

VOLATILITY IN THE AIR TRANSPORT INDUSTRY: EVIDENCE OF ITS OCCURRENCE, CAUSES AND STRATEGIES TO FACE IT

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ABSTRACT

Since its emergence, the air transport sector has been a protagonist in the transformation of the modern world, acting as a catalyst for business and tourism. However, its environment has been characterized as volatile because airlines operate in a cyclical pattern of ups and downs. Through an extensive literature review and a detailed document analysis that involved the main airlines and aircraft manufacturers in the world, the authors sought evidence of volatility in the sector, identified its causes and listed the main strategies that have been adopted to face it. The unstable and uncertain environment in the air transport industry will increasingly require a careful risk management process from companies, taking into account the different origins.

Keywords: Air transport sector; Airlines; Volatility.

Date of receipt: 28/05/2021

Publication acceptance date: 09/11/2021

Date of publication: 30/12/2021

1 INTRODUCTION

In 2014, a memorable year in which the first centenary of commercial air transport was celebrated (Airbus, 2014), 32.8 million commercial flights were carried out, carrying around 3.3 billion passengers and more than 50 million tons of cargo, resulting in a global economic impact of US\$2.7 trillion and 62.7 million direct and indirect jobs (ATAG, 2016). More than half of international tourists (54%) arrived at their destinations by air (UNWTO, 2015), using something around 1,400 airlines with a total fleet of over 26,000 aircrafts (ATAG, 2016). In Brazil, 117.2 million passengers were transported, representing an increase of 68 million people compared to a decade ago (ANAC, 2015). That year, IATA (2015) named the country as the fourth largest domestic market in the world and the tenth overall.

Over its first century of existence, the air transport industry helped shape the modern world, stimulating the economy, business and tourism (O'Connell, 2018). Its importance has been remarkable, as suggested by previous data on its growth and gigantism, but also its dynamics, revealed by a cyclical financial performance (O'Connell, 2018), with narrow profit margins for airlines (IPEA, 2010), including losses and bankruptcies (Alan & Lapré, 2018).

Whereas the “volatility” is a feature that is attributed to what is subject to change, it seems appropriate to use the term to describe this industry. Its intricate and complex gear undergoes frequent changes, influenced by national and international circumstances. In this study, the motivation for using the term came from the main enablers of the air transport service: the airlines. “The airline industry has historically been an extremely volatile industry subject to numerous challenges” (Southwest, 2015, p. 1). “We operate in a continually changing business environment, and new risks and uncertainties emerge from time to time” (American Airlines, 2015, p. 30). This industry is characterized by “seasonal fluctuations” (Lufthansa, 2015, p. 40) and is inserted “(...) in a volatile environment, which is severely exposed to economic cycles and other external factors” (p. 50). In this context, instead of writing a new book, the serious consequences of the covid-19 (coronavirus) pandemic on airlines add a new chapter to a script that has been known for decades.

As an “inherently unstable” industry (US GAO, 2008, p. 8) that reveals a repeating cyclic pattern of ups and downs (Cronrath, 2018), the air transport arouses interest in analyzing and understanding the volatility that characterizes it. This is the motivating fact that justified the authors to frame the following research questions for this study: What is the evidence of volatility in the air transport industry? What are the factors that influence this volatility? What strategies have been adopted to face them?

Aiming to answer these questions, this article was structured as follow: the next section presents studies that discuss volatility in the air transport industry; the method is detailed in section 3; the next three sections provide answers to each of the previous questions; finally, the conclusions and references are presented.

2 STUDIES ADDRESSING VOLATILITY IN THE AIR TRANSPORT INDUSTRY

Many authors have studied volatility in the air transport industry, directly or indirectly. Therefore, the literature review presented here is not intended to be exhaustive, but rather to offer a sample of studies already carried out. The complexity and extent of this industry offer numerous research opportunities from different perspectives. But its relevance doesn't just attract researchers from academia.

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Fluctuations in airline profitability were analyzed by Cronrath (2018), who simulated models for the US industry and concluded that external shocks (crises, wars, *etc.*), economic development, oil prices and the behavior of the airlines themselves influence the industry's profitability pattern. Borenstein (2011) identified that the terrorist attacks of September 11 (2001) in the US ("9/11"), the oil price and the differences in the costs of traditional airlines (network carriers) in relation to those that adopt the Low Cost Carrier (LCC) model were influencing factors in the financial volatility of the industry. Pierson and Sterman (2013) concluded that the aggressive use of yield management (a strategy in which ticket prices are changed in order to maximize revenue) can increase the variation of profit and loss.

O'Connell (2018) investigated the challenges to profitability that are faced by European, Asian and US airlines. The author found that these challenges require quick response strategies. Alan and Lapré (2018), analyzing the operational performance of US airlines, made predictions that point to future financial difficulties. Pearce (2013), in turn, studied aircraft manufacturers, airlines, leasing companies, service providers, airports and travel and cargo agents, concluding that the low profitability of these companies results from the inability to attract capital to support expansions in emerging markets.

There are researches that approach industry dynamics from other perspectives. Evripidou (2012) investigated the reasons and risks of mergers among airlines. As these companies consider growth as a mandatory factor for survival, Merkert and Morrell (2012) sought to estimate the ideal size for an airline to achieve efficiency. Lenartowicz, Mason and Foster (2013) analyzed the reasons and success factors associated with mergers and acquisitions involving LCC airlines in the European market. Budd, Francis, Humphreys and Ison (2014) also investigated this business model, identifying airlines that entered and exited the market from 1992 to 2012 and the variables that impacted their success or failure.

The literature produced in Brazil also offers studies that revolve around volatility. Bielschowsky and Custódio (2011) analyzed the history of the Brazilian airline industry since its inception, discussing the entry and exit of companies in the market in line with the Brazilian political-economic evolution. Jesus (2009) investigated competition in the Brazilian airline industry from the perspective of access to slots (time intervals for landing and taking off, granted to airlines at congested airports). Cravo (2014) compared some forms of slot allocation, highlighting the negative points and the contribution of each one to competitiveness. Pereira (2012) sought to understand the competition in the first decade of this century through the analysis of the TAM (currently LATAM) and Gol cases, companies that have consolidated in the Brazilian market adopting different strategies. Correia, Mello and Meza (2011) analyzed the evolution of the operational performance of Brazilian airlines between 2001 and 2005, highlighting in this period the entry of Gol in the market (the first Brazilian airline to adopt the LCC model). Miotto, Souza and Diehl (2008) chose some variables to analyze the impact of structural changes in the industry (including deregulation and the reduction of entry barriers) on the performance of airlines. Airline costs were the subject of the study by Kajibata (2012), who found that cost reduction strategies are changeable due to external factors and the actions of competitors.

The analysis of studies that address volatility in the air transport sector shows that most of them focus on the US and European markets. Furthermore, as their most recurrent objectives focus on the causes of volatility, it is usually portrayed from a narrower perspective, through one or another set of evidence (depending on the study). Researchers also often choose a few specific factors to investigate the causes of volatility in the air transport sector. If, on the one hand, this strategy deepens the understanding of the perspective of the chosen factors, on the other it prevents a more complete view of the set of factors that influence the complexity of this very relevant industry.

3 METHOD

In a preliminary survey, studies were identified (previous section) that aroused the authors' interest in understanding some aspects of volatility in the air transport sector. Assessing the need to expand the research, they sought documents from players in the sector's value chain and from Brazilian and international organizations, such as IATA (International Air Transport Association), ICAO (International Civil Aviation Organization) and ANAC (Agência Nacional de Aviação Civil, the Brazilian aeronautical agency), which allowed data triangulation (Blaikie, 1991) to interpret the phenomenon of interest.

