FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

Boeing vs Airbus: a fair match?

A textbook Duopoly revisited: Strategic interactions in the aerospace industry

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Preamble

Since this thesis mainly involves an analysis of the publicly available information regarding Boeing and Airbus and an overview of the academic literature covering this topic, this research was not adversely affected by COVID-19 restrictions. Feedback moments between the student and supervisor were conducted by means of telephone call, however.

“This preamble is drawn up in consultation between the student and the supervisor and is approved by both”

Preface

As an avid enthusiast of all things relating aviation, the topic of a comparison between Boeing and Airbus immediately grabbed my attention. It seemed the perfect opportunity to apply the skills learned in my years at Ghent University in a practical case. I genuinely enjoyed researching this topic and would like to express my gratitude towards some people who contributed to making this thesis possible.

Firstly I would like to thank my supervisor, prof. dr. Herman Matthijs for suggesting this interesting topic and for his insightful feedback. My final and very unusual year at Ghent University would not have been the same without the support of my friends and family to whom I am especially grateful. Special thanks to my girlfriend, Lisse, for her practical insights in this work and her never ending support.

I hope you enjoy the read!

Michiel Verduyn,

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Acronyms and abbreviations used

AR: Annual report

ATAG: Air Transport Aviation Group

B: Billion

BEUR: Billion Euros

CF: Cash Flow

CIF: Inclusive of Cost Shipping and Freight

CIS: Commonwealth of Independent States

CPO: Chief Procurement Officer

DDR: Deutsche Demokratische Republik (German Democratic Republic)

DoD: Department of Defense

DoJ: Department of Justice

EASA: European Aviation Safety Agency

EBIT: Earnings Before Interest and Taxes

EEA: European Economic Area

ESP: Spain

EU: European Union

FAS: free alongside ship

FCF: Free Cash Flow

FR: France

FY: Fiscal year. The period used for accounting purposes. This generally aligns with the calendar year as is the case with Airbus and Boeing.

GAAP: Generally Accepted Accounting Principles

GBP: British Pound Sterling

GDP: Gross Domestic Product

GE : General Electrics

IFRS: International Financial Reporting Standards

IPO: Initial Public Offering

LCA: Large Civilian Aircraft

M&A: Mergers and Acquisitions

M: Million

MEUR: Million Euros

NATO: North Atlantic Treaty Organization

nmi: Nautical Miles (1852 meters)

R&D: Research and development

RPK: Revenue Passenger Kilometer; a metric used to convey the airline traffic on a certain route. (Number of paying passengers * distance travelled in Km)

S&P: Standard and Poor's

SAS: Société par Actions Simplifiée (Joint stock company)

SE: Societas Europeae

SEC: Securities and Exchange Commission

UAC: United Aircraft Corporation

UK: United Kingdom

US: United States

USD: United States Dollar

USPP: US Private Placement

USSR: Union of Soviet Socialist Republics

WTO: World Trade Organisation

1. Introduction

As we speak there are currently only two global players in the production of large passenger jets, Boeing and Aircraft. They are the pinnacle in innovation of the American and European aircraft industry respectively and the culmination of more than a century of progress in the production of aircraft. Boeing and Airbus are often cited as being a textbook duopoly. Given their enormous market power and influence on the global airlines industry, the decisions of these two firms are often heavily scrutinized by both the press and authorities. This clash has subsequently led to geopolitical power struggle between the United States of America and the European Union.

Both firms are comparable in their product portfolio, being mainly large commercial jets and defence equipment, but differ in some critical ways. Boeing has a significantly larger defence department focussing on the research and development and manufacturing of military technology and equipment. This defense expertise conveniently allows for synergies with its commercial airline department[1]. In contrast, Airbus's profits are considerably more dependent on its operations regarding passenger jets, as its military component is smaller both in absolute size and in comparison, to the companies' total revenue stream compared to Boeing's. Furthermore, Airbus has throughout its history relied extensively on subsidies and other governmental financial incentives. Boeing's critique on this financial aid has ultimately led to a WTO dispute (WTO, 2010). Airbus retaliated by filing a parallel WTO challenge stating that Boeing, through its sizeable military operations is receiving indirect support from the United States in the way of defence contracts.

Travel by airplane has received a sizeable amount of criticism in contributing to global warming. Aircraft manufacturers recognize the impact of their products in carbon pollution and are heavily researching and marketing more fuel efficient aircraft. This ongoing fierce competition between the firms and the ensuing political fallout set the stage for a sector that would face its largest challenge in history: a pandemic essentially limiting all discretionary travel around most parts of the world. With airlines seriously reconsidering their future perspectives, orders on new planes have taken a major hit. Stock prices of plane manufacturers plummeted, and investors are reluctant to provide cash to an already struggling industry. The global market for aircraft is heavily influenced by strategic interactions between those two major players. The current events in the global aviation industry have renewed the old question on the mind of every aviation business enthusiast: *How do Boeing and Airbus compare to each other*?

[1] Howard Appelman, Manufacturing domain leader for Boeing Defense, Space & Security in 2010 emphasized synergies between Defense and other departments in Boeing's frontier update.

The main research part of this work structured in the following manner:

Chapter 4: Provides a historic overview of the establishment of the duopoly in the large passenger jet market. The history of Boeing and Airbus is examined with regards to their founding, financial situation, product offerings and regulatory conflicts. The chapter aims to draw parallels between the entry and emergence of Airbus as a global player and potential new competitors rising up to the challenge of the duopoly in the future.

Chapter 5: Delves into the academic literature surrounding strategic decision making in a duopoly market.

Chapter 6: Examines the potential competitors in the market of large civilian aircraft and aims to identify their interactions with Boeing and Airbus and establish their comparative strengths and weaknesses.

Chapter 7: A direct comparison between the product portfolio of Boeing and Airbus and their financial situation, with attention to each firm's specific advantage and weaknesses in the civilian and defense and space market.

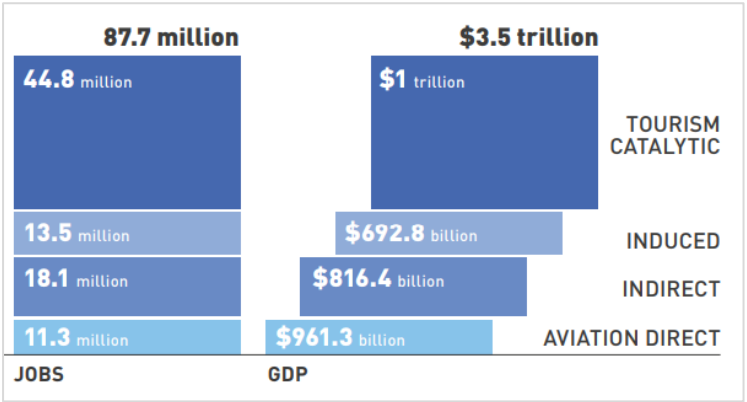
Chapter 8: An examination of the challenges in the aviation sector as of 2021. Some of which affect the firms equally, such as the decreasing demand due to the COVID-19 pandemic and global warming. Other challenges relate to specific market conditions applicable to either Boeing or Airbus.

Chapter 9: Concludes with providing an overview of future long term economic growth trends and how they relate to the demand in aircraft.

2. Relevance and motivation

It is hard to overestimate the impact of aviation on the global economy and all the people involved. The following figure calculated by Oxford Economics (2018) estimates the worldwide impact of the entire aviation industry in the year 2016. A staggering amount, and at the start of this value creating chain are the airplane manufacturers themselves. The COVID-19 pandemic is painfully present and is reshaping society in many peculiar ways. The market dynamics of plane manufacturers have intrigued economists for several decades and the emergence of Airbus as a global market player has led renowned scholars to develop insightful duopoly models. Two major firms controlling a multi-billion dollar market has raised questions about the equitability of the so called fair market competition. While the vast scale of aircraft manufacturing is often used as argument to justify the limited number of manufacturers currently available, future evolutions might prove to allow for the emergence of new competitors. This industry is continuously evolving, especially since the shockwave it recently experienced. This evolution asks for an overview of the current situation facing Airbus and Boeing and how they are coping with it. As previously mentioned, a wide range of high-quality literature exists on the market dynamics of duopolies and it would be an ambitious undertaking to contribute to it. What this work does however, is provide a critical and practice oriented overview of the current market conditions and attempts to integrate these insights with prior academic literature. A contemporary work of this nature, focussed on the broad strategic aspects of both firms is relatively scarce. Strategy is often understandably cited as a buzzword since it makes an abstraction of the day-to day business reality of companies. The vast scope of managing these large firms however, necessitates a top-down approach which this work aims to do by examining macro-economic trends in decision making.

Figure 1 Aviation industry economic impact



Source: Oxford Economics for Aviation Benefits Beyond Borders, 2018

3. Methodology and research questions

As previously stated, the aim of this thesis is to provide a better grasp of the current strategic interactions presently being carried out throughout the aerospace industry by its two major players, Boeing and Airbus. This work additionally focusses on the positioning of their major competitors and how their behaviour might influence the current status quo of the aviation duopoly. A holistic approach was used to fully encompass the wide range of key factors contributing to the strategic advantages of both companies. This work was mainly carried out by an extensive archival research using the currently publicly available qualitative and quantitative data sources deemed relevant to this topic. In addition to this archival research, a broad literature review surrounding a series of stylized facts in strategic decision making, applicable to the aerospace industry was conducted. While the aircraft industry employs a wide range of jargon, the jargon in this work is limited and clarified when not self-explanatory.

3.1. Archival research: benefits and limitations

Archival research has always been extensively applied in historic research due to its cost and time efficiency advantages and its non-invasive nature. While this work has an historic aspect to it, its main topic is strategic management of large organisation. The immense volume of business history and corporate information accumulated in the last decades repositions the method of archival research as a viable and sophisticated tool for effectively conducting singular or mixed studies in management research (Das et al., 2018). The authors further underline Aguinis et al. (2009) their observations that a mere 10% of all research designs in management studies in the 20 years prior to 2009 employ the archival research method. Furthermore, the often confidential and sensitive topics regarding corporate strategic decision making favor a less invasive approach of data gathering in comparison to the more commonly used interview-based methodology in comparable qualitative research.

In addition to employing conventional academic literature, especially in the theoretical framework, this work relies heavily on so called "**grey literature**". In general, grey literature refers to any type of information source produced and made available by an individual or organization without the express intent of commercial publication. Tillet & Newbold (2006) defined grey literature as "anything that won't stand on a shelf on its own". It includes a broad range of documents and reports such as for example patents, case proceedings, press releases, annual reports, historic records etc. It is self-explanatory that the advent of the internet has rendered the process of gathering and analysing grey literature considerably more time efficient and straight-forward in comparison to prior methods. For

example, firms are regularly posting their annual reports and other financial information for the discretion of investors and other interested readers, and the information-rich albeit lengthy commission rulings are easily accessible for industry outsiders.

Due to the inherent unorganized and unverified nature of grey literature, it poses a challenge to the researcher to verify its validity and reliability with regards to the applicable research questions. While peer reviewed papers generally comply to a strict set of universal lay-out principles, grey literature is often lengthy and heterogenous in its format, which often proves challenging to locate specific information (Mahood et al., 2014). The authors further note the ambiguity in prior studies focussed on incorporating grey literature in assessing the effects it has on publication bias. The benefits of relying on this type of information however are the facilitation of a broader research scope and providing a more comprehensive view of the available evidence according to the authors.

3.2. Data gathering

A wide variety of data were used for this research both, both qualitative and quantitative in nature and primary and secondary. The main type of information is (1) information directly provided by Airbus and Boeing themselves and includes: annual reports, press releases, supplier communications, web pages and proxy statements. A second (2) type of information is work produced by commercial organisations solicited by the firms: this includes market research reports, an IPO prospectus and credit ratings. A third category (3) is information produced and circulated by unaffiliated third parties regarding the firm. This category encompasses: reports published by (intra)governmental organizations, news articles, studies from independent firms offering insights in the industry and financial news reporting agencies. A final category (4) which was naturally used predominantly throughout the literature review is articles from peer reviewed journals.

3.3. Research questions

This work is centered around a series of strategical questions aimed at offering a holistic view of the competitive position of Boeing and Airbus against one another and against the major competitors in their industry. An initial exploratory overview on the current economic situation yielded the following questions to be examined.

Main research question: How do the two large global aircraft constructors measure up to each other in the current economic and political framework?

- **Research subquestion 1:** What mechanism drove the establishment of the duopoly, was it mainly market forces or governmental policy, or a combination of both?
- **Research subquestion 2** : What firms in what countries might challenge the LCA duopoly and how are they perceived by Boeing and Airbus?
- **Research subquestion 3:** How do Boeing and Airbus' busines operations align and what are the key differences? How does the current financial situation influence future challenges and opportunities?

4. Historic overview: establishment of the duopoly

Economic and corporate history has proven to be a valuable tool in analysing prior behavior of economic agents. In our case, valuable insights in the future of Boeing and Airbus can be obtained by taking a closer look at how the firms, their management, and the air travel industry in general, has coped with uncertainties. In addition, past behavior of firms is useful to identify specific characteristics of market participants and can help pin-point which firms are prone to collusion or have the propensity to act as a "maverick type" (Ivaldi et al., 2003). A key question this chapter aims to answer is **what mechanism drove the establishment of the duopoly**, was it mainly market forces or governmental policy, or a combination of both?

