in the previous section. Due to the large volume of data processed during our calculations and their complexity, we will describe the calculation process using year 2020 as a sample.

We began by establishing the initial decision matrix (X) containing criteria values for 2020 for our entire airline sample in table 10.

Table 10: Initial Decision Matrix 2020

Criteria/ Airline	C1	C2	C3	C4	C5	C6	C7	C8
AC	-0.553	-0.730	0.941	0.247	-0.030	-0.151	1.215	0.053
AF/KL	-2.352	-0.778	1.179	0.390	-0.019	-0.218	0.840	-0.062
CZ	-0.807	-0.254	0.740	0.293	-0.007	-0.027	0.407	-0.174
DL	-0.721	-0.922	0.979	0.221	-0.072	-0.204	1.093	0.021
FR	0.996	-0.369	0.623	0.286	-0.005	-0.085	0.981	-0.006
IAG	-2.195	-0.908	0.957	0.381	-0.036	-0.238	0.681	-0.121
LA	-3.630	-0.998	1.156	0.479	-0.038	-0.296	0.420	-0.278
LH	-1.824	-0.801	0.965	0.371	-0.028	-0.213	0.685	-0.117
QF	-1.215	-0.095	0.924	0.415	0.205	-0.123	0.596	-0.167
SQ	1.534	-0.628	0.567	0.152	0.007	-0.126	1.693	0.105
WN	2.230	-0.489	0.743	0.217	-0.054	-0.114	2.021	0.222
TK	-0.179	-0.109	0.789	0.253	0.015	-0.032	0.647	-0.089

All x_{ij} values of the initial decision matrix were then normalized using formulas (3) and (4) to obtain normalized decision matrix (N) shown in the table 11 below.

Table 11: Normalized Decision Matrix 2020

Criteria/ Airline	C1	C2	C3	C4	C5	C6	C7	C8
AC	0.525	0.297	0.390	0.710	0.151	0.540	0.500	0.662
AF/KL	0.218	0.243	0.000	0.272	0.191	0.291	0.268	0.431
CZ	0.482	0.824	0.718	0.567	0.232	1.000	0.000	0.208
DL	0.497	0.084	0.328	0.788	0.000	0.342	0.425	0.597
FR	0.789	0.696	0.908	0.590	0.239	0.786	0.355	0.545
IAG	0.245	0.100	0.364	0.301	0.130	0.215	0.169	0.313
LA	0.000	0.000	0.038	0.000	0.123	0.000	0.008	0.000
LH	0.308	0.218	0.350	0.329	0.159	0.309	0.172	0.322
QF	0.412	1.000	0.417	0.196	1.000	0.642	0.117	0.221
SQ	0.881	0.409	1.000	1.000	0.284	0.631	0.796	0.767
WN	1.000	0.564	0.712	0.801	0.063	0.676	1.000	1.000
TK	0.589	0.985	0.637	0.691	0.313	0.983	0.148	0.378

As the next step, normalized values were weighted to reflect the relative importance of the different criteria using weights, obtained through MACBETH method by Kiraci (2019) and following the approach outlined in expression (5). The resulting weighted decision matrix (V) is expressed in the table 12.

Table 12: Weighted Decision Matrix 2020

Criteria/ Airline	C1	C2	C3	C4	C5	C6	C7	C8

AC	30.503	25.942	25.472	25.643	13.433	12.826	7.500	2.776
AF/KL	24.361	24.860	18.330	19.080	13.894	10.751	6.340	2.391
CZ	29.634	36.476	31.485	23.509	14.380	16.660	5.000	2.018
DL	29.930	21.675	24.335	26.823	11.670	11.182	7.123	2.668
FR	35.788	33.926	34.977	23.844	14.462	14.875	6.775	2.580
IAG	24.898	21.990	24.999	19.509	13.182	10.124	5.847	2.193
LA	20.000	20.000	19.027	15.000	13.104	8.330	5.038	1.670
LH	26.165	24.354	24.748	19.933	13.527	10.903	5.860	2.208
QF	28.242	40.000	25.978	17.941	23.340	13.677	5.585	2.039
SQ	37.623	28.181	36.660	30.000	14.986	13.588	8.982	2.951
WN	40.000	31.278	31.377	27.016	12.408	13.958	10.000	3.340
TK	31.779	39.692	30.007	25.372	15.323	16.518	5.742	2.301

In accordance with the MABAC methodology, border approximation areas (g_i) were calculated utilizing formula (6) for each of our criteria and are outlined in border approximation matrix (G) in the table 13.