Content analysis (Krippendorff, 2004) carried out on the consulted sources required the organization of data through coding and grouping according to their meanings and similarities (Corbin & Strauss, 2015). This research step (associated with the first research question) allowed us to obtain three sets of information that reveal the volatility in the sector: (i) financial data from airlines, (ii) information on bankruptcies, mergers and acquisitions (also from airlines) and (iii) data on purchase orders for new aircrafts. As far as possible, we sought to include the Brazilian case in the discussion. Regarding the first set of information, inconsistencies observed between some indicators released by ANAC and those calculated using financial data from Brazilian airlines (available in ANAC yearbooks) led to the decision to consider the latter to the detriment of the former, as they seemed more reliable. Cancellations of purchase orders for new aircrafts required treatment in the raw data released by their manufacturers.

When this research was being completed, it was still difficult to determine the effects of the coronavirus pandemic (Covid-19) on the economy and different industries. Without complete information available, any attempt to broadly and faithfully represent the current reality of the air transport sector (one of the most affected) could prove to be hasty or partial, given the uncertainties. Thus, the authors considered it more appropriate, in methodological terms, to punctually illustrate the consequences of this tragedy, still based on preliminary data.

Seeking to provide a broader picture of the causes of volatility, the main factors influencing this industry were identified and classified. It is a fundamental vision to understand the dynamics of the sector. In addition, the main strategies adopted by airlines to face these factors were also identified. At this point, it is important to highlight that this study differs from the others by the perspective adopted in these two analyzes (causes and strategies): although many authors analyze or present information about airlines, this study offers an interpretation of the view of the service providers themselves (airlines) on the subject of volatility. To answer the second and third research questions, the authors analyzed official documents released by the airlines, which required the establishment of a punctual (cross-sectional) cut.

When the first ideas about this research emerged, in the second half of 2016, the authors sought annual reports from companies in the sector, relating to the previous year. As not all of them were available at the time, the 2014 reports were considered. For the selection of airlines, the IATA ranking of the same year was considered, which indicates the largest companies in the world taking into account domestic and international flights (the ten largest were considered). As it would be desirable to identify possible particularities associated with Brazilian companies, the only two Brazilian airlines that were publicly traded at the time were added to the group. Table 1 shows the companies that were considered in the study and the documents analyzed.

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The authors chose to include the four main aircraft manufacturers in the research. As the information included in the airlines' reports reflects their specific points of view, the documents of these other companies allowed us to assess this information, confirming, at the end of the analysis, a strong convergence of content, which contributed to data triangulation.

TABLE 1 – Companies and documents considered in the research.

Airline and origin	Documents analyzed	Airline type
Ryanair (Ireland)	Ryanair (2015)	Low Cost Carrier (LCC)
easyJet (UK)	easyJet (2015)	
Southwest (USA)	Southwest (2015)	
Gol (Brazil)	Gol (2015)	
Lufthansa (Germany)	Lufthansa (2015)	Network carrier
American Airlines (USA)	American Airlines (2015)	
China Southern (China)	China Southern (2015)	
Delta Air Lines (USA)	Delta Air Lines (2015)	
United Airlines (USA)	United Airlines (2015)	
Air China (China)	Air China (2015)	
China Eastern (China)	China Eastern (2015)	
LATAM (Brazil e Chile)	LATAM (2015)	Executive and large commercial aircraft manufacturers
Boeing (USA)	Boeing (2013, 2014, 2015)	
Airbus (Europe)	Airbus (2014, 2015)	
Embraer (Brazil)	Embraer (2015a, 2015b)	
Bombardier (Canada)	Bombardier (2015a, 2015b, 2015c, 2015d)	Executive and medium commercial aircraft manufacturers

Source: Elaborated by the authors.

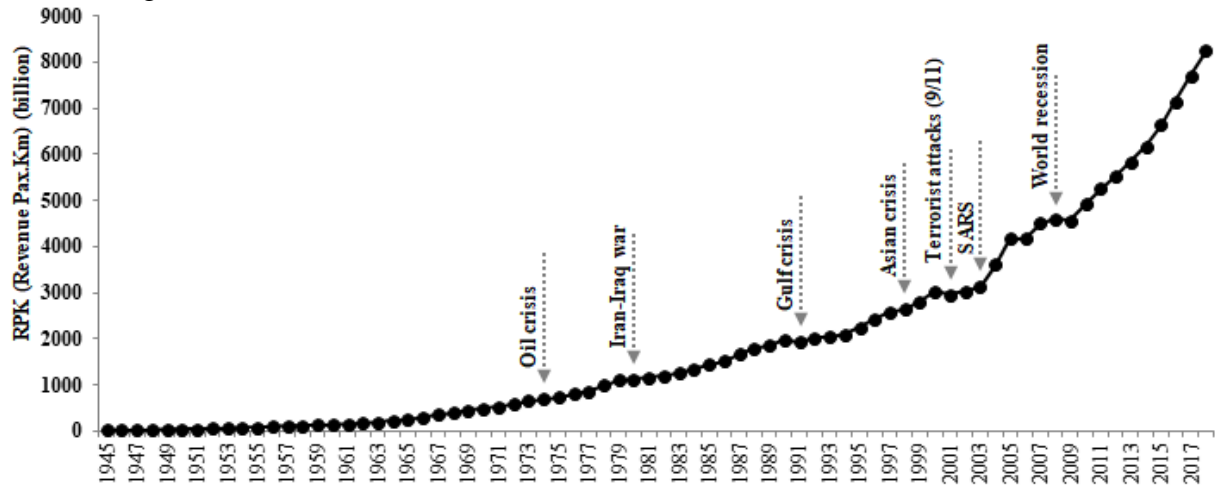
The documents in Table 1 required a considerable effort of content analysis (following the same procedure described above). Identifying a cause or strategy is not always straightforward. Furthermore, although annual reports typically have a section on risks and opportunities, the authors concluded that it would be necessary to review the entire content of the documents, as important information was presented or discussed in other sections. The documents in Table 1 have 140 to 456 pages and more than four thousand pages were analyzed.

4 EVIDENCE OF VOLATILITY IN THE AIR TRANSPORT INDUSTRY

It is interesting to note that world air traffic has been persistently growing, as only a few years have seen their numbers drop (Figure 1). This growth illustrates the importance of the sector as the wars, conflicts, economic recessions and political instabilities that impacted the world in the last 30 years have not prevented an average annual growth in world air traffic close to 5% (Airbus, 2014; Boeing, 2014). In Brazil, air traffic also shows consistent growth (Figure 2), despite the economic recession having affected the demand for flights in recent years.