Before the 1970s the manufacturing industry of large commercial aircrafts was undoubtably dominated by the United States. The second world war lay the foundations of the industrial landscape of the country for the following decades. The war necessitated production of a variety of military equipment. After the war ended this industrial capacity could be freed up to be used for civilian purposes. In the 1960s, after the introduction of the jet engine, commercial aviation became accessible to the general public and really had a chance to take off. In the 1970s however a new player arrived at the scene, Airbus. The decision of Western-European countries to enter the aircraft manufacturing business completely reshaped the economic landscape in the subsequent decades. The following paragraphs provide a brief historic overview of the history of Boeing and Airbus with emphasis on their financial situation and strategic decision making.

4.1. Boeing

4.1.1. The early years

The company's origins lay with William E. Boeing who had a keen interest in airplanes and in 1917 incorporated "Boeing Airplane Company". Before large scale air travel became available to the general public, Boeing relied heavily on the funds provided by the US government in the airmail business to boost its cashflow. A vast improvement in the safety and reliability of air travel came with the introduction of the revolutionary 247 aircraft in 1933. Boeing claims the twin engine aircraft was the first modern passenger liner. A trip from New York to Los Angeles still took 20 hours with seven stops, inconceivably slow in the modern jet age but a leap ahead of the competition at the time.

4.1.2. World war II: Boom years

During World War II Boeing was contracted by the military to produce a wide range of equipment, predominantly bombers. The most successful type produced were the B-17 and B-29 bombers. Boeing built a staggering 17 thousand "Flying Fortresses", as the B-17 was commonly referred to, a testament to the increasing industrial might of Boeing (The National WWII Museum, 2020). By the end of the war the B-17 was considered obsolete and was being replaced by the B-29. This aircraft gained notoriety by being the only aircraft to this date to ever use a nuclear weapon in combat.

The B-29 cost 639 thousand USD per unit when it was introduced, amounting to approximately 11.5 million USD in 2021 (Federation of American Scientists, 1997). The cost of developing the aircraft however was notoriously expensive.

4.1.3. Cold war: dawn of the jet age

In the beginning of the cold war, Boeing introduced its first jet-propelled bombers: B-47 "Stratojet" and B-52 "Stratofortress". Boeing stated that every jet aircraft today is a descendant of the Stratojet (Boeing, n.d.(a)). The B-52 became the quintessential bomber of the Vietnam War and remains in service to this day. Commercial jet aviation began its life with the introduction of the de Havilland Comet, produced by a British firm. Boeing responded with its 707, ushering in the jet age (Boeing, n.d.(b)). The jet airliners completely revolutionized how people reached their destination. At the time airlines already posed a significant threat to railroad companies but it was the first-time transatlantic travel was made safe, reliable, convenient and most importantly, fast. The ocean steamers who had for over a century dominated the transport of passengers over the Atlantic became obsolete in a matter of years. The time it took for most passengers to cross the Atlantic was reduced from several days to a matter of hours. This rapid transition demonstrates how quickly a new radical technology can significantly change the way how people travel.

In the 1960s Boeing invested heavily in another new revolutionary aircraft. The Boeing 747 was presented and immediately became arguably the most recognizable aircraft to this day. Thanks to its size this "Jumbo jet" offered airlines the opportunity to let passengers indulge in unprecedented luxury on an aircraft[2].

[2] Not taking into account the airships of the airships of the 1930s which, although slow a dangerous, offered more amenities to passengers compared to airplanes.

4.1.4. Jumbo jets, financial woes and competition

With the 747 Boeing clearly cemented its position as a global leader in aircraft manufacturing. In addition to giving a boost to Boeing's reputation it was a symbol of the United's States dominance in aircraft technology during the Cold War. This prestigious project came at a cost, however. The development of the 747 during the late sixties cost Boeing 1.2 billion USD or slightly less than 10 billion USD in 2021 dollars (U.S. Congress, Office of Technology Assessment, 1991). That seems a reasonable amount today even accounting for inflation, considering the development cost of airbus' A380, Airbus' own modern "Superjumbo" is reported to run upwards of 20 billion euros. When the development costs are compared with the total market capitalisation of Boeing in the 1970s the picture looks completely different. The 1.2 billion cost represented over three times the market capitalization of the firm at the time (Ibid.). In today's world where the market capitalization of Boeing is fluctuating around 140B USD according to yahoo finance as of April 2021, the cost of a comparable project in terms of the firm's value today would be comparable to the annual GDP of an average sized economy, which of course is inconceivable. Considering how vastly smaller markets for aircraft and economies in general were in the 1970s compared to today, the development of a single aircraft type allows for much larger economies of scale. In addition to the huge investments poured into the 747 project, two other aircraft were launched with a similarly hefty development price tag, the 757 and 767. In the late 1970s, this again took a hefty toll on the company financially with their combined cost exceeding the firm's value (U.S. Congress Office of Technology Assessment, 1991). With production of the 747 projected to end in 2022 an icon of the aviation industry is at the end of its lifecycle.

Starting in the 1970s Boeing was facing increasing competition from two other American manufacturers, Lockheed and McDonnel Douglas. Both companies produced airliners and defence equipment. McDonnel Douglas merged with Boeing in 1997 while Lockheed merged with Martin and holds the title of largest US Federal defense contractor under the name of Lockheed Martin, giving Boeing a second place in 2020 (Bloomberg Government, 2020). Boeing became a public company in 1962 and has since performed a series of stock splits with varying ratios. The splits were mainly motivated by investor liquidity perspectives, i.e. the company decided to split the stock and thus offering more stocks at a lower price to make it more attractive for smaller investors (Fool, 2017). The last split was in 1997 but considering the uncertain times the company is facing as of 2021, a future split seems unlikely.

4.1.5. Mergers and Acquisitions

The 1980s were characterized by fierce competition with McDonnel Douglas. Boeing worked on some prestigious military projects as well as the Space Shuttle program. Throughout the 1980s and early 1990s Boeing introduced several other successful LCA models which are still in extensive use to this day. During the years of economic growth of the late 1990s Boeing saw potential in a series of mergers and acquisitions. In 1996 the firm acquired Rockwell, a US defense contractor. In the same year Boeing expressed its interest to pursue a merger with its main US competitor, McDonnel Douglas. On the other side of the Atlantic at the time, European countries were collaborating to make Airbus a market leader in the production of LCA's. When the Commission of the European Communities was notified by Boeing's intent, it contested the merger's compatibility with the common market, arguing that the merger would fall within the scope of the Merger Regulation (European Commission, 1998). The American Federal Trade Commission however argued that the merger was not in violation of fair competition regulations (Karpel, 1997). The case received extensive attention from scholars on international law (Boeder et al., 2000; Luz, 1999). The European commission was intent on receiving concessions from Boeing instead of outright blocking the merger, which illustrates the misapplication of anti-trust laws in favour of external, non-legal considerations (Miller, 1998). Despite these objections however, the merger went through, and Boeing became the only American firm surviving in the LCA market.

Conflicts lay ahead however, as the EU contesting the merger was a clear indicator of the fierce competition Airbus and Boeing would be having in the 21st century.

4.2. Airbus

Airbus' history began when Boeing was already a leading player in both the LCA and Defense Segment. The innovations in jet engine technology following the second world war undeniably propelled the aircraft industry to a higher level in terms of generated welfare. This new technology came at a cost however. R&D in jet propelled aircraft was radically more expensive than traditional piston powered planes. This naturally drove smaller manufacturers out of business as the fixed costs to develop jet planes was out of their reach. The introduction of the jet engine was a catalyzing force that led to all but the disappearance of European aircraft manufacturing by the early sixties (Neven et al., 1995).

Air travel in Europe however was booming at the time and the question to challenge Boeing, McDonnel Douglas and to a lesser extent, Lockheed, was gaining momentum with European government. The large domestic market of the United States allowed LCA manufacturers to produce

on an extensive scale, thus scale economies were a natural occurrence in the industry. The very long development cycle of aircraft and the significant financial risk involved in such a venture doesn't make it an attractive prospect for private agents to invest in. Market failure was a genuine concern in the aircraft industry as a monopoly by Boeing would not be advantageous in terms of competitive pricing of aircraft. At the time the determination of the Western European countries to the success of Airbus is illustrated by the scale of the financial commitments from the governments of France, Germany and the UK (Neven et al., 1995).

4.2.1. A new Consortium

Airbus was established in December 1971 as a Groupement D'Interêt Economique (GIE). A unique type of partnership was formed were the members of the consortium included British, French, German and Spanish parties. It was remarkable in the way that Airbus Industrie oversees the after-sale services and marketing while each member was responsible for the R&D and production of aircraft while being incorporated in their respective countries (European Commission, 1997).

Table 1 Airbus Consortium Members

Consortium Member	Percentage Stake
Daimler-Benz Aerospace Airbus, DDR (DASA) (Privately owned)	**37.9%**
British Aerospace (Privately owned)	**20%**
Aerospatial, FR (Government owned)	**37.9%**
CASA, ES (Government owned)	**4.2%**

Source: European Commission,, 1997

The details of the governmental support are a relatively complex mechanism but in essence Airbus is able to finance its projects by using what resembles equity but is nominally debt in the way that Airbus is able to borrow funds that it is only requested to pay back whenever the venture is profitable (Baldwin & Krugman, 1988). The American competitors took notice of the government support Airbus was receiving but it is widely believed that they decided not to contest this in the early years due to concerns that European governments would encourage their national airlines not to collaborate with the American manufacturers. The extensive political implications are again evident by the fact that government to government negotiations were even more decisive than those negotiations between the founding companies themselves (U.S. Congress Office of Technology Assessment, 1991).

4.2.2. First flight: A300

In 1967 it was decided to design a wide-body medium range aircraft by combining the expertise and technology of a number of European firms. Only then the American manufacturers, which at the time

together controlled 80 percent of the market, could be challenged (Airbus, 2019.). Airbus wanted to offer a technologically advanced aircraft to be able to gain a competitive advantage. The result was the A300. After it was launched it was essentially a new product since no comparable aircraft was on the market then. In 1982 however Boeing launched its new 767, a twin engine medium range wide body (twin-aisle) aircraft which directly challenged the A300. Baldwin & Krugman (1988) argued analytically that by introducing the A300, Airbus essentially blocked Boeing from establishing a monopoly. US arguments for unfair governmental support include lending conditions considerably more favorable than what could be obtained on regular financial markets, such as the absence of risk premia (WTO, 2010) . By doing this, Baldwin and Krugman argued that subsidy Airbus received caused prices of aircraft to drop at the cost of Boeing's profits and the "subsidy" itself[3]. The equitability of the launch aid received by Airbus is a subject of lengthy legal wrangling and both parties have solid arguments from their point of view. This discussion is however beyond the scope of this thesis but interested readers can consult the wide range of panel and case reports provided by institutions such as the WTO and European Commission. The WTO dispute is illustrative of a larger issue however, it is not only conducive to how the competition between Boeing and Airbus will evolve but additionally has a significant effect on the strategic position of potential competitors, which will be discussed later on (Olienyk & Carbaugh, 2011).

Although the A300 lay the foundations for Airbus's rise to dominate the LCA market, its introduction was ultimately overshadowed by another European aircraft, the Concorde. Despite its promising allure of nearly halving transatlantic travel time, it ultimately was a failure and subsonic flight remains the norm to this day.

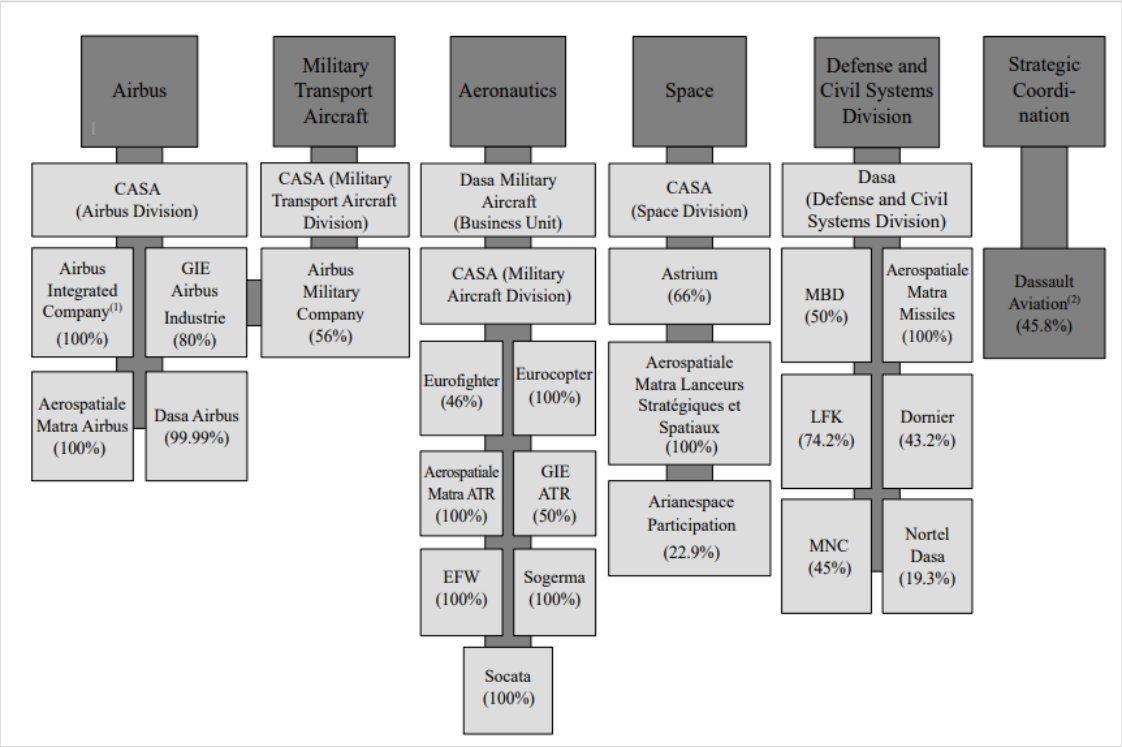
4.2.3. Capturing market share through collaborated efforts

Given the success of the A300, Airbus sought to capture more of the global LCA market by diversifying its offer of aircraft. In 1984 the A320 was launched which proved to be extremely successful in securing orders with airlines. The aircraft was a direct competitor of Boeing's equally successful 737. The corporate structure of Airbus remained complex throughout the 1980s and 1990s. The difficulties associated with the diverging interest of the different companies who formally made-up Airbus contributed to the decision of incorporating a new company combining the assets and know-how of the member firms. This ultimately led to a meeting in 1997 when a group of European heads of states and government discussed with the major European companies in the industry to seek strategic and industrial mergers (EADS, 2000). EADS, European Aeronautics and Defence Company was formed by

[3] Net welfare benefits however are smaller, cfr (Baldwin & Krugman, 1988) for a detailed analysis

consolidating the European Aeronautics and Defense industries. The objective of the merger, according to the IPO was to firmly establish EADS as one of the two leading companies in all the industries it serves. The IPO prospectus lists driving consolidations in the Aerospace and Defense industry as one of EADS key strategic objectives. One of the unique characteristics of this IPO was the offering on the Paris, Frankfurt and four Spanish stock exchanges. The divisions that made up EADS after the consolidation are presented below.