Table 13: Border Approximation Matrix 2020

Criterion	C1	C2	C3	C4	C5	C6	C7	C8
g_i	29.389	28.259	26.714	22.385	14.255	12.535	6.502	2.388

After establishing the BAA matrix, we measured distances of all elements contained within the weighted decision matrix (V) from their respective border approximation areas (g_i) and recorded the results in the matrix (Q) shown in the table 14.

Table 14: Border Approximation Area Distance Matrix 2020

Criteria/ Airline	C1	C2	C3	C4	C5	C6	C7	C8
AC	1.115	-2.316	-1.241	3.258	-0.821	0.291	0.999	0.388
AF/KL	-5.027	-3.398	-8.384	-3.305	-0.360	-1.785	-0.161	0.002
CZ	0.246	8.218	4.771	1.124	0.126	4.125	-1.502	-0.371
DL	0.542	-6.584	-2.379	4.438	-2.585	-1.353	0.621	0.279
FR	6.400	5.668	8.264	1.459	0.207	2.340	0.274	0.192
IAG	-4.491	-6.268	-1.715	-2.876	-1.073	-2.411	-0.655	-0.196
LA	-9.389	-8.259	-7.687	-7.385	-1.151	-4.205	-1.464	-0.718
LH	-3.224	-3.905	-1.965	-2.452	-0.728	-1.632	-0.642	-0.181
QF	-1.146	11.741	-0.736	-4.444	9.085	1.142	-0.916	-0.349
SQ	8.235	-0.078	9.946	7.615	0.731	1.052	2.481	0.563
WN	10.611	3.019	4.663	4.631	-1.847	1.423	3.498	0.952
TK	2.390	11.433	3.293	2.987	1.069	3.982	-0.759	-0.088

As the last step of the MABAC method, we calculated criteria functions (S_i) for each of our alternatives by summing their element distances (g_i) across different criteria as outlined in the equation (10). Criteria function values for the entire studied period are displayed in the table 15.

Table 15: Airline Criteria Functions 2015 - 2020

Year/ Airline	2015	2016	2017	2018	2019	2020	2020'
AC	8.08	6.26	13.83	11.56	17.45	1.67	8.00
AF/KL	-31.14	-21.97	-24.59	-26.89	-19.33	-22.42	-38.69

CZ	-20.08	-23.70	-26.56	-25.54	-20.41	16.74	23.80
DL	9.18	10.26	-3.99	-0.22	13.53	-7.02	-9.77
FR	38.06	41.07	39.61	23.24	14.85	24.80	30.37
IAG	-2.47	8.40	9.74	19.20	13.46	-19.68	-10.34
LA	-22.22	-21.02	-20.40	-18.25	-17.74	-40.26	-23.06
LH	-4.90	6.31	8.56	-3.82	1.71	-14.73	-29.54
QF	-7.98	-9.58	-16.50	-7.54	-11.66	14.38	20.26
SQ	24.53	18.60	22.71	16.95	-12.41	30.54	15.09
WN	34.43	36.49	38.97	40.36	44.14	26.95	18.00
TK	9.18	-13.22	-3.35	9.76	8.99	24.31	33.33

Airlines were then ranked based on their criteria function values in a descending order. The complete ranking is displayed in the table 16 and shows that without government measures, Air France-KLM would represent the worst alternative in 2020' as it reached the lowest sum of distances from the border approximation areas with Lufthansa and LATAM Airlines being second and third worst. On the other side of the spectrum, our MABAC analysis indicates that Turkish Airlines would be the optimal alternative followed closely by Ryanair.

Table 16: Airline Criteria Functions Ranking 2015 - 2020

Year/ Airline	2015	2016	2017	2018	2019	2020	2020'
AC	6	7	4	5	2	7	7
AF/KL	12	11	11	12	11	11	12
CZ	10	12	12	11	12	5	3
DL	5	4	8	7	4	8	8

FR	1	1	1	2	3	3	2
IAG	7	5	5	3	5	10	9
LA	11	10	10	10	10	12	10
LH	8	6	6	8	7	9	11
QF	9	8	9	9	8	6	4
SQ	3	3	3	4	9	1	6
WN	2	2	2	1	1	2	5
TK	4	9	7	6	6	4	1

Due to the fact that the border approximation areas take on different value for each year, the previous application of the MABAC methodology only allows us to directly compare financial performance between the different airlines but not the performance of a particular airline across the studied time period. In order to compensate for this limitation, we followed the MABAC methodology for the second time using years as alternatives and calculating value functions for each airline in our sample. The resulting matrix of value functions is presented in table 17.