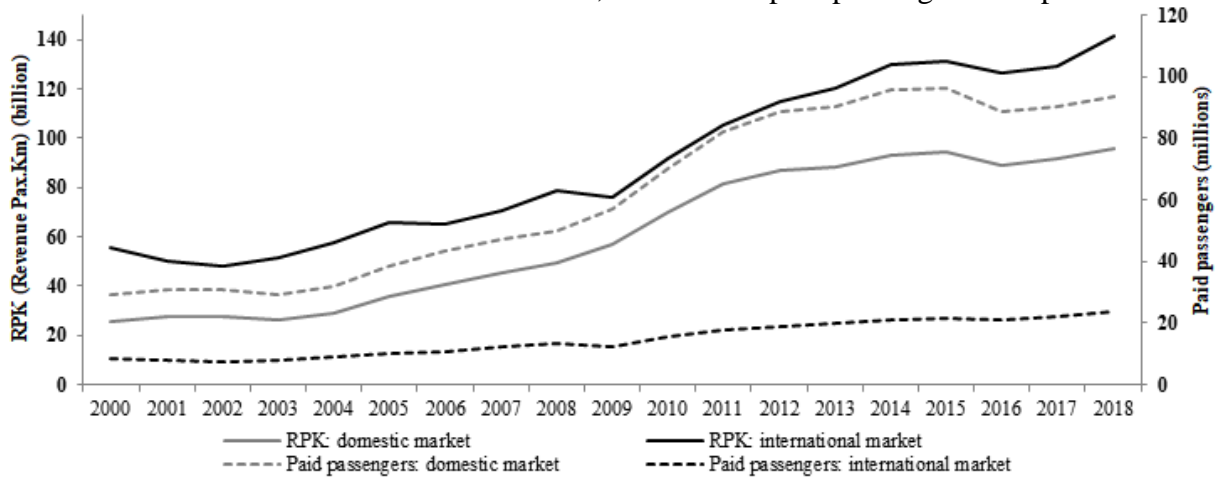
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FIGURE 1 – Evolution of world air traffic, in RPK (indicator of demand for the sector, being the result of multiplying the number of paying passengers transported by the distance traveled on each flight).



Source: Elaborated by the authors based on: DBS Bank (2017) (years: 1945 to 1993), ICAO (2006) (year: 1994), ICAO (2007) (1995 to 1997) and ICAO yearbooks from 2007 to 2018 (1998 to 2018). Data available until 2018.

FIGURE 2 – Evolution of air traffic in Brazil, in RPK and paid passengers transported.



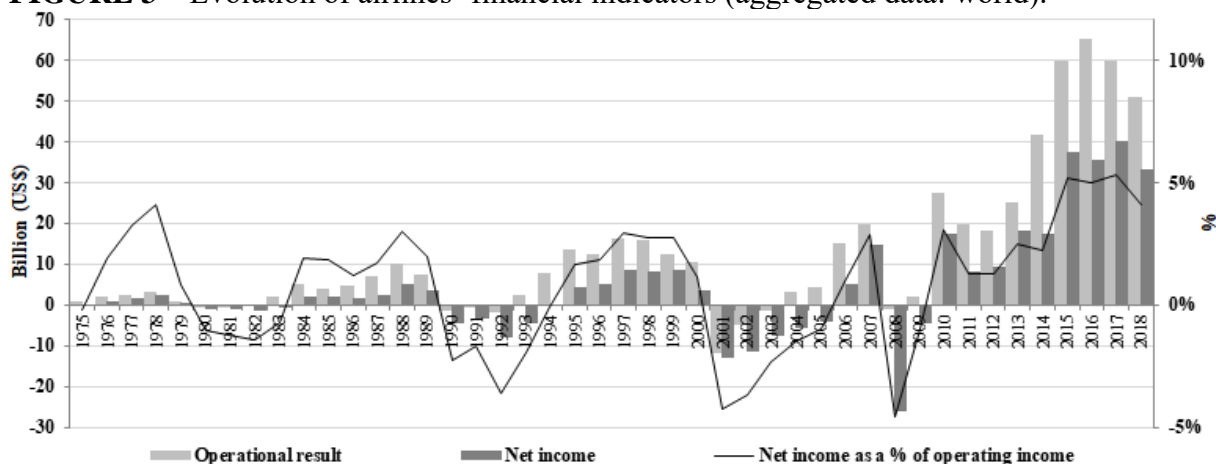
Source: Prepared by the authors based on the yearbooks from 2011 to 2018 of ANAC. Data available until 2018.

The strong and persistent growth of world air traffic, on average greater than that of the economy (Cronrath, 2018), could suggest that airlines operate in an invariably favorable environment. The reality, however, reveals a very different scenario. To illustrate volatility in the air transport sector, three sets of information associated with airlines are presented below.

4.1 Financial indicators of airlines

The aggregate financial indicators of airlines (Figure 3) have fluctuated around zero, following, for decades, a cyclical behavior with increasing amplitude (Jiang & Hansman, 2006; Pierson & Sterman, 2013; Cronrath, 2018). Although this pattern is not exclusive to airlines, the air transport sector represents one of the most consistent examples of this type of behavior (Cronrath, 2018). Pierson and Sterman (2013, p. 130), who studied the US case, state that “(...) consistent profitability has been elusive” in this sector.

FIGURE 3 – Evolution of airlines’ financial indicators (aggregated data: world).



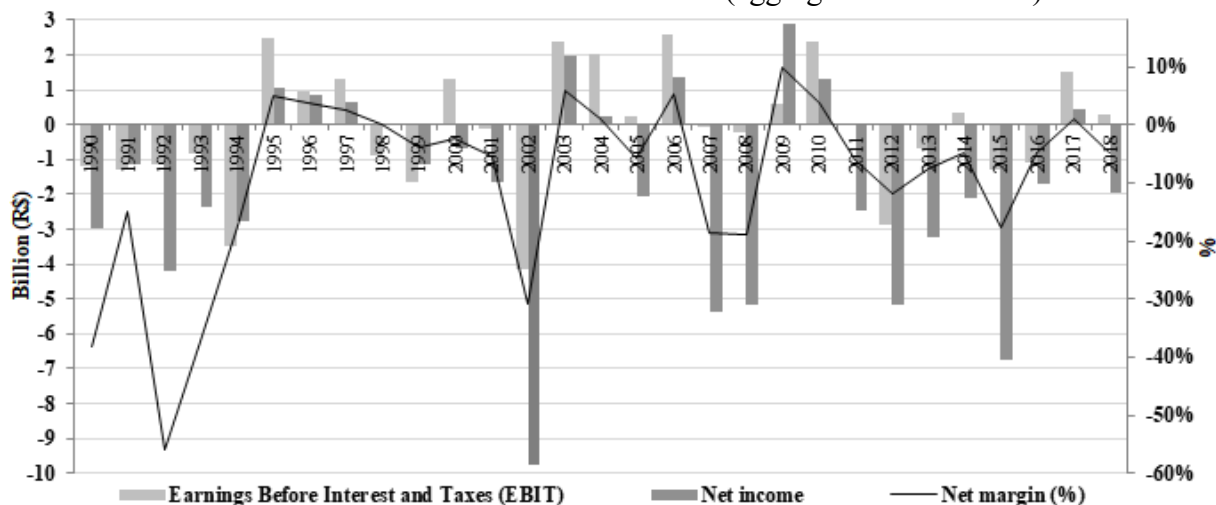
Source: Elaborated by the authors based on: <airlines.org> (there was a conference with the data contained in the annual reports and other ICAO documents).

An industry’s business cycles are typically observed through non-seasonal recurring variation in profitability, asset utilization, employment, and so on. (Sgouridis, Sussman, Weil, & Bozdogan, 2008). Some authors have even estimated the profitability cycles for the airline industry (typically formed by the “peak”, “recession”, “valley” and “recovery” phases: demand and revenue growth, beginning of a crisis and the consequent recession, the end of the crisis and, finally, the trajectory of demand and revenue recovery), reaching a total length of around ten years (Jiang & Hansman, 2006; Cronrath, 2018). Jiang and Hansman (2006) found that important events (such as 9/11) did not significantly change the length of the cycle, although they appear to have contributed to the increase in its amplitude. For these authors, the cyclicity in the sector is endogenous.