Figure 2 EADS Simplified Group Structure



Source: EADS, 2000

The chart illustrates the unwieldy corporate structure of Airbus when the group was known as EADS. In 2001 Airbus SAS was established as a joint stock company. The move towards a more simplified corporate structure continued in the first decade of the twenty first century. In its 2013 annual report, Airbus detailed the new strategy towards a clearer corporate structure. Eurocopter became Airbus Helicopters, Cassidian, Astrium and Airbus Military were merged to become Airbus Military and Space, and Airbus commercial became known as Airbus. The company states that a strong brand name for these three divisions will be a major asset. Airbus Helicopters remains market leader in its segment to this day. In October the company acquired BAE systems 20 percent stake in Airbus which reduced the company's cash position for 2006 by 2.75 BEUR (*Airbus, 2007)*. With a revenue of almost 20 billion GBP in 2020, BAE Systems is a global player in the manufacturing of military equipment and a main competitor of Airbus. In 2017 the company changed its name to Airbus SE which it still holds today. It

was incorporated under a SE, Societas Europeae, a unique legal entity in accordance with EU corporate law. This further reflects the transcontinental activities and aspirations of the company.

5. Theoretical framework: strategic decision making in a duopoly

The following pages offer a theoretical analysis of which factors could determine the strategic decision-making process of profit maximizing firms in the aircraft manufacturing industry. The framework is built around a serious of stylized facts in strategic decision making expanded with a literature review of empiric and analytic research by scholars in business strategy, international trade and public administration. It includes factors determining how strategic managers decide to embark on risky and long-term investment projects and how they cope with possible threats in the way of exogenous market shocks and potential competitors. The aviation industry is highly globally connected with costumers and producers relying on worldwide distribution networks and bound to stringent regulation. This theoretical framework aims to clarify how global competition in aircraft manufacturing is shaped by the interactions between a series of intertwined competing and surprisingly, to a large degree collaborating firms.

Classical micro-economic theory provides a valuable framework for analysing an equilibrium between two firms offering a *similar yet differentiated products* to consumers. It is commonly known that the competition between Airbus and Boeing is often quoted as the exemplary case of a textbook duopoly. A duopoly is an intermediate form between monopoly and perfect competition.

5.1. General characteristics of a duopoly market

A major characteristic of this theory is **interdependence**: when one firm adjusts the price or any other substantial characteristics capable of influencing the consumers decision making progress of its product, the competitor has to reflect on its corporate strategy in order to remain competitive

Furthermore, the duopoly theory implies certain **features of a monopoly**: Especially in the case of capital heavy industries such as the production of aircrafts, market entry requires significant barriers to be overcome for new entrants. The existence of **scale and scope economies** is implied. As is the case with a monopoly, the relative size of the investment cost to the market results in both large-scale cost intensive manufacturing and the offer of a wide range of products to fully capture the largest possible market share. It should be noted however that since these theories assume typical economic supply and demand mechanism, the application of duopoly models on Boeing and Airbus poses significant challenges. The two firms both have a large military component where the demand side of the products operates differently than in the market for civil aircraft. A unique feature of the defense

market is the way how the government operates both as a regulator and a single, monolithic product procurer, i.e. a monopsony (Driessnack & King, 2004).

Cournot developed a model to illustrate a market equilibrium between two firms competing for the same demand. The *Cournot model* implies that any new entrant could potentially enter the market and that the technology is freely available, however significant fixed costs are required. In addition, new entrants have to compete with incumbent firms who have already established a loyal customer base.

5.2. Game theory in corporate decision making: strategic variables

5.2.1. What determines corporate strategy?

Strategic decision making is at its core determined by heterogeneity in firm organizational capabilities, behavior and competitive advantage (Trigeorgis & Reuer, 2017) An oligopoly, in this case, a duopoly is defined by the strategic interactions between its participants. I.e strategy is an inherent feature of a duopoly (Spencer & Brander, 2008). Traditional economic theory assumes rationality of its agents. Irrational and downright wasteful investment decisions, deemed strategically sensible by its managers, have been pervasive in aircraft manufacturing, however. This chapter further elaborates on these decisions and offers a brief overview of the common paradoxes and fallacies scholars have observed in this industry. Powell et al. (2011) argue for the integration of concepts of social psychology in strategic management since realistic assumption about human cognition contribute to strengthening the usefulness of strategic theory.

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5.2.1.1. Examplary case: A380 project

Kretschmer (1998) took a closer look at the developer's dilemma in the case of Boeing and Airbus. It is an application of the well-known prisoner's dilemma, a key component in game theory. The author states the "developer's dilemma" which posits that when two companies are given the opportunity to tap into a potentially lucrative market, in this specific case that of the new generation "super-jumbo", only one can reap the benefits. The market is not big enough to pay-off the required investments for such a huge (almost 10 billion euro) project4 to two firms. This was the reason behind Boeing's cancellation of its new super-jumbo project since the projected losses would be too high given the

[4] The estimated project cost was reported to be 9.5 billion euro (2000 euros), the actual project cost is estimated to be significantly higher

competition with Airbus' new A380. If none of the companies would have developed their super-jumbo, an ex-ante very lucrative market would remain unexplored. Whereas if both companies would have gone through with their investment projects, the potential losses would be significant. In this case, the Nash equilibrium would be if only one of the firms develops their project, which is exactly what happened. Airbus went through with the development of their new A380, which would fail to live up to the hype due to shifting airline preferences over time, while Boeing cut their losses stating, "the market isn't ready". This illustrates the significance of a classical textbook problem such as the *prisoner's dilemma* in a modern and complex business environment.

In hindsight the A380 project was a financial failure. Besides showing not to be profitable to airlines, the extra costs incurred by airports to facilitate the handling of this enormous aircraft are a financial loss. Opposite to the tangible reality of the A380 not living up to its promise financially, it does however give airlines a reputational boost due to its high prestige. The comfort it offers in comparison to smaller planes does provide incentives for certain travellers to fly with airlines operating A380 flights. The event that ultimately caused airbus to pull the plug from the program was Emirates' decision to not continue ordering the aircraft (Airbus, 2020). Airbus counted on airlines deploying these large jets, with a high capacity, on very busy routes between "Hubs" (Eg. London, the Gulf States, Singapore, etc.) Travellers however prefer to fly directly between their home cities and their destination instead of having layovers at larger hubs, thus shifting the preference towards smaller jets catering to this need. Aircraft models such as the Boeing 777 and 787 Dreamliner and Airbus' A350 cater to this market by offering airlines a smaller aircraft at a lower cost in comparison to the A380 and to a lesser extent Boeing's 747. The smaller aircraft implies less capacity and thus revenue, but this is offset by lower operational costs in terms of fuel, personnel and airport fees. Chapter 7 offers more insight in a potential contemporary application of this developer's dilemma in addition to researching airplane market dynamics. In the following pages I go into further detail on the strategic variables involved in influencing the decision-making process of Boeing and Airbus.

5.2.2. Sunk costs: market exit and project abandonment implications

Given the characteristics of a duopoly and the large investments required for firms to bring a good to the market, both Airbus and Boeing have some degree of monopoly power. These large fixed costs provide a significant deterrent to new firms and can lead to what is called a Cournot-Nash equilibrium. (Grossman, 1981) introduces the concept of how firms make contracts with customers in studying the Cournot strategies and how this implies that a firm's strategy is given by a supply function. The author

argued that not only fixed costs provide a barrier to entry but also sunk costs. These sunk costs include investments that are impossible to recuperate should the project fail to materialize.

Gibrat (1931) stated that a firms proportional growth rate is unrelated to its absolute size. Cabral (1995) used prior empirical work to establish a theoretical framework to refute "Gibrat's Law". The author used the concept of sunk costs to provide an explanation for the observed inverse relationship between firm size and firm growth. Small firms are expected to have a lower likelihood of survival (Mata et al., 1995) and thus of leaving a new market than larger firms. They can expect to have a high risk of potential losses i.e. sunk costs. The strategic decision for smaller firms is to minimize potential losses since the likelihood of failure is large. In a realistic case sunk costs are not expected to be completely "lost" should the project fail. A firm can expect to recoup some of its costs through sales or acquisitions by other firms.

5.2.2.1. Paradoxes

Seabright (1996) introduced the term "**starfish effect**" to economic theory and used it to explain how entry of a new player in an oligopolistic market might paradoxically facilitate the entry of another player by reducing the scale and scope effects of the incumbent firm and thus reducing its output. This is further illustrated by the theory that although extremely high sunk costs in aviation makes entry by a new firm unlikely, it consequently renders exit by the new firm equally unattractive, thus neutralizing the incumbent firm's predation strategies[5] (Cabral & Ross, 2008). Reduced predation strategies arguably contributes to creating a more attractive environment for another new player to the market.

5.2.2.2. Fallacies

The "**sunk-cost fallacy**" i.e. the way economic agents take into account the amount of resources that has been invested in a project to determine the future outcome of said project, has become a well-documented phenomenon in behavioral economics and investment decision making (Arkes & Blumer, 1985). It is an indicator of how rational economic behavior is influenced by psychological factors. The aircraft industry is especially vulnerable to this less than ideal way of thinking. Aircraft manufacturers invest huge sums into projects where the rate of success is hard to estimate but the potential pay-offs if the project succeeds are significant. This phenomenon even derived its name from an event in the aircraft industry. The Concorde was a highly ambitious, but ultimately financially disastrous project where huge funds were committed to its success, supporting on the reasoning that prior investments justify future investments. This event led to the sunk cost fallacy also being called the "**Concorde**

[5] A predatory firm is a any company who seeks to aggressively acquire other firms or part of their business units while relying on their significantly larger financial resources.

effect". Furthermore Statman and Sepe (1989) found empirical evidence that the stock market perceives a firm's decision to terminate a project as good news, hence this is reflected in the share price.

The sunk cost fallacy is extremely common and can be a major factor in clouding manager's decision-making process. From a purely economic perspective, prior investments are irrelevant when the project is known to fail, however psychological motive often get the upper hand.

The sunk cost theory is applicable both to existing firms wishing to diversify their product range by investing in a new project and to new firm vying to enter an existing market. The "liability of newness" suggest that firm age increases the likelihood of survival (Stinchcombe, 2000). There is evidence to support the theory that recessions have a moderating effect on both the likelihood of firm exit and the type of exit. During economic boom cycles the likelihood of dissolution by M&A increases in high tech sectors, while in bust cycles the likelihood of closure increases (Grilli et al., 2010). The likelihood of larger firms exiting a market increases more rapidly than the likelihood of SME's doing the same when demand is low, however smaller firms still remain more likely to face difficulties than larger firms contributed by their smaller financial buffer (Varum & Rocha, 2012).

The fact that prior investments should not be a factor in determining future investments is intuitively clear, but the introduction of the concept of sunk costs in strategic decision making asks for a critical review of the market power of established and larger players.

5.2.3. Learning by doing

Fudenberg & Tirole (1983) discuss the consequences of firms' using experience as a strategic variable, they specified how firms consider the effect of their learning-by-doing on the actions of their rivals. *Learning-by-doing* intuitively means that firms manage to continuously decrease the marginal costs of, in our example production of aircraft throughout the product's life cycle. They do this by applying knowledge previous gained in the long run and thus becoming more efficient. Another key characteristic of studying strategic planning of firms acting in the same industry is the degree *of diffusion of knowledge*. Innovation doesn't occur in a complete vacuum, there is a certain degree of transfer of knowledge gained within a firm to across the whole industry. Based on research on Chinese firms with joint ventures it is argued that significant channels of knowledge acquisition are established through overseeing effort and management involvement (Tsang, 2002). With economies varying in a great degree on the amount of human capital available, these aspects are a determining factor in firm's investment decisions. In a global dynamic perspective, it is proven that human capital poor agents can experience long-run output growth by repeatedly switching between different

technologies, since its lack in skill is not particularly bound to a specific technology (Yovanovic & Nyarko, 1994). It can be argued that these observations are conducive to firms in emerging economies having the opportunity to implement their largely low-tech industrial capacity for the manufacturing of more advanced products such as aircraft. The decision of domestic firms seeking to gain a foothold in foreign economies has risen the question as to what type of partnership with foreign manufacturers is most beneficial. Dhanaraj and Beamish (2004) argue that the degree of equity ownership in joint ventures is strongly correlated with the degree of success, with wholly owned subsidiaries having on average a much smaller dissolution rate than traditional join-venture partnerships with minor equity involvement. Fudenberg & Tirole (1983) state the following implication for policy makers, learning by doing clearly improves welfare and further welfare benefits can be obtained by transferring incentives to the more mature phase of the industry through balanced- budget tax schemes.