Table 17: Year Criteria Functions 2015-2020

Airline/ Year	AC	AF/KL	CZ	DL	FR	IAG	LA	QF	SQ	TK	WN	LH
2015	3.68	8.16	6.32	19.13	18.88	10.13	27.00	22.70	29.03	47.75	7.81	16.71
2016	8.71	26.78	8.93	26.95	38.15	36.36	32.72	26.57	25.19	-0.83	20.38	32.12
2017	28.07	32.05	28.38	13.81	28.35	34.11	39.70	25.58	26.01	34.44	25.05	32.88
2018	28.98	25.71	26.93	14.88	13.32	27.65	34.39	35.29	14.54	31.53	17.68	18.23
2019	17.64	26.15	-0.90	19.25	-17.11	25.26	28.20	-1.80	-19.18	20.85	14.52	19.20
2020	-18.31	-19.89	-10.41	-17.97	-22.00	-43.15	-58.74	-30.63	-3.20	-47.14	-11.62	-25.01

2020'	-34.03	-64.70	-29.19	-42.51	-26.61	-53.54	-58.74	-44.36	-42.59	-47.68	-41.48	-63.20

After ranking the alternatives (table 18), we can conclude that 2020' represents the least optimal alternative for every single airline in our sample. Likewise, we can infer that while government measures managed to partly mitigate the impacts of COVID-19 health crisis on financial health of our sample, they did not fully offset them. However, government aid provided to Singapore airlines was significant enough that 2020 represents a more optimal alternative for this airline than 2019.

Table 18: Year Criteria Functions Ranking 2015-2020

Airline/ Year	AC	AF/KL	CZ	DL	FR	IAG	LA	QF	SQ	TK	WN	LH
2015	5	5	4	3	3	5	5	4	1	1	5	5
2016	4	2	3	1	1	1	3	2	3	5	2	2
2017	2	1	1	5	2	2	1	3	2	2	1	1
2018	1	4	2	4	4	3	2	1	4	3	3	4
2019	3	3	5	2	5	4	4	5	6	4	4	3
2020	6	6	6	6	6	6	6.5	6	5	6	6	6
2020'	7	7	7	7	7	7	6.5	7	7	7	7	7

6 Discussion

In this chapter, we will discuss the results of our research as well as possible problems associated with the research design.

Our analysis indicates that airlines were in a high risk of bankruptcy even before the COVID-19 pandemic. This conclusion was confirmed by the results of both Altman Z-Score and Springate S-Score tests. 2020 values of both scores showed a significant negating impact of the COVID-19 pandemic on the default probability across the entire carrier sample. Furthermore, MABAC analysis demonstrated that all carriers except Singapore Airlines exhibited the worst overall financial performance in 2020.

Risk indicator analysis for the hypothetical scenario 2020' suggests that in line with our expectations, relief measures provided by various governments had a significant positive impact in mitigating airline default risk. Likewise, we observed overall improvement in terms of liquidity. On the other hand, profitability and debt ratios showed only relatively small improvements. This can be attributed to the choice of instruments that government used to support the industry throughout 2020. The prevalence of long-term debt financing as identified by McKinsey (2021), meant that governmental aid did not significantly impact profitability and debt ratios analyzed. Thus, the study indicates that the main goal of government support was not to compensate for losses incurred during the COVID-19 pandemic, but to ensure future viability of the industry.