Figure 3 shows a recovery for airlines in recent years after the global economic recession that erupted in 2008-9. The same is not observed in Figure 4, which presents the aggregated data of Brazilian airlines. However, the expectation regarding the effects of the coronavirus pandemic is that the numbers will tend to converge very soon: IATA (2020a) estimated that 2020 tends to be the worst year in history for the sector, with net losses around US\$84 billion. The sharp drop in revenues, reflecting the retraction in demand and the reduction in tariffs (the second stimulating the first), in addition to high fixed costs, led companies from all regions of the world to negative results.

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FIGURE 4 – Evolution of airlines’ financial indicators (aggregated data: Brazil).



Source: Elaborated by the authors based on the yearbooks (from 1994 to 1999, from 2001 to 2008 and from 2018) of ANAC.

Given this scenario, it is not surprising that the air transport sector is treated as an unattractive environment for investments. IATA usually compares the return on capital invested in the sector with a weighted average cost of capital (representing an opportunity cost, that is, what investors would earn if their capital were invested in another asset with a similar risk, in the same country). Considering data from 1993 to 2018, the first was only above the second from 2015 onwards (IATA, 2018; Pearce, 2018). This in practice means that, “(...) except at a handful of airlines” (IATA, 2018, p. 3), until 2014 investors lost money for every dollar invested in this business.

(...) The airline industry has generated one of the lowest returns on invested capital among business sectors. Even at the peak of business cycles over the past 20 years, on average, financial returns for airlines have never met investors’ cost of capital. (Embraer, 2015b, p. 20)

The lack of attractiveness for investments is not the only implication of fluctuating financial indicators. According to Cronrath (2018), layoffs, bankruptcies and mergers have affected this industry for decades. With regard to layoffs, they affect not only airlines (Gittel, Cameron, Lim, & Rivas, 2006; Lee, 2018), but – as a ripple effect – also companies positioned in other tiers of their value chain. According to Guerra (2012), after 9/11 and during the 2008-9 crisis there were several layoffs at aircraft manufacturers. In the case of Embraer, for example, 1,800 employees were dismissed in 2001 (14% of its staff) and 4,200 in 2009 (20%). More recently, 2,500 employees have left the company, amid layoffs and volunteer dismissal programs (G1, 2020a; on layoffs at Boeing, see Sgouridis et al., 2008).

The inevitable loss of many jobs raises one of the most negative expectations of the coronavirus pandemic. Considering only airlines, IATA (2020a) estimated for 2020 a 35% reduction in the total number of employees, compared to the previous year (other examples: Financial Times, 2020; Reuters, 2020).

4.2 Bankruptcies, mergers and acquisitions involving airlines

Several authors (Gong, 2007; US GAO, 2008; Jayanti & Jayanti, 2011; Manuela, Rhoades, & Curtis, 2016) cite cases where airlines file for recovery or bankruptcy in the US market. Considering the absence of an official publicly available compilation (Gong, 2007), researchers end up having to use unofficial sources. One of the most referenced (A4A, 2018) presents a list showing that 24 US airlines were liquidated (Chapter 7 of the US bankruptcy law) and 180 requested recovery (Chapter 11) between 1979 and 2018 (for a comparison not direct, but still useful: there were approximately 170 airlines operating scheduled flights in North America in 2016 – Gillen, 2018; Pavlovic & Babic, 2018).

Major is the term used by the US Department of Transportation (DOT) to designate the large national (American) airlines with revenues above \$1 billion. Thirteen majors operated in that market between 1980 and 2005. The rate of those that went bankrupt or requested recovery (some more than once) was 77% (Gritta, Adrangi, Davalos, & Bright, 2006). When analyzing the situation of the seventeen majors that currently exist (DOT, 2018), it can be concluded that this rate has fallen, but remains high (53%).

The US air transport industry has also experienced waves of consolidation (US GAO, 2008; Kwoka & Shumilkina, 2010; Vaze, Luo, & Harder, 2017; Ciliberto, Cook, & Williams, 2018), that is: a considerable number of mergers and acquisitions concentrated in specific periods, especially after the deregulation of the sector (1978). The examples are plentiful (Evripidou, 2012; Merkert & Morrell, 2012; Lenartowicz et al., 2013; Manuela et al., 2016; Vaze et al., 2017; Ciliberto et al., 2018), but three relatively recent mergers are noteworthy for the size of the companies involved: Delta Air Lines and Northwest Airlines (2008), United and Continental Airlines (2010) and American Airlines and US Airways (2013) (Hsu & Flouris, 2017; Gillen, 2018; Carlton, Israel, MacSwain, & Orlov, 2019). According to Manuela et al. (2016, p. 138), “The number of airlines designated as major carriers in the United States (US) has always been relatively small and virtually no carrier has achieved this status without acquiring or merging with another carrier at some point in its history”. Kwoka and Shumilkina (2010) and A4A (2016) cite around 40 mergers and acquisitions that have taken place in the US since deregulation.

In an industry that has a natural tendency to concentration (due to the high costs and potential gains associated with economies of scale), it is important to emphasize that mergers and acquisitions often result from strategic decisions taken voluntarily. Thus, they cannot necessarily be characterized as negative events (unlike bankruptcies). However, among the possible reasons for mergers and acquisitions, the literature (Evripidou, 2012; Németh & Niemeier, 2012; Cortés, García, & Agudelo, 2015; Manuela et al., 2016; Hsu & Flouris, 2017; Pavlovic & Babic, 2018) also points out several directly related to volatility in the sector: crises (political, economic), financial difficulties, need to reduce risks, competitive pressures, etc.

In Europe there are also many cases of airlines that went bankrupt or filed for recovery (Gong, 2007; Jayanti & Jayanti, 2011; Budd et al., 2014; Burghouwt & Wit, 2015). In addition, the trend of market concentration has been quite visible in the last two decades (Merkert & Morrell, 2012; Németh & Niemeier, 2012; Pavlovic & Babic, 2018), although at a slower pace than in the US (due to barriers policy and regulatory issues).

Since the financial crisis in 2008, the airline industry in the United States underwent a series of consolidations (...). During a similar time frame (...), significant consolidation

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through airline mergers occurred in Europe, as well, changing the competitive landscape of the continent. (Hsu & Flouris, 2017, p. 42)

Cases of mergers and acquisitions are cited by several authors (Evrpidou, 2012; Merkert & Morrell, 2012; Németh & Niemeier, 2012; Lenartowicz et al., 2013; Hsu & Flouris, 2017; Pavlovic & Babic, 2018) and some data help to illustrate consolidation on that continent. Burghouwt and Wit (2015), for example, studied 17 European countries. The number of scheduled airlines decreased from more than 200 in 1990 to less than 130 in 2013. Budd et al. (2014), in turn, identified 43 regular LCC companies operating in Europe between 1992 and 2012. Of these, only ten remained operational, representing “a failure rate of 77%” (p. 80).

Data on Latin America are sparser. In the database consulted by Cortés et al. (2015, p. 206) it appears that in the 1990s there were 21 announcements of mergers and acquisitions in this region, while between 2000 and 2013 this number rose to 72 (growth of 243%). Table 2 shows bankruptcy, merger and acquisition cases involving Brazilian

TABLE 2 – Examples of bankruptcy, mergers and acquisitions involving Brazilian airlines.