5.2.4. Regulations and institutions

As is argued in the historic overview of Boeing and Airbus, the way these firms determine their commercial strategies is undeniably intertwined with the regulation- and institutional framework from wherein these firms operate. They are more than a background context but strongly and directly influence the way companies formulate and implement strategy to gain a competitive advantage (Ingram & Silverman, 2002) This view is not only applicable to the domestic market but can be extended toward foreign investments of these firms. Anand & Delios (2002) studied absolute and relative resources as determinants for international acquisitions and argued that while technology is sourced locally and exploited globally, downstream capabilities are being sourced and exploited locally. The authors define downstream capabilities as not geographically fungible and including aspects such as marketing.

In aviation, joint-ventures and acquisitions are a common occurrence, with firms even collaborating with potential competitors with the aim of promoting synergies. Meyer et al. (2009) have found that institutional frameworks are a strong determinant in the *type* of strategic partnerships that are formed, with weaker institutions incentivizing firms to acquire resources by **joint ventures** and stronger institutional frameworks promoting **acquisitions** of domestic firms by foreign companies. Peng et al. (2008) further argue for the integration of institutional characteristics of emerging economies in international business strategy.

When the scope of the observed consolidations in aerospace is expanded from the strict duopoly in the LCA market to the firm's defense and space units, government defence procurement centralization played a significant role in the consolidations process in addition to the more traditional

presumption of consolidations driven by lower government defense spending after the cold war. (Driessnack & King, 2004)

5.2.5. Strategic decision making in times of crisis and uncertainty

The COVID-19 pandemic and the ensuing economic downturn has again questioned the importance of strategic planning on firm performance.

There is evidence to support the theory that strategic management is beneficial to the firm in the way that it accounts for behavioral changes in corporate decisions by competitors. A corporate strategy is useful in establishing a clear offensive path of the firm (Preble, 1997). However it often fails to account for changes in macro-economic trends, such as a pandemic, due to the unpredictable nature of these events. With prospect theory (Kahneman and Tversky, 1979) clearly established that in uncertain situations economic agents significantly overweigh low probabilities which leads to increased risk taking from a purely psychological point of view.

> "*The most important feature of entry and exit decisions in an environment of ongoing uncertainty is "**hysteresis**"" – (Dixit, 1989)*

In a general context, the phenomenon of hysteresis implies the persistence of effects after the causes that have instigated those effects have been removed. In the field of international trade, the theory states that foreign firms are forced to stay in a domestic market after entry due to the improbability of recovering the incurred entry costs even after the causes that moved them the new market have been removed (Dixit, 1992) In the case of the aircraft duopoly Airbus saw an opportunity to tap into the lucrative and booming US LCA market in the 1960s even though the troublesome economic situation of the 1970s and consequential increase in fuel prices would reduce its opportunities. (Bernanke, 1983) argued that economic agents are benefitted by delaying commitment of scarce and unrecoverable resources to an investment project when faced with uncertainty, while awaiting new information.

The academic consensus on firm risk-taking behaviour during crises is rather ambiguous. Some scholars argue that low performance increases manager's tolerance towards risk taking behavior (Gavetti et al., 2012). There is however evidence to suggest that during periods of economic crises, firms are reluctant to explore new opportunities for revenue and acquisitions in markets abroad. They rather decide to focus on their home market and core business to minimize risks (Cerrato et al., 2016).

Taken into considerations the assumptions of these models, what is important to remember from this broad theoretical overview is that both Airbus and Boeing compete on a market where the demand

for the product of each individual manufacturer is highly dependent on macro-economic trends, but also and arguably more importantly on the product offered by, and in general the behavior of their competitor.

6. Threats to the duopoly

The aforementioned rise of emerging markets and their boost to the global aircraft fleet has raised the question in what way these countries pose a threat to Airbus' and Boeing's duopoly in LCA. The increase of globalisation in the decades following the second world war has shifted the global epicentre of the manufacturing industry from Europe and America to Asia. Mainly motivated by lower labor costs, firms have relocated their plants to regions in emerging economies. China has become the factory of the world and history has shown that this shift in economic power is not cyclical but is here to stay for the long term. Economists are almost unanimous that China will become the largest economic power in the world in the near future. With this increased economic strength follows the threat, from a western point of view, of a nation that can harness its industrial and economic strength to apply pressure to other nations. In addition to the threat from new manufacturers emerging in rapidly growing economies, other more established aircraft manufacturing industries might tap into the duopoly's market share by increasing their efforts in producing large passenger aircraft. While underlining the competitive advantages of these potential competitors, this chapter provides some more background on how firms in these countries interact with Boeing and Airbus in more collaborative ways. In contrast to the defense market where Boeing and Airbus are competing with a multitude of other firms, a duopoly by definition implies the absence of (potential) competitors in the LCA market. It is therefore valuable to critically analyse firms operating at the fringes of the market and establish whether they have the capabilities of future competition with Boeing and Airbus.

Bédier et al., (2008) stated that the key characteristics of a nation's economy to be suitable to accommodate a new aircraft manufacturer are the following: **government stewardship of aerospace industry**, **access to capital, design capabilities, manufacturing capacity and product and demand**.

Initially the rise of emerging economies was mostly fuelled by their comparative advantages in low tech, labour intensive industries such as textiles. However in more recent decades, China in particular has caught up with other economies in areas of the economy requiring skilled labour to produce high tech manufactured goods. The two most important imports to the US from China in 2019 were: electrical machinery (125B USD) and machinery (92B USD) (Office of the Unites States Trade Representative, n.d). The total amount of imports amounted to 451 billion USD[6], a staggering increase of 342% percent compared to levels in 2001 when China was not yet a member of the WTO (United States Trade Representative, n.d.)

[6] The US import figures appear to be inflated compared to its export since both import and export are calculated using different Incoterms (CIF compared to FAS) (Shenkar, 2006)

Imports to the European Union are comparable both in size (363 billion Euro) and composition; mostly comprising of machinery and vehicles (Eurostat, 2021). Both the US and EU run large trade deficits with China and what is most worrying from the perspective of European and American aircraft manufacturers is the composition of this trade deficit. It is not illogical to assume that since China has already established a strong strategic position in the manufacturing of machinery and vehicles it would also seek to gain a foothold in the aircraft industry, especially since its soaring domestic demand for reliable but cost-efficient aircraft.

The concern among aircraft manufacturers and industry specialists for a new player threatening the Airbus and Boeing duopoly is not a recent one. Aircraft manufacturing has always been a generator of large trade surpluses for Western Economies, especially for the United States, the concern of economists and politicians that a new player gains a foothold in this industry is well grounded. It is clear that due to the high value adding nature and possible applications in military technology, aircraft manufacturing is often a bone of contention between national governments. The evolution of the industry is not only an economic issue but also, and arguably more, a political one. A new aircraft manufacturer could certainly challenge the status-quo and create significant political turmoil. Given the history of the duopoly where Airbus successfully challenged the hegemony of the United States in aircraft manufacturing through sustained governmental support, all eyes are on the new economic powers which could repeat this historical event.

6.1. China and Comac: a potential challenger of the status-quo?

In China, the main competitor for domestic airlines on the short to medium distance is high speed rail. Given the vast geographic expanse of China, the country has spent billions of dollars on its high-speed rail network to facilitate domestic travel. As of 2020 the country has an unprecedented 37,000km of modern high-speed rail. On these medium distance domestic routes, rail travel is directly competing with airlines. The expansion of high speed rail is both a sign of the vast increase in travel needs and possibly, a factor which is of bigger concern for aircraft manufacturers, a shift of customer preference towards a more modern and cleaner way of travel. The shift back to travel by rail is happening all over the world, with China leading the way. The United States, where travel by car and airplane is still the predominant way of domestic travel for most people, is lagging behind.

With the significant increase in domestic travel in China, the country has previously relied solely on imported airplanes to fuel this demand. China Eastern Airlines, Air China and China Southern Airlines, the “big three” among Chinese airlines all boast a large fleet of Boeing and Airbus airliners. These planes are mostly small, narrow body i.e. single-aisle aircraft, ideal for these short routes. The US,

which is currently still the largest domestic market for commercial jets, has seen the position of largest Airliner gone to a Chinese airline. China Southern airline has recently taken the spot of largest airline in the world from US based Delta Airlines (Hashim, 2020).

To capitalize on this boom in domestic demand for airplanes, Chinese industry has been working on its own new commercial airplane. Motives for this are unclear but one can assume that not only economic factors are at play. Given the extensive experience and scale advantages of Airbus and Boeing at manufacturing commercial jets, it is unlikely that producing an aircraft at a lower cost will be economically viable in the short term. More political motives might be at play, including independence from foreign companies and a certain sense of national pride. This sentiment is reflected in the seemingly inexhaustible financial sources available to the company, however the reluctance of foreign suppliers to provide parts to Comac is expected to be a significant challenge.

Comac, a state-owned aircraft manufacturer based in China has been investing heavily in a new commercial jet suitable for short to medium distances. The model ARJ 21 has been on the market for several years as of 2021, however this jet is not considered a significant threat to Airbus and Boeing. As a regional jet its capacity is limited to around 90 passengers (Comac, n.d.). This capacity is at the lower fringes of the jets offered by Airbus and Boeing. Of more concern is the introduction of the new **C919 jet**. Comac has been working on this product for extensive amounts of time now, but this airplane is expected to be delivered to customers in 2021.

As previously stated, the company is considered a symbol of the manufacturing and technological might of China. This sentiment is reflected in the seemingly inexhaustible source of state funding available to the company. Comac is an unlisted state-owned enterprise and thus trying to get a grasp of the financial situation of the company is almost impossible due to its opaque nature. This financial opacity might prove to be an asset of the company since it essentially limits its competitors from assessing its strategic capabilities. However, the reluctance of foreign suppliers to provide parts to Comac is expected to be a significant challenge (Oxford Analytica, 2015). The significance of global trade in an industry as complex as aircraft manufacturing is hard to overestimate.

In April of 2020 the Trump administration provided the approval for jet engine manufacturer General Electric to export its engines to China for use in the manufacturing of Comac's new jet, stating the company is not considered a threat to national security (Qiu, 2020). At the end of his term however President Trump reportedly added Comac along with Xiaomi and seven other Chinese companies to a military blacklist. American investors will be banned to invest and have to divest their currently held assets in these companies (Stone, 2021). This illustrates the inconsistency of American foreign trade policy towards Chinese firms. It also is a key example of the **intertwinement of global aircraft**

manufacturing supply chain. Both Boeing and Airbus are also relying on GE to provide high quality jet engines for their aircrafts.

The ambitious aspirations of Comac are illustrated by its prestigious new project: the development of a large wide body aircraft capable of flying long distances. Comac is collaborating through a joint venture with Russian aviation conglomerate UAC to produce a more cost efficient wide body aircraft, the C929 (Wenqian, 2017). The partnership combines the technical expertise of Russian firms with the financial leeway of Comac. When the C929 is added to Comac' product offering, the company will have a full range of aircraft available comparable to Boeing and Airbus. Although the aircraft is still in its early stage of development and given the estimated development cycle of an aircraft of this size to be over a decade, it could be an indicator of intensified upheaval in the market in the distant future.

6.2. Russia: revival of former industries?

Ever since the cold war, the Soviet Union has had a strong presence in construction and design of military oriented aircraft. The central government decided which type of aircraft it required and dictated nearly every aspect of its production process. Starting in the 1980s however, the industry shifted its focus towards a more civil oriented aviation industry by manufacturing LCA's, largely motivated by upgrading the country's civil aviation network, creating employment and generating revenue through potential exports (Andersen & Peder, 1993). Aviation in Russia during the final phase of the cold war was relatively technologically advanced, even offering a supersonic aircraft comparable to the Western Concorde, the Tupolev-144. After the dissolution of the USSR and a rapid transition towards a market-oriented economy however, its industry was ill-prepared to compete on a global level. The Commission argued in 1998 that the lack of available capital for the Russian firms remains a serious bottleneck which limits the possibility of Russian aviation competitiveness on a global level for at least the first decade of the 21st century.

In a similar process as what previously occurred in Western European countries, a presidential decree backed by Vladimir Putin stipulated a move towards a more consolidated aviation industry in Russia, with the aim of "protection and development of the scientific and industrial potential of the Russian aircraft industry, the security and defense of the state, and the concentration of intellectual, industrial, and financial resources to implement long-term aviation programs." (UAC, n.d.). UAC offers a wide range of aircraft in four categories, civil i.e. passenger jets, military, transport and strategic and special purpose aircraft. From a financial perspective the company is surprisingly open, openly publishing its Annual Reports in IFRS for the interests of its investors. This is in stark contrast to the lack of financial openness from Chinese manufacturer Comac. The latest financial information available however

covered the fiscal year 2017. The company reported a consolidated revenue of approximately 450 million Russian rubbles in 2017 which is in another league compared to the revenue generated by Boeing and Airbus. Contemporary academic coverage in English focussed specifically on the Russian aviation industry is scarce. Interestingly however it is reported that strategic partnerships, mainly in the form of joint-ventures, between the western duopoly and Russian as well as Chinese firms have been an impetus in gaining technologic knowledge and even complying to international avionic certification standards for these competing firms (MacPherson & Pritchard, 2003).