Trend analysis of both risk indicators identified a positive correlation between the magnitude of financial aid provided by the governments and the level of default risk. This observation is in line with findings of Abate et al. (2020) discussed in earlier chapters. It is important to note, that there were two exceptions to this rule in our sample. First, Singapore airlines received unproportionally large amounts of government support which resulted in a drastic improvement of risk and liquidity ratios. MABAC analysis revealed that the carrier moved from being an average alternative in 2020' to be the best alternative in the entire sample in 2020 exhibiting better performance than in the pre-crisis year 2019. On the other hand, LATAM airlines that ranked among the carriers most likely to go bankrupt in hypothetical scenario 2020' of our trend analysis, did not receive any financial aid and filed for bankruptcy in 2020. MABAC method ranked the airline as the

least optimal choice in 2020. The fact that LATAM Airlines indeed filed for bankruptcy protection, and that other airlines with similar 2020' risk scores, that received government support managed to successfully navigate the difficult year, enforces two discourses. Firstly, it supports conclusions of previous analyses that both Altman Z-Score and Springate S-Score can be used to successfully predict financial failures in aviation industry (e.g. Abdullah et al., 2020; Kiraci, 2019; Dhamelia, 2021; Gritta et al 2008) and that MCDM methods such as MACBETH and MABAC can be used for complex financial evaluations (e.g. Ensslin et al., 2000; Santos et al. 2011; Mastorakis; 2012). Secondly, in shows that government support helped to mitigate impacts of COVID-19 and perhaps even avoid bankruptcy of certain carriers.

COVID-19 constitutes a "black-swan" event that has had an unprecedented impact on air transport industry. Our research contributes to a clearer understanding of the financial implications of such event on airlines and provides insight into the importance of government relief measures in the context of the crisis. While previous research of novel coronavirus impact on aviation industry focused mostly on analyzing and forecasting evolution of operational indicators on industry level (e.g., IATA, 2020; Congressional Research Service, 2020; Suau Sanchez et al. 2020; Dube et al., 2021) and relief policy design considerations (e.g., Macilree & Duval, 2020; OECD,2021), our approach combines the knowledge from both literature streams and uses combination of atomistic and comprehensive financial analyses to provides detailed insights into the financial implications of the pandemic as well as policy responses by analyzing individual airlines. We also demonstrated that MCDM methods can be used as a viable input for government and airline decision-making process and can be utilized as a powerful tool to determine relative position of an airline amongst its competitors.

As we demonstrated in our analysis, large sums of taxpayer money were used to support the air travel industry during the downturn triggered by COVID-19 pandemic. It is therefore imperative to assess the effectiveness of such support measures in great detail and ensure reasonable allocation of resources. Furthermore, as discussed in the earlier chapters of the thesis, air transport industry plays a strategic role in the present globalized economy, connecting people, businesses and governments and driving economic growth. Monitoring financial health of the industry is in the best interest of every country.

A possible limitation of our research design comes from the assumptions taken to calculate the scenario 2020'. We constructed this hypothetical situation by isolating financial impacts of government support on income statements and balance sheets of our airline sample. However, in reality, it is not possible to accurately predict the results of 2020 in absence of government support. For example, carriers might have been able to compensate the lack of cash by turning to the private markets. On the other hand, it is also likely, that airlines would not be able to source the same amount of cash through private markets that they did in 2020 without previously granted government support that improved their financial position and therefore likelihood of obtaining resources. Another possible caveat we identified is that the choice of indicators used in our analysis was limited by the ones used by Kiraci (2019) due to lack of resources needed to acquire MACBETH software license. While all indicators are indeed relevant for the industry, the sample lacks dedicated cash indicator, that as identified by IATA (2020) is one of the most relevant KPIs in COVID-19 environment. Following studies should take this into consideration when assessing financial performance in airline industry.

7 Conclusion

This thesis aimed to identify and quantify the financial impacts of COVID-19 pandemic on aviation industry and assess the effectiveness of state support provided as a response to the crisis.

We analyzed evolution of selected risk, debt, profitability and liquidity indicators of an airline sample both individually and in a more comprehensive way, based on their relative importance, using MACBETH and MABAC multiple criteria decision-making approaches. All indicators used were computed using balance sheet and income statement data. We focused our research on period of 2015-2020 as well as on a hypothetical 2020 scenario where no government support was provided.

Our findings show that the downturn triggered by COVID-19 had strong negative impact on the air transport industry. This trend was most visible in default risk indicators of Altman Z-Score and Springate S-Score as well as profitability. Likewise, our data indicates that government support was successful in decreasing the risk of bankruptcy without significant impact on profitability. Both conclusions were further supported by results of MABAC analysis.

We demonstrated that our methodology can be used as a viable input in public policy design and airline competitive intelligence. It has a potential to increase the efficiency with which public resources are allocated.