Airline	Foundation	Relevant event
Cruzeiro do Sul	1927	1975: sale to Varig; 1992: incorporated by Varig.
Varig	1927	2006: sale to Varig Log; 2007: sale of the newly formed company (VRG Linhas Aéreas) to Gol.
Panair do Brasil	1930	1965: end of operations.
VASP	1934	2005: end of operations.
Transbrasil	1955	2001: end of operations.
Nordeste	1976	1995: sale to Rio Sul; 2002: start of incorporation by Varig.
Rio Sul	1976	2002: start of incorporation by Varig, one of its founders.
TAM	1976	2010: announced the agreement to merge with LAN Chile, forming LATAM (in 2012); 2020: request for judicial recovery (in the US).
Itapemirim	1997	1998: sale to TAM.
TRIP	1998	2012: incorporated by Azul.
Avianca	2003	2018: request for judicial recovery; 2020: bankruptcy.
BRA	2005	2007: end of operations.
Webjet	2005	2012: incorporated by Gol.

Source: Elaborated by the authors based on: Castro and Lamy (1993), Malagutti (2001), Oliveira (2011), LATAM (2012), ANAC (2016), Ferreira (2017), G1 (2018, 2020b), Veja (2020) and ANAC yearbooks (1993, 1998, 2001, 2003, 2005, 2006, 2008 and 2012).

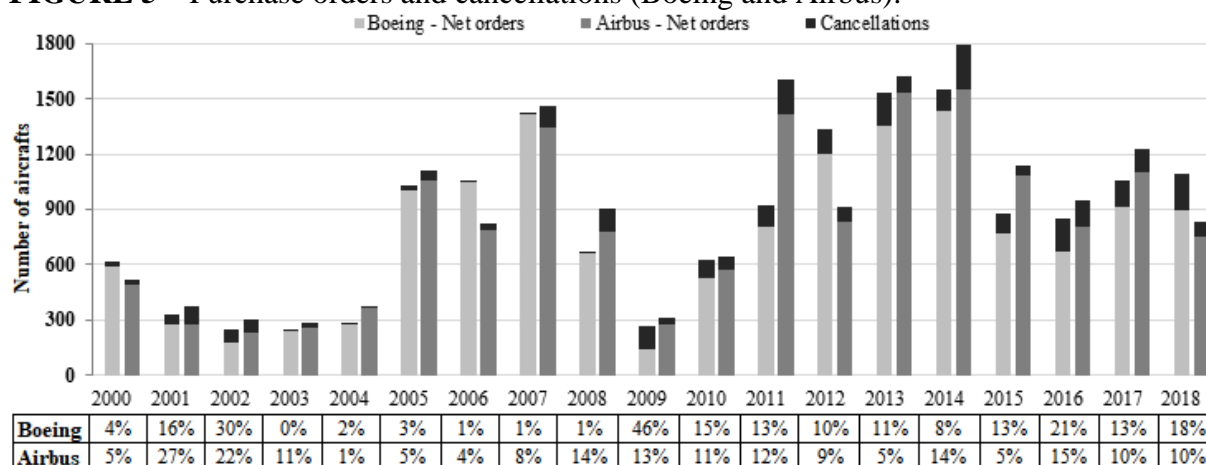
With many uncertainties surrounding the end of the coronavirus pandemic, airlines expect a slow and challenging recovery. The main obstacles identified by IATA (2020b) are: the high debts, the restrictive actions agreed in the sector (such as physical distance and cabin cleaning and checks, which add time and reduce aircraft use, impacting efficiency operational), the post-pandemic economic recession and consumer confidence (which will only recover when they feel more comfortable with controlling the pandemic and stabilizing their personal financial situations). Depending on these variables, the world could be about to experience new waves of bankruptcies, mergers and acquisitions over the next few years (some signs are shown in: Asianews, 2020; G1, 2020b).

4.3 Purchase orders for new aircrafts

Some information related to aircraft manufacturers also reveals volatility in the air transport sector. The ups and downs of airlines reflect directly on purchase orders for new aircrafts (Figure 5). These variable orders tend to follow the aggregate profitability of the world air transport sector (Cronrath, 2018). For example, it is observed that “the volatility of Airbus and Boeing orders received is similar (...)” (Sgouridis et al., 2008, p. 7).

It is important to highlight that the effects of the profitability cycles of the airline industry are not restricted to new purchases of aircrafts, but also affect orders that have already been signed. The purchase of a commercial aircraft (formalized in a contract) often takes place years before delivery. While waiting to receive new aircrafts, an airline may be forced to postpone or even cancel firm orders due to deterioration in general economic condition or its particular financial situation. All aircraft manufacturers confirm these risks (Airbus, 2015, p. 9; Boeing, 2015, p. 7; Bombardier, 2015c, p. 83; Embraer, 2015a, p. 8). Although they try to emphasize that cancellations do not represent risks to the backlog, it is noted that in several years they are significant in relation to the gross orders received (see the table in Figure 5).

FIGURE 5 – Purchase orders and cancellations (Boeing and Airbus).



Source: Elaborated by the authors based on data available in: Boeing: Fraser e Chruszcz (2010) and <www.boeing.com>; Airbus: Credit Suisse (2016), Airbus (2017, 2018, 2019) and <www.airbus.com>.

The Delta Air Lines annual report (2015, p. 250) shows evidence of the existence of a “Customer Order Desk” in the company, which has as one of its attributions the “management of order changes and cancellations”. It is important to note that when an airline requests the cancellation of a purchase order, it must pay heavy fines. Embraer (2015a, p. 9) stated: “In 2014, we had revenue of US\$14.5 million related to contractual fines paid by customers for contract cancellations, compared to contractual fines of US\$40.8 million in 2013 and US\$41.7 million in 2012” (please note, from Figure 3, that these were favorable years for the global air transport sector). Thus, occurrences of this type are extremely undesirable (both for aircraft manufacturers and their customers) and are concrete evidence that airlines suffer difficulties whose gravity forces them to change plans.

There is also the occurrence of postponements, when an airline requests that an aircraft delivery be delayed in relation to the original date defined in the contract. Although they occur with some frequency (perhaps even more than cancellations, as they represent a less

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critical situation once orders are held), data on delays are difficult to obtain (examples can be identified in: Easyjet, 2015; Lufthansa, 2015; Reuters, 2016, 2019).

The scenario of cancellations and postponements could get worse in the short term due to the coronavirus pandemic. In a first-half report, released in June 2020, IATA stated:

For 2020, commercial airlines currently have around 960 new aircraft scheduled for delivery. This is approximately 40% lower than the number originally planned at the beginning of this year. In light of the very challenging industry outlook, we expect that airlines will consider further cancellations or postponements over the second half of the year. (IATA, 2020a, p. 3)

This concern is obviously echoed by aircraft manufacturers (Airbus, 2020; Boeing, 2020), even though the effects of the crisis are still difficult to quantify. The immediate action, therefore, has been to adapt production systems (and supplies) to new levels of demand.

5 FACTORS (CAUSES) THAT INFLUENCE VOLATILITY IN THE AIR TRANSPORT INDUSTRY

Looking to the future, it is not difficult to imagine that airlines will continue to face difficulties (Pierson & Sterman, 2013), which leads to the question of what are the causes that make the environment of this industry so dynamic. Based on the documents analyzed (Table 1), the factors shown in Table 3 contribute (directly or indirectly, to a greater or lesser degree) to the volatility in the sector. In practice, these factors are variables whose patterns or magnitudes can represent threats or opportunities for the companies (depending on their abilities to face them). Factors were classified (in some cases requiring choices) according to their point of occurrence. It is important to clarify that the search for a more complete picture of the causes of volatility implied some trade-offs, one of them being the impossibility (due to space limitations) of providing detailed information about them.