6.3. Brazil: Embraer, niche player going mainstream?

Situated in Brazil, Embraer is the third largest manufacturer of civilian aircraft products and is widely reported as a competitor of Boeing and Airbus. The company has a strong foundation in the manufacturing of small regional jets up to 150 seats and claims to have a 29% global market share in this segment (SEC, 2021a). Embraer has grown from a small government-controlled company aimed at promoting the national aviation industry to a global, publicly listed market player with an annual revenue of almost 4 billion dollars in 2020. In contrast to Boeing and Airbus, Embraer's positioning on the aviation market is focused primarily on production of smaller aircraft aimed at the consumer's demand for short range, flexible and affordable services. In addition to producing commercial airliners for regional flights, the company has strong interests in defense products and niche markets such as executive and private aircraft, with 17.3% and 28.4% of their total revenue derived from defense and executive business units respectively. In contrast to Russian and Chinese manufacturers, Embraer is focused on the global market with domestic demand playing a minor role for the firm. The firm's international character is illustrated by its revenue being almost entirely dominated in US dollars. (Embraer, 2021; SEC, 2021a; 2021c). These international aspirations result in the firm being regularly obligated to report its financial information to US regulators such as the SEC. In addition to these financial regulations, the company's global market presence is significantly determined by uncertainties involved in obtaining international certifications for its aircraft. Embraer reports regulators such as the FAA and EASA as being particularly stringent, and thus securing these certificates for their aircraft is lengthy, costly and involves significant uncertainties whether approval is obtained at all.

As reported by the company, it is competing directly with Airbus' smallest commercial jet, the A220 for market share in the segment for low demand routes. Embraer does not directly disclose Boeing as a competitor; however it can be argued that the company seeks to gain market share from Boeing's

smaller aircraft such as certain versions of the 737 in addition to Airbus' other smaller aircraft like the A318 and A319.

6.3.1. Joint ventures causing conflicts

On January 24, 2019, Embraer entered into a "Master Transaction Agreement" with Boeing aiming to establish a new level of **strategic partnership** by creating two joint-ventures in both the commercial and defense business units (Boeing, 2020; Embraer, 2021). The agreement was terminated by Boeing stating that Embraer did not satisfy the necessary conditions of the partnership (Boeing, 2020). Boeing claims that the firm merely exercised its rights to terminate the partnership, Embraer however argues being in full compliance with the agreement and that the resulting arbitration proceeding filed by Embraer are a valid enforcement of their rights. In its 2020 annual report, Boeing does not disclose a reasonable estimate of the potential loss incurring from the proceedings by Embraer, while Embraer claims their losses from the terminated partnership amount to over 111M USD incurred in 2019 (Boeing, 2021; Embraer, 2021). With the agreement, Boeing sought to further advance its **consolidation efforts** in the commercial aircraft business which would significantly strengthen the duopoly. The transaction valued Embraer's commercial aircraft operations at 4.75B USD of which Boeing would acquire 80% for a transaction price of 3.8B USD (Boeing, 2018). Boeing was anticipating pre-tax cost synergies of 150M USD by year three. It can be argued that Embraer being the smaller firm was comparatively more adversely affected by the termination of the partnership regardless of whether the conditions of the agreement were met. In a similar fashion to the government support received by Airbus, Embraer is benefiting from **government support** to improve domestic airline services *(*Oxford Analytica, 2014a) The flip side of the governmental support Embraer received by Brazilian government, is its arguably weak institutions. The process of Boeing forming a joint-venture with Embraer is in line with the research arguing that in weaker institutions, joint-ventures are preferable in comparison to a direct acquisition of a foreign firm.

Finally, a stark contrast of the market conditions where Embraer operates, in comparison to Boeing and Airbus, is the presence of increasing political instability combined with weak economic performance and currency risks[7] in the years 2019 and 2020 in Brazil. Embraer acknowledges that these characteristics may adversely affect their operations and ultimately financial performance (Embraer, 2021). Older studies have concluded that Embraer will not be a significant challenger to Airbus' and Boeing's dominance since, despite its solid products and positive financial performance,

[7] A large fraction of Embraer's costs are incurred in Brazilian reals while revenue is almost exclusively in USD. Volatility of the real would affect the company's margins (Embraer, 2021)

the company has no ambitions to compete with the more experienced players in the 150-plus seat aircraft category (Oxford Analytica, 2014c). This historic observation, combined with the short-term prospects of the aviation industry looking quite grim, is not expected to change in the near future.

6.4. Canada: end of an independent national aviation industry?

Vehicle manufacturing in Canada has a long history with the countries' most well-known manufacturer, Bombardier tracing its history back to 1907 when it started producing snowmobiles. In the 1970s the firm started producing trains and in the 1980s Bombardier ventured into the aerospace sector. Similarly to Embraer, Bombardier currently has a wide range of aircraft aimed at private and executive travel. In the beginning of the 21st century to company sought to embark on its most aviation project to that date, the development of a narrow-body commercial jet aimed at regional flights, the C-Series. The company faced solvency problems however, with its debt increasing to a substantial 9.3B USD in 2020 (Bombardier, n.d.). In 2014 Bombardier sought to gain cost advantages and signed an agreement with Chinese manufacturer Comac for the cooperative development of common systems for Bombardier's C-Series and Comac's C919, however the deal was terminated not long afterwards (Oxford Analytica, 2015).

6.4.1. C-Series becomes A220

The argument of **inequitable subsidies** again arrived at the scene when Boeing filed an anti-dumping petition at the U.S. Department of Commerce which determined that the C-series was sold at less than fair value. The US International Trade Commission however concluded that the US industry, represented by Boeing, is not materially threatened or injured by Bombardier's aircraft in this department (USITC, 2018). Bombardier's victory in the case was short-lived however, as the company's precarious financial state necessitated a divestment of its C-Series operations. While Boeing's complaint was pending, the threat of tariffs[8] urged Bombardier to negotiate with Airbus for a potential sale of its C-Series. The deal is reported not to be motivated by synergetic alliances, but merely by an ailing company seeking to circumvent these tariffs (Financial Times, 2018). Regardless of the motives of the deal, Bombardier needed cash.

What began as a strategic partnership between Bombardier and Airbus ended with the complete divestment of Bombardier in its C-Series (now A220) in 2020, with Airbus paying 591M USD for a 75% stake, with the remainder held by the government of Quebec (Airbus, 2020). The business unit

[8] Reportedly up to 300%

become known as Airbus Canada Limited Partnership and is represented in Airbus' corporate structure in the next chapter of this work. With the carve out of Bombardier's C-series effectively came an end to Canadian presence in the manufacturing of large commercial Aircraft. The end of Bombardier's commercial aircraft manufacturing was further accelerated by the sale of its CRJ regional jet program to Mitsubishi in 2020 for approximately 550M USD *(Bombardier, 2020).* The company's private jet business unit however remains operational to this day. With Canada being a developed country harbouring strong institutions, the strategic decision of airbus to *acquire* Bombardier's business line rather than forming a collaboration through a joint-venture is in line with prior research regarding the institutional framework of cross-country collaboration.

6.5. Japan: Close collaboration with American aviation manufacturing

In Japanese economic history, aviation has played a major role until after WWII, when the country's manufacturing capacity of aircraft was severely limited. In recent decades however, Japanese industrial conglomerates such as Mitsubishi have made major progress in establishing themselves as key players in the aircraft manufacturing market. It is reported that the impact of Japanese industry on Boeing's operations is hard to overestimate, with former US ambassador to Japan, Caroline Kennedy, even holding a seat in the board of directors of Boeing (Ostrower, 2020). While a strong degree of collaboration exists between Mitsubishi and Boeing, with nearly a third of the components in Boeing's 777 and 787 being manufactured by Mitsubishi, it can be argued that Japanese industry might be on a path to producing their own larger jets in order to compete with the duopoly (Olyienk & Carbaugh, 2011). Whether Mitsubishi decides to jeopardize its strong business collaboration with Boeing by trying to enter the lower end of the LCA market itself remains to be seen in the future. The firm reports that its new SpaceJet regional aircraft is destined to disrupt the status quo in the underserved regional jet market, which is indicative of the ambitious plans of the company (Mitsubishi, n.d.)

6.6. How are Boeing and Airbus perceiving this threat to their market presence?

- **Boeing** acknowledged in their 2019 and 2020 annual reports the threat they are facing from industry competitors in the LCA market. They recognize that the grounding of 737MAX aircraft has significantly impacted their market share in the delivery of single aisle aircraft in 2019. Furthermore, other competitors which are discussed above are competing with Boeing with the support of extensive government funding. Boeing states that these competitors are developing aircraft which may not be commercially viable given the extensive "launch aid". The government funds significantly reduce the commercial risk associated with the research and development of new aircraft. They further state that this market environment creates an atmosphere of extreme price competition which is expected to intensify in the following years (Boeing, 2020; 2019)
- **Airbus** offered a brief analysis of the competition in their 2020 annual report. The company mentions Embraer as a potential competitor since in addition to their regional jets, the Brazilian company is extending its focus to the development of larger jets. In comparison to Boeing, Airbus specifically mentions the Chinese constructor Comac with the development of their C919 aircraft in their annual report. In this manner, the company sends a signal to its shareholders that it intends to incorporate this potential threat in its future strategy (Airbus, 2020).

6.7 Summary and findings

To conclude this chapter, the following table provides a concise overview of the main factors facilitating and holding back the aspirations of the aforementioned firms in weakening the market dominance of Airbus and Boeing's duopoly. While these factors contribute to incentivizing or disincentivizing these firms to challenge the big players, a main factor influencing the future outlook of the LCA market is the *willingness* of the small players to step up and compete and bear the associated risks and is arguably much harder to get a grasp of as an outside agent. Finally, a prerequisite for the economic viability of another major player is the scale of the future LCA market. Chapter 9 aims to shed some light on this topic.

Table 2 Duopoly Competitors Overview

Country and firm	Current stage of Development	Strengths	Weaknesses and barriers	Perceived by Duopoly as threat
China: Comac	New player: narrow body aircraft (C919) ready for sale and direct competition for 737 and A320 type aircraft Wide body long range aircraft in early development stage with collaboration of UAC	Plentiful funding Large domestic market	Reluctance of foreign suppliers to cooperate Reputational and geopolitical issues Acquiring international certification	YES
Russia: UAC	Established player: wide range of large civilian and military aircraft	Extensive experience Joint ventures with Duopoly	Lack of (foreign) capital Reputational and geopolitical issues Acquiring international certification	YES
Brazil: Embraer	Established player: Various narrow-body short range jets	Extensive experience	Strong ties with duopoly → less incentive to compete Acquiring international certification	YES
Canada: Bombardier	Bombardier's commercial aviation division is defunct as of the end 2020.			
Japan: Mitsubishi	SpaceJet : regional jet	Large industrial conglomerate	Strong ties with duopoly → less incentive to compete	YES

7. Direct comparison

7.1. Product portfolio

As previously stated, both Airbus and Boeing have a strong presence in designing and manufacturing large aircraft for both military and civilian purposes. In addition to those main business divisions both companies offer a wide range of products and services in support of space programs. The following table gives a concise overview of the diverse range of products offered by both firms as of 2021. While this chapter is for a part *descriptive* in nature since it aims to highlight the key differences between the two firms, it also includes an *explanatory* component by underlining the factors that could influence product demand.

Research questions: How do Boeing and Airbus product offerings align and what are the key differences? What does the competitive landscape look like? How does the current financial situation influence future challenges and opportunities?

Figure 3: Boeing and Airbus product portfolio overview

Product type	Boeing	Airbus
Passenger Aircraft[9]	YES	YES
Freighter Aircraft	YES	YES
Corporate jets	NO	YES
Civil helicopters	NO	YES
Military helicopters	YES	YES
Corporate helicopters	NO	YES
Military jets	YES	YES
Satellites	YES	YES
Space Launchers	YES	YES
Weapons	YES	NO[10]
Unmanned aircraft	YES	YES
Intelligence services	YES	YES

Both firms have different methods of categorizing their product range.

[9] Both firms are specialized in producing large passenger jets. Airbus however owns a 50% stake in ATR GIE, the world's larges producer of regional (propellor) aircraft. Although limited, Airbus's earnings derived from these investments are influenced by competitive market forces on the regional aircraft market.

[10] Although Airbus is often included in the top arms-producing companies worldwide, it does not directly produce weapons (i.e guns, missiles etc). As detailed in the corporate structure in the pages below, it does however own a 37.5 percent stake in MBDA which is a major missile supplier for arms systems on Airbus' military products.