As discussed in the previous chapter, we identified two possible limitations of our research design. Firstly, in the current environment of airline cash shortage, inclusion of a pure cash indicator could improve the accuracy of the results. Secondly, while still providing a useful insights, on the effectiveness of government support, the complexity of market economy does not allow us to accurately estimate what would the industry look like should no government support be provided in 2020.

Annex

Table A.19: Government Aid for Lufthansa AG

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
equity	300	WSF Direct investment	Germany
equity	4,547	WSF Silent Participation I	Germany
Long-term liabilities	1,000	WFS Silent Participation II	Germany
Long-term liabilities	1,000	KfW credit facility	Germany
Long-term liabilities	76.3	CARES Act Loan	United States of America
Operating Income	137.7	CARES Act Grant	United States of America
Long-term liabilities	443.7	Credit facility for SWISS and Edelweiss	Switzerland
Operating Income	150	Equity capital injection for Austrian Airlines	Austria
Long-term liabilities	300	Credit line for Austrian Airlines	Austria
Long-term liabilities	130	Credit facility for Brussels Airlines	Belgium
Long-term liabilities	3	Participation certificate for Brussels Airlines	Belgium
Staff costs	293	Wage and social security contribution reimbursement	Germany, Austria and Switzerland

Source: Lufthansa annual report 2020

Table A.20: Government Aid for IAG

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Staff costs	344	Grant within the "Temporary Wage Subsidy Scheme (TWSS), "Wage	Ireland

		Subsidy Scheme" (EWSS) and "Coronavirus Job Retention Scheme" (CJRS)	
Long-term liabilities	75	Financing agreement with	Ireland
Current liabilities	328	"Coronavirus Corporate Finance Facility"	United Kingdom
Long-term liabilities	1,010	Syndicated financing agreements	Spain

Source: IAG annual report 2020

Table A.21: Government aid for Air France-KLM

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Long-term liabilities	4,000	State-guaranteed loan	France
Long-term liabilities	3,000	Subordinated shareholder loan	France
Long-term liabilities	665	Revolving credit facility	Netherlands
Long-term liabilities	277	Direct loan	Netherlands

Source: Air France-KLM annual report 2020

Table A.22: Government aid for Qantas

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Operating income	12.1	"International Freight Assistance Program"	Australia
Staff costs	161.5	"JobKeeper Payment"	Australia
Staff costs	3	Wage support to local companies in order to protect employment	Australia

Costs of goods sold	21.8	"Australian Airline Financial Relief Package" consisting of refunds and waivers of government charges	Australia
Costs of goods sold	3	"New Zealand Aviation Relief Package" consisting of refunds and waivers of government charges	New Zealand

Source: Qantas annual report 2020

Table A.23: Government support for China Southern Airlines

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Other income	535	Not specified	People's Republic of China
Current assets	66.5	Not specified	People's Republic of China
Long-term liabilities	29.1	Not specified	People's Republic of China

Source: China Southern annual report 2020

Table A.24: Government Support for Air Canada

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Staff costs	554	"Canada Emergency Wage Subsidy"	Canada

Source: Air Canada annual report 2020

Table A.25: Government Support for Singapore Airlines

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Staff costs	362.3	Wage support under "Stabilization and Support Package"	Singapore

Equity	3,368.7	Equity injection through state-owned holding company	Singapore
Equity	2,222.2	Convertible bonds through state-owned holding company	Singapore
Long-term liability	3,943.2		

Source: Singapore Airlines annual report 2020

Table A.26: Government Support for Delta Air Lines

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Operating expenses	3,459.9	Grant under CARES Act	United States of America
Long-term liabilities	1,402.9	Low-interest loan under CARES Act	United States of America

Source: Delta Air Lines annual report 2020

Table A.27: Government Aid for Ryanair

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Long-term liabilities	674.9	Unsecured debt under HM Treasury and "Covid Corporate Financing Facility"	United Kingdom
Staff costs	84	Various government retention schemes	Various governments

Source: Ryanair annual report 2020

Table A.28: Government Aid for Southwest Airlines

Aid class	Amount (in m EUR)	Description as disclosed in AR	Support provider
Operating expenses	2016.6	Grant under CARES Act	United States of America

Long-term liabilities	35.1	Warrants issued under CARES Act	United States of America
Long-term liabilities	855.8	Promissory note issued to Treasure under CARES Act	United States of America

Source: Southwest annual report 2020

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