TABLE 3 – Factors influencing volatility in the air transport sector.

A. Factors internal to the company
A1. Air accident or incident (involving the aircraft and its components) It encompasses equipment repair or replacement costs, service interruption, insurance costs (which have risen significantly since 9/11) and claims, brand impact <i>etc.</i>
A2. Threats to/failures in technologies used in airline processes (except the aircraft and its components) It encompasses the misuse of company information (such as data about customers, employees and partners). Airline processes are extremely dependent on various information and communication technologies. For example, Ryanair sells more than 99% of tickets through its website, suggesting that the company would be at a huge loss if this system were to seriously fail.
A3. Related to human resources
A.3.1. Loss of skilled labor (for example, to competition) and difficulty in hiring/replacement The sector depends on skilled and, in many cases, highly specialized labor (such as flight crews). Meeting demand in periods of economic growth may be compromised by the shortage of professionals.
A.3.2. Unionization The high level of unionization in the sector strongly influences labor negotiations and remuneration, benefits and retirement policies.
A.3.3. Strike Example: in 2014, Lufthansa pilots went on strike for 15 days, resulting in more than 8,600 canceled flights and a loss of € 222 million.

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<p>A.3.4. Others Succession of leadership in key business processes, trend towards more flexible work structures, corruption, bribery <i>etc.</i></p>
<p>B. Factors internal to the air transport sector</p>
<p>B.1. Related to regulatory and legal issues established by governments and aeronautical authorities The regulatory and legal environment in the air transport sector is complex and dynamic, requiring compliance and adaptations to the rules of each country in which an airline operates.</p>
<p>B.1.1. Air transport security It affects the aircraft (its certification, operation and maintenance), employees (experience and qualification, work schedules <i>etc.</i>), passengers (which require monitoring in order to identify suspects) and airports (its systems, facilities and operations).</p>
<p>B.1.2. Environmental issues: noise (landings, take-offs and ground operations), gas emissions (by aircraft or ground operations) and toxic substances (ground operations) Example: flights during part of the night were banned at Congonhas (Brazil) and Frankfurt (Germany) airports. The sector has been under increasing pressure (especially in Europe) to reduce the environmental impact and increase the use of alternative energies.</p>
<p>B.1.3. Fees related to air transport Fees do not always represent costs for airlines, but can be passed on to passengers.</p>
<p>B.1.4. Consumer protection legislation For landing or take-off delays, flight cancellations, baggage problems <i>etc.</i></p>
<p>B.1.5. Legislation affecting airline employees or operations In the case of employees: salaries, benefits and charges, retirement rules <i>etc.</i> In the case of operations: rules related to baggage, access to airports/slots, permission for flight routes and times, authorization for alliances with other companies, bilateral or multilateral agreements between countries <i>etc.</i></p>
<p>B.1.6. Financial and governance legislation Many of the world's leading airlines belong to large conglomerates, are publicly traded and operate in different regions, being subject to simultaneous compliance with different financial and governance legislation.</p>
<p>B.1.7. Competition protection legislation Includes restriction on foreign ownership of domestic airlines.</p>
<p>B.2. Internal competition (within the sector)</p>
<p>B.2.1. Expansion of the LCC model in the world and strengthening of airlines in the Asia-Pacific and Middle East regions The LCC model has grown remarkably over the last few decades, gaining market share especially from the network carriers. The Asia-Pacific and Middle East regions are base to some of the largest and most powerful airlines in the world, which benefit from their geographical position (in the "middle" of the world) and the controversial (and debatable) support they receive from their governments.</p>
<p>B.2.2. Alliances, mergers, acquisitions and shareholdings When they involve the company itself: there may be difficulty with approvals from government agencies, operational efficiency may be impacted, the complexity associated with the integration of different systems, technologies, resources, processes and procedures may be greater than estimated <i>etc.</i> When they involve competitors: they can be strengthened through gains in scale, increased network and access to new markets, improved financial resources and reduced costs.</p>
<p>B.2.3. Existence of state-owned airlines or those that have government participation Present notably in the Asia-Pacific and Middle East regions. The provision of resources or subsidies by governments would result in unfair competition.</p>
<p>B.3. Infrastructure problems Their impacts are more severe when they affect airlines' hubs (main airports).</p>
<p>B.3.1. Related to airports It encompasses: congestion (generates capacity restrictions, including the need to operate through the concession of slots), failure, limitation or lack of air traffic control systems (which can result in delays or interruptions to operations, in addition to inefficiencies), unavailability or limitation of facilities (for administrative, check-in, maintenance and operation areas).</p>
<p>B.3.2. Related to accessibility (to airports) Unavailability or limitation of means of public transport and access routes.</p>
<p>B.4. Demand seasonality Although in aggregate terms air traffic has kept growing, volatility is revealed when the data is analyzed in a disaggregated way, by regions or countries.</p>

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<p>B.5. Changes in customer needs or preferences They result from changes in the consumption pattern or in the expectations of different types of passengers.</p>
<p>B.6. Quality problems, delays or interruptions in the supply of goods or services Caused by parts and aircraft manufacturers or other types of suppliers (examples: fuel suppliers, suppliers of systems and technologies that support operations, airports and their respective suppliers <i>etc.</i>). Airlines belong to complex and extensive supply chains that demand sophisticated coordination and integrations among members.</p>
<p>C. External factors</p>
<p>C.1. Economic variables A favorable economic condition is an ideal scenario for an airline.</p>
<p>C.1.1. Economic development (of regions and countries) It encompasses: economic or financial crises, inflation, industrial activity, evolution of the Gross Domestic Product, international trade <i>etc.</i></p>
<p>C.1.2. Associated with the population It includes: level of unemployment, income, level of confidence in the economy, access to credit, growth trend in educational trips and to visit friends and relatives <i>etc.</i> Tourism is a catalyst for the economy and the air transport sector, but they also directly fuel it</p>
<p>C.1.3. Middle class growth rate (in the case of emerging countries) It influences educational and leisure travel.</p>
<p>C.2. Financial risks</p>
<p>C.2.1. Market risks It includes: exchange rate (airlines operate in different countries, and their revenues, costs and expenses are subject to exchange variation), fuel price (depends on several factors: supply and demand, world refining capacity, international stock levels, natural disasters, geopolitical factors, exchange rates, speculation about the energy futures market <i>etc.</i>) and interest rates (for investments, loans and debts – example: payment of aircraft leasing). In the companies studied, in 2014 fuel expenses represented 33% (network carriers) and 38% (LCC's) of operating expenses.</p>
<p>C.2.2. Access to credit and credit and liquidity risks Difficulty in accessing credit (for example, for the acquisition of new aircrafts), risks associated with investments made or their responsible institutions, and the risk of the company not having the resources to honor its obligations. Access to credit is affected by the airline's risk rating.</p>
<p>C.3. Demographic variables</p>
<p>C.3.1. Population growth and age group distribution Example: the increase in the proportion of senior citizens favors educational, leisure and health trips.</p>
<p>C.3.2. Urbanization Urban agglomerations demand services and connectivity, influencing air transport (there is a positive correlation between the percentage of urban population and the number of air trips <i>per capita</i>).</p>
<p>C.4. Political issues</p>
<p>C.4.1. Government policies Taxes and fees, interventions in the economy (inflation control, import restrictions <i>etc.</i>), basic interest rate, infrastructure investments, sector subsidies <i>etc.</i></p>
<p>C.4.2. Crisis or political instability Examples: the crises in Venezuela and Ukraine.</p>
<p>C.4.3. Globalization It favors interaction among countries and industries.</p>
<p>C.4.4. Agreements (or lack of agreements) for the liberalization of air transport among countries Agreements can open an airline's market to competitors. In turn, the lack of agreements makes it difficult for the airline to operate in new markets. There are currently more than 2,500 bilateral agreements among countries in the air transport sector and some regions (in Asia and Africa, especially) still offer opportunities for further opening their markets.</p>
<p>C.5. Armed conflicts, wars and terrorist attacks They can directly or indirectly impact an airline. Examples: delay or interruption of operations, increase in the cost of insurance, costs related to the intensification of security measures, drop in demand, damage to aircraft, employees or passengers <i>etc.</i></p>
<p>C.6. Weather conditions and natural disasters A key factor in the air transport industry is maintaining a high daily aircraft utilization rate, allowing airlines to generate revenue and dilute fixed costs. This rate is influenced by several factors, including weather</p>