Boeing utilizes **four divisions**: (Boeing, 2021)

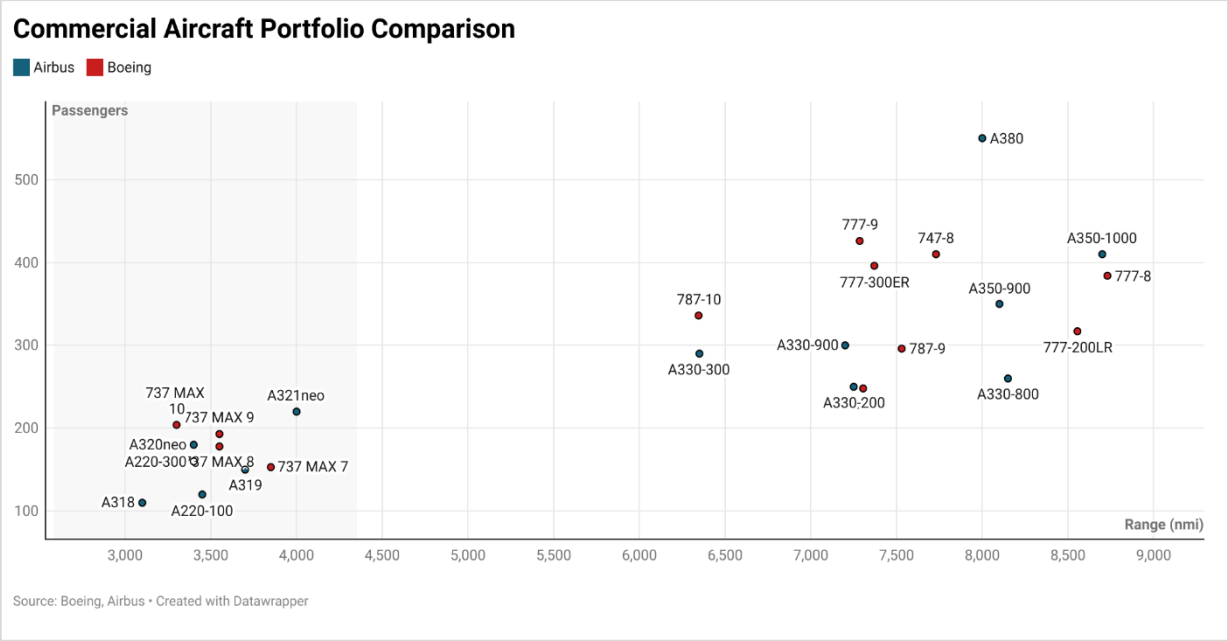
1. Boeing Commercial Airplanes (BCA): producing and marketing of commercial jet aircraft in addition to fleet support services primarily to commercial airlines worldwide.
2. Defense, Space & Security (BDS): “research, development, production and modification of manned and unmanned military aircraft and weapons systems”.
3. Global Services (BGS): Sustaining aerospace platforms and systems with a full spectrum of products and services to commercial and defense customers worldwide.
4. Boeing Capital Segment: ensuring that customers have the adequate financing they need to buy and take delivery of their products.

While Airbus categorizes its revenue streams along its **three major business units (**Airbus, 2021)

1. Airbus: Commercial Airplanes in the 100 seats and more categories also includes the holding function of the company its bank activities.
2. Airbus Helicopters: Development, manufacturing, marketing and sale of civil and military helicopters; provision of helicopter related services.
3. Airbus Defence and Space: Design, development and delivery of military aircraft and space systems. Including space launcher systems and service support. This division also encompasses intelligence services.

7.1.1. Civilian Airplanes

Figure 4: Commercial Aircraft Portfolio Comparison[11][12]



The graph above was compiled by gathering the technical specifications for each commercial passenger plane provided by the respective manufacturers. The key factors airlines take in consideration when deciding which plane to employ on a certain route mainly depend on the intensity for demand on the route and the distance between the airport of departure and destination. Note the two distinct groups on the graph which clearly separates narrow body aircraft from wide body aircraft. Naturally there is a linear correlation between range and passenger capacity of an aircraft, as larger airplanes carrying more passengers tend to have longer ranges. A certain airline might for example prefer to employ several flights per day on a short, but high demand route using a short range, narrow body aircraft as opposed to one flight on a high-capacity plane. This is a clear choice from a financial perspective, minimizing the investment in large, expensive planes that would remain idle for the most part of the day and in addition offering travellers the flexibility to travel on their preferred time slot. In essence, an aircraft is a **revenue generating asset** and an airliner maximizes its profit by maximizing the time an aircraft is in flight.

[11] When providing the capacity of an aircraft Boeing and Airbus both specify the maximum amount of passengers an airplane can carry and the typical amount which is used in a 2 class (narrow body), 3 class (wide-body) or even 4 class (A380) configuration. I used the typical configuration as opposed to the maximum as this is of most interest in airliners.

[12] I used nmi or nautical miles as a unit for aircraft range. Although support for a transition to SI-units is strong, imperial units are still pervasive in aviation.

The gap between the range of wide body and narrow body planes is something which manufacturers are aware of. There currently isn't a plane available that combines the economics of a narrow body plane with the range of wide body planes. As of 2021 Airbus is working on a new airliner, the **A321XLR** which the company claims will be able to fly 4700nmi and thus enable airliners to cater to slim demand, medium distance flights (Airbus, 2019a). Since most low budget airlines exclusively fly a single type of narrow body aircraft, a possible future evolution would be for these airlines to compete with more full-service airlines on transatlantic routes using this plane. Airbus expects the A321XLR to enter service in 2023. The A321XLR is a classic example of Airbus' trying to reap the benefits of scope economies. The cost in developing and producing this aircraft is significantly reduced thanks to the already existing technology in its present aircraft portfolio. Boeing consequently has hinted toward the development of a similar aircraft aimed at filling the gap in its product range. This new potential aircraft dubbed **NMA** (New Mid-market Aircraft) is reported to compete directly with Airbus's A312XLR (Hemmerdinger, 2021). The author further states that the events surrounding the 737MAX groundings have pushed this project back from the top of Boeing's priority list, however. It remains to be seen if the market for medium-range narrow body aircraft is large enough to support two competing aircraft. If this is not the case, the industry could see another case of the prisoner's dilemma of the "Superjumbo" where one firm has to abandon its ambitions in this market in favor of the other firm to avoid industry wide losses.

As illustrated in this graph and argued in the theoretical framework above, both firms offer **similar but diversified** products to airlines. The decision of a certain airline to commit themselves to a plane for their particular geographic market includes a variety of factors beyond range and passenger capacity. With large airlines often placing orders on more than a hundred individual airplanes the deals involved in these processes are lengthy, complex and require thorough examination by both the manufacturer and the airline. Several airlines have large undiversified fleets, and their employees are often used to operating aircraft from a single manufacturer. For example, the planes operating by Ryanair are exclusively Boeing 737-800. For a low-cost airline keen on minimizing unnecessary costs, this is a solid strategical decision. A **diversified fleet** implies extra training for pilots and cabin crew to familiarize themselves with the aircraft, less economies of scale when maintaining the plane, different security protocols to follow etc. In contrast to these disadvantages of a diversified fleet, airlines can often bargain enormous discounts when ordering a large set of individual aircraft types from a certain manufacturer.

7.1.1.1. Aircraft pricing: the main selling point

With Boeing and Airbus being publicly traded companies the firms are obliged to regularly publish the size of their orders received from airlines. Simply multiplying the list price of the aircraft with the amount of planes in the order however is not an accurate representation of the future revenue streams of the particular firm. Airbus and Boeing are notoriously confidential with the actual transaction prices and details of these orders. For example, when publishing new orders the manufacturer received, they often decide not to disclose the customer who purchased the aircraft. It is widely believed however that **discounts averaging around 50**% off the official list price are not exceptional. With orders often exceeding the 10B USD dollar price per deal, bargaining power of airlines is a serious consideration in securing a deal with aircraft manufacturers.

In addition to acquisition price of aircraft models, Boeing and Airbus are heavily marketing the **fuel efficiency** of their planes as a selling point for airlines. Aircraft are notoriously known for burning enormous amounts of fossil fuels and the associated greenhouse gas emissions. While modern aircraft are reported to operate at similar fuel efficiencies as modern compact cars, the large distances travelled on flights compared to travel by road remains an issue (Air Transport Aviation Group, 2020). The European commission reports that direct emissions from air travel contributes a substantial 3.8% of total carbondioxide being released in the environment in 2017 (European Commission, 2017). On a global level the relative emissions are nearly half those from in the EU at 2% *(ATAG, 2020).* Besides complying to regulations and working towards a greener public image, airlines are incentivized to use more fuel-efficient planes from a purely financial perspective. With less CO2 emissions comes savings in jet fuel. Jet fuel is reported to account for 10 to a staggering 30 percent of airliner's operating expenses, depending on oil prices, and thus major airliners have financial mechanisms in place to hedge fluctuations in this highly volatile commodity (Air Transport Department, 2008). Airline industry operating margins are below average compared to other industries and thus a relatively small reduction in fuel consumption by using a more efficient plane can result in significant cost saving[13]. For example, Boeing claims its new 787 series aircraft to be 25% more fuel efficient. This reduction could save airlines millions in operating expenses and thus critical percentages in operating margins. As previously implied, aircraft pricing remains a sensitive subject, it is thus difficult for outsiders to gather sufficient knowledge on this topic. Airbus even decided not to publish the official list prices of its commercial aircraft portfolio for the years following 2018. To gain a sense of scale of amount for

[13] For reference, A. Damodaran reports pre-covid 2018 operating margins of 11% for the global aerospace industry.

which aircraft are sold I included a list of average list prices of commercial aircraft by Boeing in Airbus, which can be consulted annexed to this work.

7.1.1.2. Freighters

In addition to offering a wide range of passenger jets, both firms have ventured into the lucrative market of freight aircraft. A vast range of products is transported worldwide by aircraft. Ranging from perishable produce to high value electronics. As stated previously in the historic overview, Boeing in its early years derived a significant portion of its revenue indirectly from the rise of air mail. With the emergence of e-commerce and dedicated parcel delivery services, air freight has risen in importance in the last decades. With passenger demands and comfort being less of a concern for manufacturers, air freighters are often older aircraft models being repurposed for transporting cargo. The associated high development cost for researching and developing new and innovative passenger aircraft is therefore not a strategic component in this department. In addition to offering dedicated freighter aircraft based on previous models, the freight market is also an opportunity for airlines to sell their written off passenger jets. The aircraft currently on offer by Boeing and Airbus for freight services are represented in the table below in order of increasing size of the aircraft and were sourced from their website.

Table 3 Freighter Aircraft overview.

Boeing	**Airbus**
737-800BCF	A321-PF2
767-300 Freighter	A330 200F
767-300BCF	A330P2F
747-8 Freighter	BelugaST[14]
777 Freighter	BelugaXL

7.1.2. Defense, space and helicopters

Since both companies consider Defense and Space a singular category for accounting purposes the following paragraphs provide a concise overview of both their products in this category. Regarding defense and space expenditure, the US military remains the largest generator of revenue for aircraft defense contractors. In FY 2021 the proposed budget for **national security** amounted to 740.5 billion USD of which 56.9 billion USD is invested in the Air Domain, which includes the acquisition of a large amount of fighter jets and helicopters (US Department of Defense, 2020). The largest order went to

[14] The Airbus Beluga is unique in the way that it is perfectly suited for transporting voluminous cargo such as other aircraft fusilages.

Lockheed Martin for the investment in 79 F-35 Joint Strike Fighters, amounting to 11.4 Billion USD. Boeing's share in the list include 15 KC-46 Tankers, 24 F/A-18 E/F Super Hornets, 52 AH-64E attack helicopters, a P-8A Aircraft and 12 F-15EX fighter jets amounting to a total acquisition price of 8.169B USD for Boeing (*DoD, 2020).* In addition to military equipment, Boeing offers a wide range of government services including Engineering, Supply Chain Management, Training & Professional Services and Data Analytics (Boeing, 2021).

In its Defense and Space Market outlook, Boeing assesses the potential markets for its Defense and Space products through 2029. The company estimates the global market to represent a value of 2.6 trillion USD. Of this large and stable market, the US represents a 60% of the total market share.

The defense market in other parts of the world is much more fragmented in comparison to the one in the United States. **NATO member states** are urged to meet their defense spending targets. With military policy being undeniably intertwined with economic policy, it can be argued that thanks to Airbus' presence in Europe, defense departments of the member states will be inclined to procure a significant proportion of their new investment from Airbus. In addition to the widely held believe of defense markets being significantly less volatile compared to commercial jets, this military spending by NATO members will further secure Airbus' position in the defence and space departments.

Airbus uses the following categorization for its defense airplane portfolio.

- **Light & Medium Aircraft**: C212, CN23 and C295
- **MRTT'S**: A310, A330
- **Heavy Transport Aircraft**: A400M
- **Combat Aircraft**: Eurofighter

The following table is included for overview purposes. Details and technical specifications of the products listed are readily available on Boeing and Airbus' websites and annual reports and can be consulted for further references.

Table 4 Defense and Space Product Porfolio

	Product type	
Product Category	**Boeing**	**Airbus**
Fixed-Wing Strike	EA-18G Growler Advanced F-15 and F-15EX F/A-18E/F Super Hornet T-7A Red Hawk	Eurofighter
Military Rotorcraft	AH-64 Apache MH-139A Grey Wolf AH-6 Little Bird V-22 Osprey	Light • H125M • H145M Medium

	H-47 Chinook[15]	• AS565 MBe • H160M Heavy • H215M • H225M Specialised • Tiger • NH90 HForce
Civilian Rotorcraft	N/A	Intermediate Single • H125 • H130 Light twin • H135 • H145 Medium • AS 365 N3+ • H155 • H160 Super medium • H175 Heavy • H215 • H225 Corporate Helicopters
Human Space Exploration	CST-100 Starliner International Space Station (ISS) Space Launch System (SLS) United Launch Alliance (ULA)	International Space Station (ISS) Space Launch System (SLS) • Ariane 5 • Ariane 6 Columbus programme Automated transfer vehicle (ATV) Orion European Service Module Bartolomeo
Satellites	Commercial Satellites & Services • SES-20, SES-21 (C-Band Satellites) • O3b mPOWER Satellites • ViaSat-3 Satellites Government Satellite Systems • Wideband Global SATCOM 11+ (WGS-11+)	Optical Earth observation satellites • S250 optical • S450 optical • S950 optical Radar Earth observation satellites • S250 radar • S850 radar Telecommunications Satellites

[15] While its primary function is transport of military equipment and troops, the Chinook helicopter is also being purposed for humanitarian aid. *(Boeing, 2021)*

	• X-37B Orbital Test Vehicle (OTV)	• Eurostar series • Electric propulsion satellites • OneSat
Defense freighter and passenger airplanes	C-32* P-8A Poseidon/P-8I* C-40A Clipper* VC-25B* KC-46A Pegasus* 737 Airborne Early Warning and Control (AEW&C)*	A400M "Atlas" A330 MRTT* C295
Missile Defense	Ground-based Midcourse Defense (GMD) Minuteman III Intercontinental Ballistic Missile (ICBM)	N/A
Weapons	Directed Energy Harpoon Joint Direct Attack Munition (JDAM) -JDAM Extended Range (JDAM ER) -Laser JDAM Patriot Advanced Capability-3 (PAC-3) Missile Seeker Small Diameter Bomb (SDB) Laser SDB Standoff Land Attack Missile Expanded Response (SLAM ER)	N/A[16]

As can be observed in the table above, Boeing and Airbus' product range offered for defense and space applications is much more heterogeneous in comparison to their product range in the category of commercial jet airliners. Both firms have their respective niches catering to a wide range of markets. For example, Airbus has arguably a competitive edge on Boeing in the department of satellite products thanks to its diverse range of products. Furthermore, Boeing is the only firm of the duopoly with extensive experience in producing weapons, while Airbus has a global market presence in civilian helicopters compared to practically none by Boeing. Additionally, a major weakness of Airbus in comparison to its European competitors in defense aerospace is its lack of participation in the US led F-35 fighter jet programme, the largest current defense aerospace programme (Oxford Analytica, 2014b). This lack of Airbus' participation in securing US defense contracts will arguably prove to be beneficial for Boeing's position in this field.

* Commercial derivatives

[16]Only indirectly through minority interest in MBDA, cfr infra.

7.1.2.1. Competitive Landscape

Due to Airbus and Boeing's different product offerings in the defense and space department and Boeing not being active in the civilian helicopter market, their main competitors differ in some key aspects. Hoover Company Records provides a convenient and up to date overview of the main competitors of Boeing and Airbus, which is represented below, excluding the competitors in the LCA department discussed more comprehensively in the previous chapter. While Boeing is mainly competing with American firms, Airbus is facing competition with some other European firms and Kawasaki in Japan, which also produces a range of civilian helicopters.

Table 5 Boeing Defense and Space Competitors

Competitor	Gross revenue in USD (2019)
AGUSTAWESTLAND HOLDINGS LIMITED	103.86M
BAE SYSTEMS PLC	23,644.62M
DASSAULT AVIATION	7,718.67M
General Dynamics Corporation	39,350.00M
Kaman Corporation	761.61M
LEONARDO SPA	9,968.02M
Lockheed Martin Corporation (Top Competitor)	59,812.00M
Northrop Grumman Corporation (Top Competitor)	33,841.00M
Raytheon Company	29,176.00M
Raytheon Technologies Corporation	77,046.00M
Rockwell Collins, Inc.	8,665.00M
Space Exploration Technologies Corp.	1,697.75M
THALES	279.36M

Source: Hoover's Company Records, 2021

Table 6 Airbus Helicopters, Defense and Space Competitors

Competitor	Gross revenue in USD (2019)
Aerojet Rocketdyne Holdings, Inc.	1,981.50M
ANTONOV PLC	410,958.00
BAE SYSTEMS PLC	23,644.62M
Bae Systems, Inc.	9,798.22M
Bell Textron Inc	3,317.00M
DASSAULT AVIATION	7,718.67M
E'Prime Aerospace Corporation	240,550.00
KAWASAKI HEAVY INDUSTRIES, LTD	14,842.59M
LEONARDO SPA	9,968.02M
Lockheed Martin Corporation	59,812.00M
Northrop Grumman Corporation	33,841.00M

Raytheon Company	29,176.00M
SAAB AB	3,677.56M
Sikorsky Aircraft Corporation	2,985.27M
Space Exploration Technologies Corp.	1,697.75M
THALES	279.36M

Source: Hoover's Company Records, 2021

7.2. Financials[17]

The adverse market conditions exacerbated by COVID-19 have resulted in an unprecedented financial crisis for aircraft manufacturers. Liquidity constraints are a real threat facing Boeing and Airbus. The three major credit rating agencies[18], Moody's, S&P and Fitch reflected these financial constraints in their latest updates presented below. While these ratings still fall withing the range of "investment grade", the current economic situation and in the case of Boeing, the 737MAX groundings have certainly impacted the long-term financial outlook of both firms. Boeing is remarkably scarce with providing external credit ratings on its website in comparison to Airbus.

Table 7: Overview Credit Ratings

Rating Agency	**Boeing[19]**	**Airbus[20]**
Moody's	Baa2	A2
Fitch	BBB-	BBB+
S&P	BBB-	A

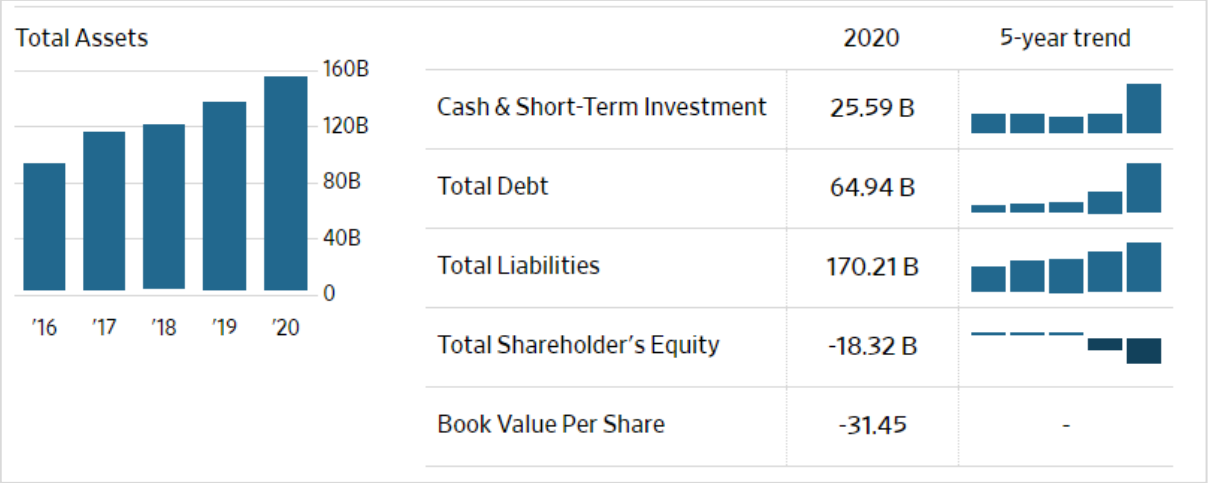
A key metric in analyzing the future expectations and value of a firm is its Enterprise value. It is a more comprehensive metric for the value of a firm compared to classic market capitalization as it incorporates the value of total debt and cash in the equation. Valuation analysis based on EBIT(DA) multiples and free cash flow to the firm (FCCF) is difficult for firms with negative earnings and CF since these may not accurately reflect the future financials of the firm. Therefore, the following pages provide an overview of the three key financial categories used by investors and analysts for assessing the firm's financial performance: Balance Sheet, Income Statement, Cash Flow. In addition, an overview of the ownership structure and shareholdings of the firms is presented for the year 2020.

[17] Note: Boeing and Airbus use different accounting standards. Boeing reports in US GAAP and Airbus in IFRS. For ease of comparison, abstraction of these differences was made in order to facilitate a direct comparison.
[18] On a side note: interestingly the rating agencies have received similar critique as aircraft manufacturers. Being an oligopoly and controlling virtually the entire market with high entry barriers for new entrants.
[19] Source: SEC
[20] Source: Airbus

7.2.1. Balance sheet

7.2.1.1. Boeing

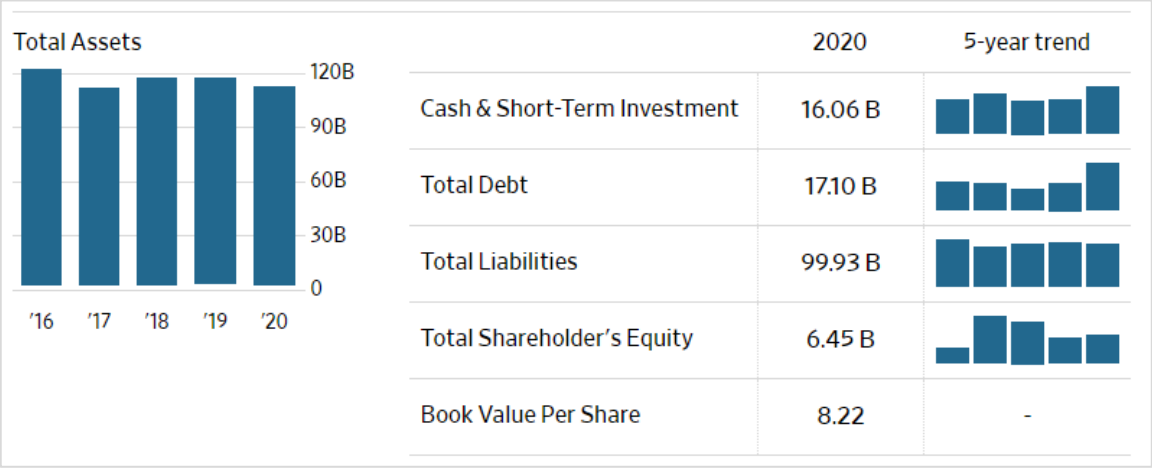
Figure 5 Boeing Balance Sheet Overview



What is most striking about Boeing's balance sheet is the sharp increase in cash & short-term investments and total debt in 2020 which coincided with the extra measures taken by the firm to maintain its liquidity. Furthermore, shareholder's equity first reached negative values in 2019 following the 737MAX groundings, which was further exacerbated by the pandemic when the firm reached more than 18B USD in negative equity.

7.2.1.2. Airbus

Figure 6: Airbus Balance Sheet Overview



Source: Visualization by WSJ, 2021

Airbus' balance sheet shows a similar trend, be it less severe. The firm's cash and short-term debt investments increased rapidly in 2020 while its total liabilities remained relatively constant. In contrast to Boeing the firm has not recorded negative shareholder's equity following the pandemic.

7.2.2. Income statement

7.2.2.1. Boeing

Figure 7: Boeing Income Statement Overview

Source: Visualization by WSJ, 2021

Boeing's income statement gives a negative picture of the companies' operations, with earnings deeply below zero in FY2020. On a quarterly level, after a severe loss in the last quarter of 2020, the company reported significant higher earnings in the first quarter of FY2021 though. Sales and revenue growth was already on a sharp decline in 2019 and remained similar in 2020.

7.2.2.2. Airbus

Figure 8 Airbus Income Statement Overview

Source: 1 Visualization by WSJ, 2021

Airbus's earning are significantly more positive in comparison to Boeing's with a modest increase in income, which still remains negative for 2020 while its EBITDA remained positive for both 2019 and 2020. The relative decline in revenue is similar with a decrease of almost 30%.

7.2.3. Cash flow

7.2.3.1. Boeing

Figure 9 Boeing CF Overview

Source: 2 Vizualization by WSJ, 2021

Similar to its earning, Boeing had a negative cash flow in FY2019 which further decreased to almost -20B USD in 2020. The firm's cash position is precarious, and although debt issuances offer some respite, Boeing stated in its 2020 annual report the following quarters are expected to show a similar

trend. A positive cash-flow is expected when sales in commercial aircraft resume its historical growth pattern (Boeing, 2021).

7.2.3.2. Airbus

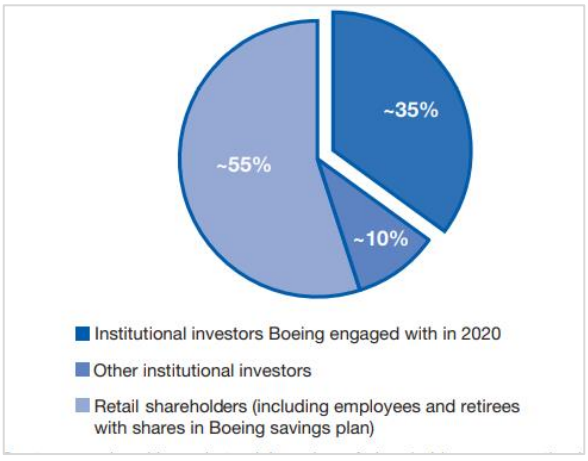
Figure 10: Airbus CF Overview

Source: Visualization by WSJ , 2021

Again, a similar pattern is observed as with Boeing. Airbus' capital expenditures have slightly increased over the last five years while the revenue fell from a solidly positive number in 2019 to a deeply negative 7.18B EUR in 2020.

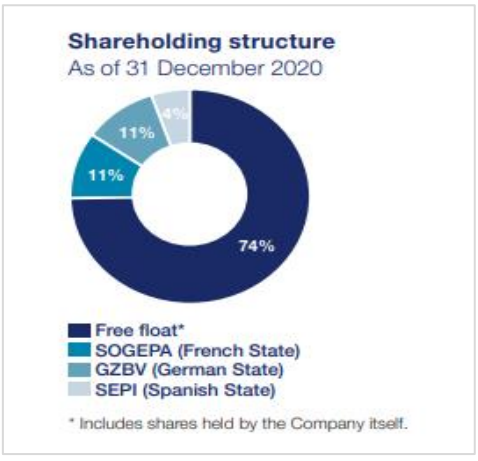
7.2.4. Ownership structure

Figure 11 Boeing Ownership Structure



Source: Boeing, 2021

Figure 12 Airbus Ownership Structure



Source: Airbus, 2021

7.2.4.1. Boeing

In its 2021 annual meeting of shareholders, Boeing represented the ownership structure of the company. More than half of the shares are held by retail shareholders while institutional shareholders owned an additional 45% percent of the firm. Boeing engaged with the majority of the institutional investors. CNN compiled a list of the top 10 owners of Boeing which can be consulted annexed to this work.