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conditions (a relatively common problem) and natural disasters. Example: between April and May 2010, Ryanair canceled 9,490 flights due to the eruption of a volcano in Iceland.
C.7. Contagious diseases Examples of relevant cases that have affected the air transport sector in recent years: the SARS epidemic in Asia (2003), the global H1N1 outbreak (2009) and the Ebola epidemic in Africa (2014). Unfortunately, the global pandemic caused by the coronavirus (started in 2020) can already be added to this list.
C.8. Alternative modes of transport and technologies that eliminate the need for transportation There are alternatives to air transport: not traveling or traveling by other means. Examples of alternative modes of transport: private cars, interstate buses and high-speed trains (typically used over short and medium distances in regions without the presence of mountain ranges or large expanses of water or desert), cruise ships (an alternative to travel by aircraft, in the case of tourism) <i>etc.</i> Information and communication technologies (such as Internet, videoconferencing <i>etc.</i>) can make transport unnecessary under certain circumstances.

Source: Elaborated by the authors based on the analysis of the documents cited in Table 1.

In the face of such a long list, a search for prioritization is inevitable. A more general analysis would point to the effects of economic variables on air traffic and airline results. While obvious at first glance (since these factors affect any industry), the fact is that the airline industry is probably one of the first to feel the effects of an unfavorable economic condition and one of the last to recover after a crisis. This is because it depends on the performance of other sectors and, by its nature, represents a discretionary expense for citizens. It is also worth highlighting some factors that contribute to making the air transport sector a unique case: the very complex regulatory and legal environment, the high specialization of the workforce, the transformations that competition within the sector has undergone in recent decades and the consequences that can result from failures in airline operations (air transport safety issues).

When Brazilian companies are compared with foreign companies, basically the same challenges and difficulties are observed. The main difference is that Brazilian companies seem to place more emphasis, in relative terms, on certain factors, especially those associated with infrastructure problems, economic-political instability, exchange rate fluctuations, and volatility associated with the capital market (being recurrent investments of a speculative nature in the country) and the so-called “Brazil cost” (a term used to designate the structural, bureaucratic, tax, labor and economic difficulties associated with “doing business” in this country).

6 STRATEGIES ADOPTED BY AIRLINES TO FACE THE VOLATILITY

Among the various strategies considered by airlines to face the complex and dynamic environment of the air transport sector, those interpreted by the authors as the most relevant and commonly used are presented below. In the documents analyzed (Table 1), these strategies receive strong emphasis, in addition to generating broad and profound effects on the main processes, functions and businesses of the companies.

Fleet modernization

Aircraft manufacturers seek to add new technologies (associated with the engine, interior, aerodynamics, materials, manufacturing techniques *etc.*) to each new aircraft model launched. Despite the high price of a commercial aircraft, new models tend to generate strong attraction for airlines because a modern fleet better meets regulatory and environmental issues (which are increasingly restrictive, especially in Europe), reduces operating costs (fuel,

especially) and favors punctuality, reliability, comfort and safety. Thus, a fleet with a low average age can represent a source of competitive advantage.

Airlines also seek, whenever possible, to achieve the benefits of a standardized fleet: lower costs related to spare parts inventories and maintenance and training, in addition to greater flexibility in the allocation of resources (crews and equipment). However, this strategy is more viable in the case of LCC companies, since network carriers, as they have broader and more varied networks, need to have a greater diversity of aircraft models to maintain their operations.

Revenue diversification

Airlines have used a series of actions to diversify their revenues and, with this, reduce their dependence on the sale of airline tickets (which still represents, by far, the main source of income). These actions include:

- The combination of passenger and cargo transport (these transported by dedicated aircrafts or by means of belly capacity: the use of cargo compartments on passenger aircrafts), allowing for profitability of routes, mitigating seasonal effects and increasing the load factor (indicator related to aircraft occupancy rate).
- Operating in different regions (the company's results in regions undergoing recessionary periods may be offset by other regions).
- The sale of various products (especially services) to other airlines and industries, derived from skills developed over the years, such as: IT (information technology), catering (provision of collective meals) and MRO (maintenance, repair and overhaul) *etc.*
- Adopting different business models within the same organization. Examples: the German group Lufthansa includes airlines whose operations approach network carrier, LCC and charter models (non-scheduled flight); American Airlines, in turn, owns network carrier and regional airlines.
- Ancillary revenues associated with: interest on installment sales of tickets, mileage sales, seat selection, checked and extra baggage, flight change fee, early check-in, priority boarding, car and hotel reservation, sale of insurance and travel packages, on board services, sale of advertising, sale of bus and train tickets *etc.*

Network and capacity management

Companies with the greatest ability to provide convenient access to desired markets (origin-destination pairs) often gain a competitive advantage. Thus, they continually reconfigure their networks, adding new routes, adjusting the frequency of flights in existing markets and leaving unsustainable markets. Network management is a process that encompasses a complex allocation of resources (aircrafts, crews *etc.*) and a systemic assessment, as the evolution of the network affects demand on/between routes: a new route tends to fragment the market, as it partially absorbs traffic on existing routes; on the other hand, an eliminated route can negatively impact the company's network connectivity, leaving the market more exposed to competitors. To cite an example, easyJet has a "Network Development Forum", formed by a group of senior executives whose role is to approve new routes and bases and allocate assets in the company's network.

Intrinsically associated with network management is capacity management. A common fear of airlines is overcapacity in the air transport industry (one of the likely effects of the coronavirus pandemic). In an oligopolistic market, this type of situation often

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encourages price disputes that lead to reductions in tariffs and profits. Thus, capacity management is a key success factor in this sector, having a decisive influence on the results of airlines. Capacity adjustments (reductions and additions) are usually associated with the analysis of the load factor. To achieve profitability, airlines strive to ensure that the break-even point of this indicator is exceeded on the routes they serve. However, if the increase in the load factor can reduce (or delay) the need to increase capacity, a very high value for this indicator (close to 100%) is not always desirable, as other indicators can be impacted (such as the punctuality rate) and overcrowded aircrafts can mean loss of revenue for the competition.

There are a set of actions that airlines can take to match capacity and demand. Capacity adjustments can be implemented through short, medium or long term actions: increase or decrease in the daily utilization rate of aircrafts, change in flight frequency, transfer of aircrafts (of different sizes) from one market to another, temporarily park aircrafts in airport yards or hangars, inclusion or exclusion of routes, reconfiguration of cabins (increasing or decreasing the number of classes), withdrawal from service and respective sale of aircrafts and leasing or acquisition of more modern aircrafts. American Airlines and United enter into agreements with regional airlines to purchase capacity to feed their hubs or serve routes that would not be economically viable with larger aircrafts. Ryanair, on the other hand, has adopted the strategy of keeping part of its fleet parked during the winter months in Europe, due to reduced demand (in 2014, for example, this strategy affected 24% of the company's fleet).

It is important to note that the decisions that support the aforementioned actions often depend on imperfect information, making network and capacity management a complex and imprecise process.

Alliances with other companies

The companies studied declare many acquisitions (total or partial, through equity participation) and numerous alliances signed with other airlines. This evidence reinforces the changes that occur in the structure of the sector (discussed in section 4.2). Alliances are noteworthy because they represent a current defining characteristic of the way air transport service is currently provided in the world.

In alliances between companies, contractual cooperation agreements are established in which the companies involved share flights (and associated services, such as ticket sales, check-in, baggage handling *etc.*), loyalty programs and, in some cases, marketing actions and airport facilities. The potential benefits are many: gains of scale, cost rationalization, network expansion, customer base expansion and increased revenues. As the most representative elements of these alliances, code sharing agreements and interline agreements have emerged over two decades ago as an affordable way for airlines to offer destinations beyond their original network. With these agreements, an airline can sell tickets for flights operated by another company using its own code and flight number, or allow customers to combine itineraries that include flights operated by both companies.

Many agreements among airlines and other members of their value chain have also been observed, especially their partners in loyalty programs (financial institutions, retail chains stores and hotels, insurance companies, travel agencies, car rental companies, gas stations, parking, e-commerce companies, bookstores, drugstores, restaurants, bus and train companies, media companies *etc.*) and technical service providers (MRO, logistics, catering *etc.*).

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Intensive use of technologies that support the operations

Airlines are intensively seeking solutions in information and communication technologies in order to improve operational efficiency, reduce costs, increase safety and improve the level of customer service. These technologies currently support basically all aspects of an airline's operations and include: website, yield management software, ticket booking/selling system (usually interconnected with partner systems such as travel agents) and check-in, smartphone applications and other technologies that mediate customer relationships, flight scheduling system, telecommunication technologies, real-time flight monitoring system, global positioning system (GPS) landing system, on board sales systems, aircraft maintenance management software *etc.*

As these technologies represent critical success factors for strategic initiatives developed by different players in the industry, infrastructure and connectivity deficiencies become a source of concern for airlines located in developing economies.

Emphasis on loyalty programs

Loyalty programs today represent a fundamental dimension of airlines' competitive strategy. The basic mechanism behind these programs is to reward customer preference and loyalty with benefits. In simple terms, choosing a company is reflected in points that, in turn, encourage the customer to use and multiply them within the same company, as accumulated points generally cannot be transferred between programs. Thus, the virtuous circle of fidelity is fed.

The number of members that frequent flyer programs add helps show their diffusion: in 2015, Smiles (which Gol inherited from Varig) had 10.3 million members, Miles & More (Lufthansa) had more than 25 million and PhoenixMiles (Air China) had 33 million, to name a few. Lufthansa and Gol decided to set up independent companies to manage their loyalty programs.

Effort to improve customer satisfaction

From the deregulation of the air transport sector in different regions of the world (for example, this occurred in 1978 in the USA and, in Brazil, gradually from 1992) and the consequent intensification of competition, airlines felt a greater pressure for the differentiation of its services. Currently, the strategies planned to meet the changing expectations of customers have a broad scope that is strongly focused on the "flying experience" – that is, the provision of the service considering all its stages: from the purchase of the ticket to departure from the airport or arrival to the hotel. These strategies aim, for example, to reduce waiting times at airports or between connections, a greater range of entertainment options on board, the expansion of the use of technologies at all points of contact with passengers, greater transparency in sharing information (especially in contingency situations such as flight delays and cancellations) and greater amplitude and flexibility of loyalty programs.

Airlines define their strategies taking into account the differences between passengers. Some are targeted at certain niches (for example, customers who want a less commoditized service). Thus, there is a close connection between strategies aimed at satisfying customers and ancillary revenues.

Risk management

In the documents analyzed in this study, there is much evidence that airlines have formal risk management processes and give great importance to them. The reports include a section (typically broad in terms of scope) on risks and countermeasures to address them are also mentioned. With the exception of three, the others explicitly cite processes, systems, programs, policies or committees involved in risk management. Various references to management systems are also found in the documents, mainly related to quality, environment, safety and financial areas.

The content of these documents suggests a clear intention of airlines to show that they recognize the risks present in their environments and, seeking to mitigate a potential negative impression, inform that they are monitored and receive the attention of top management. This intention probably stems from particular characteristics of the sector (notably, the concern with security) and of the companies themselves (as a matter of governance, they must present information about the different aspects involved in their business).

7 CONCLUSION

In this study, evidence was presented that reveals that airlines operate in an environment of instability and uncertainty. Although, historically, world air traffic has shown strong and persistent growth (on average, greater than that of the economy), the financial indicators of these companies are quite cyclical. It should be noted that, from the perspective of these data, the picture of Brazilian companies seems even more delicate. Furthermore, bankruptcies occur relatively frequently in this sector. Mergers and acquisitions, which are equally recurrent, are not always the result of opportunities sought in favorable conditions, as they are also the result of dramatic circumstances experienced by airlines. Volatility in the air transport sector can also be observed through changes in purchase orders for new aircraft, as airlines, by force of circumstances, may be forced to postpone or even cancel orders that have already been placed.

When looking to analyze the causes of volatility in the air transport sector, one comes across an extensive list of factors, many of which are not under the control of companies. This fact makes it difficult to establish preventive strategies to face them. It is also important to note that, although many of these factors are common to other industries, they take on particular characteristics in this sector. The vulnerability of air transport is also amplified due to its high dependence on the performance of other industries.

The years 2020 and 2021 will be marked in history by the global coronavirus pandemic. Despite the gravity of the present moment, it is not a mere act of hope to remember that this was not the first and will probably not be the last large-scale tragedy the world will face. In this sense, it is still feasible to believe that the airline industry will continue to stimulate the economy, business and tourism, while it will continue to be affected by various forces at the micro and macro levels (O'Connell, 2018). This leads to concerns about how to deal with the factors that make this industry so turbulent. In this study, the main strategies adopted by airlines to face their environment of instability and uncertainty were discussed. Among them, one in particular deserves to be highlighted (reinforced by the difficulties and challenges of the current moment): companies in the sector will increasingly be required to undertake a careful risk management process, taking into account their possible origins (internal to the organization, internal to the sector and external – these associated with the macro-economy). Thus, resources must be used to establish response mechanisms (preventive

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or reactive, depending on the specific characteristics of each factor) in the context of formal and robust business risk management processes.

When more concrete data becomes available on the effects of the pandemic on the air transport sector, it is bound to reveal a bleak picture. But even if this pandemic had never existed, it would not change the fact that this is one of the most dynamic, complex and sensitive industries in the world. In this context, the airlines' risk management process represents a fertile field for further investigations.

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