7.2.4.2. Airbus

Airbus' main difference in this regard is that a significant portion of the firm's capital is held by the French, German and Spanish State through a series of entities. The remainder of the shares is held by the public which includes the free float and 0.06% shares held by Airbus itself. A detailed depiction of the ownership structure is annexed to this work. According to Dutch financial law, the market regulators are to receive notification from entities who own substantial interests in the company. The largest public shareholders are Capital Research and Management Company, the Goldman Sachs Group Inc and BlackRock, Inc who own 9.90%, 3.35% and 3.06% of the share capital respectively (Airbus, 2021).

7.2.5. Shareholdings

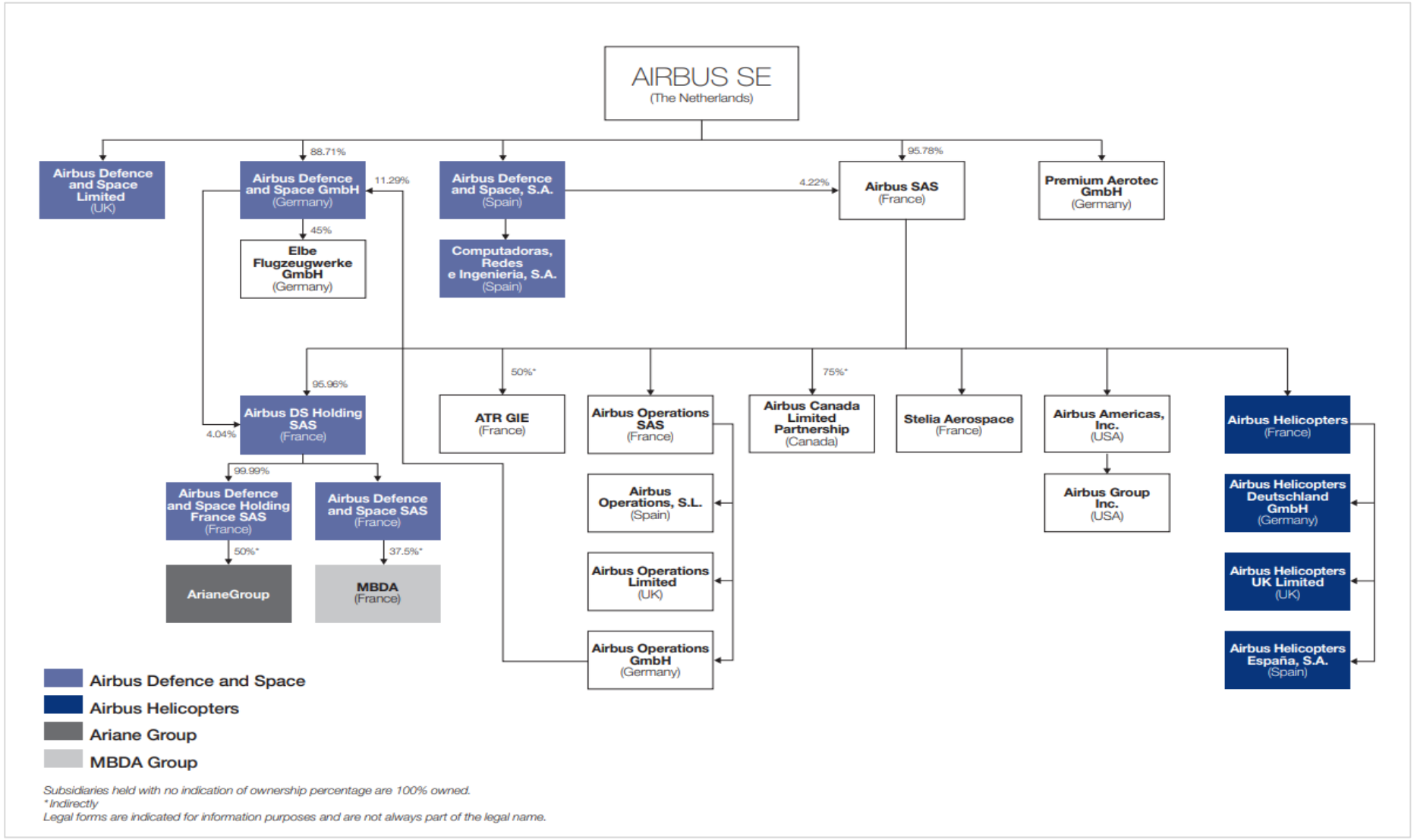
7.2.5.1. Boeing

In contrast to Airbus, Boeing does not provide a schematic overview of its subsidiaries to outsiders. A full list of all subsidiaries of the firm can be consulted on the website of the SEC however. Similarly to Airbus, Boeing has a large number of subsidiaries, 282, most of whom are incorporated in the state of Delaware *(SEC, 2021b).*

7.2.5.2. Airbus

In its latest annual report (FY2020) Airbus presented this simplified organisational structure. It includes the divisions and main business units. For ease of presentation, certain immediate holding companies have been omitted. As of year-end 2020 Airbus controls 260 entities, of which 177 are fully consolidated entities, 58 joint ventures and 25 associates (Airbus, 2021). When presenting their financial statements Airbus, includes the financials of Airbus SE and all materially controlled subsidiaries (Airbus, 2021.) As detailed in chapter 4, this corporate structure is the result of a lengthy process of mergers, acquisitions and partnerships with both European and global firms.

Figure 13 Airbus Shareholdings



Source: Airbus, 2021

7.2.4. Summary

While the entire aviation industry is in a difficult financial position, as illustrated in the graphs in the pages above, the long-term prospects of the firms are reflected in the decent credit ratings the companies' received. The rating agencies however incorporate a wide range of assumptions in their models such as future introduction of new aircraft types, the main assumption however is the return of travel to baseline pre-pandemic levels by 2023. Intuitively this is a very reasonable assumption given the ongoing vaccination efforts. The firm's solvency is expected to be guaranteed by their extensive backlogs and positive long-term prospects, the main issue remaining is whether the firms are capable of sustaining these negative cash positions and how likely investors are to maintain the cash burn. Chapter 8 provides a more detailed overview of the measures taken by Boeing and Airbus to secure their liquidity. While chapter 9 aims to provide insights the long-term opportunities for the firms.

8. Current Challenges

A contemporary analysis of the aircraft industry would remain seriously lacking without taking into considerations the impact the **COVID-19 pandemic** has had on this sector. When the pandemic spread to worldwide proportions in March 2020, the global flow of passenger traffic came to a virtual standstill. Airlines were hit especially hard as their main revenue flow was cut off. They had to rely on their cash buffers and bailouts [21] from governments. Other financial methods were employed to secure the short-term financial security of the company which are discussed below for the respective firms based on the statements in their annual accounts. Other contemporary global challenges for aircraft manufacturers include the **grounding of the Boeing 737MAX** after two disastrous crashes involving the new aircraft. Airbus on the other hand faces **uncertainty concerning trade with the UK** following the Brexit since it has a considerable base of operations in the country. A final challenge which will be of increasing importance in the decades to follow and one which will arguably affect the entire economy as a whole and everyone involved in it is the **reduction of fossil fuel dependence** in combatting global warming.

8.1. Reacting to a pandemic

8.1.1. Airbus

Airbus responded to this liquidity crisis by accessing a new 15 billion euro credit facility termed out by bonds and USPP issuances. The company choose to withdraw the 2019 cash dividend amounting to 1.4 billion euro. In addition to the 15 billion euro credit, Airbus obtained a further 6 billion euro credit facility in October 2020. Furthermore, construction capacity was cut by approximately one third compared to pre-pandemic levels. This decision considerably affected the workforce since 15,000 positions are expected to be lost no later than summer 2021. In addition to these reductions, government partial unemployment schemes are in place to protect the positions not subject to reductions. Interestingly Airbus has decided that no impairment of goodwill is deemed necessary throughout the year 2020. Tests have been performed based on future cash flow projections to determine whether an impairment was necessary[22].

[21] The term "Bailout" has received an often-negative connotation since the financial crisis, where tax-payers euros and dollars were used to save a faulty banking system. I do however not intend to convey the same negativity to this term in the case of financial aid to aircraft manufacturers following an exogenous shock such as pandemic since the appropriateness of these financial support is widely supported by industry specialist with the purpose of safeguarding a strategic industry.

[22] These figures were sourced from the financial statements

A solid indicator for the expected future revenue streams an aircraft manufacturer is its backlog. Airbus its **backlog**[23], which is the estimated future transaction prices where the company can assure with *reasonable* certainty that the transaction to customers will take place, amounts to a total of approximately 373 billion euro at year end 2020 *(Airbus, 2021)*. A decrease of almost 100 billion euro compared to 2019. Of this total backlog value, 4% are orders related to Airbus helicopters and 9% related to Airbus Defence and space.

The management of Airbus considers the financial resources of the company to be sufficient to maintain the going concern for the following twelve months.

8.1.2. Boeing

Boeing's 2020 annual report provided investors with information regarding the measures the firm took to reduce the company's exposure to the business related effects of the pandemic. After a period of closure in March and April of 2020 a number of its manufacturing centres across the US resumed operation. The firm acknowledges the supply chain shortages it experienced due to capacity reduction from their suppliers. This adversely impacted their financial position. In addition to reducing its R&D spending by 1.3B and a reduction of the workforce through a series of lay-offs by approximately 26,000 employees, Boeing has performed a numbers of debt issuances to boost its liquidity. The debt issuances comprised of a 13.8B USD two-year delayed draw term loan, followed by 25B USD of fixed rate senior notes in the second quarter of 2020 and an additional 4.9B fixed rate senior notes in the fourth quarter. The resulting debt balance at year-end amounted to 63.3B USD (Boeing, 2021).

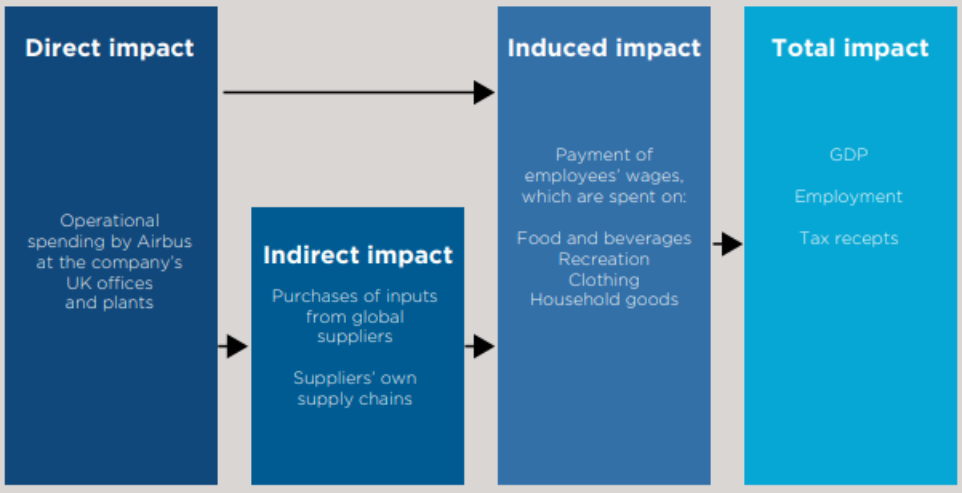
8.2. Brexit: what precautions were implemented by Airbus?

Airbus remains a solid contributor to the UK's economy directly and indirectly. As previously mentioned in the historic overview of Airbus and Boeing, the UK has always been a hub for aircraft research, innovation and manufacturing. In 2015 nearly 15 thousand people were employed by Airbus across the UK, with four dominating sites (Oxford Economics, 2017). Its benefits to the UK's economy are not limited to generating employment, direct economic output and tax revenues from Airbus, however.

[23] "The backlog valuation is based on the estimates and assumptions and will mainly be released into revenue over a period of seven years". (Airbus, 2021) Cfr. Annex for backlogs of both firms.

The indirect and induced benefits however are larger. Indirect benefits are estimated at 3.8 billion GBP and include the value added by the input components in aircraft manufacturing, which are produced by other businesses in the UK. In addition, foreign suppliers to Airbus often source their inputs from UK firms and by this process also contribute to value added in the UK. The study by Oxford Economics lists Safran in France as an example. Safran orders metal components from an undisclosed UK company in order to produce its engines for Airbus aircraft. Finally, Airbus contributes to the UK's economy in an induced manner which is arguably harder to calculate. The wages earned by employees of the firm are invested back into the economy and sustain a further 38,700 jobs in the UK (Oxford Econ., 2017). The following graph illustrates these channels of wealth creation. It should be noted that the mechanisms of these wealth generating revenue streams are likely not limited to Airbus' UK activities or even Airbus as a whole for that matter. One could argue that an aviation manufacturer that has a global presence generates wealth and jobs through a similar process in the country it has a presence in. It is an example of a globalized economy where a developed country can benefit from its highly skilled labor in manufacturing high-value adding products.

Figure 14 Airbus impact generating mechanisms



Source: Oxford Economics, 2017

The impact of the Brexit on Airbus' operations in the UK and beyond still involves a number of uncertainties as of 2021 but the company made it clear that it took the necessary adjustments to mitigate the risk involved with the UK leaving the EU. In 2018 the firm's CPO sent a memorandum to the firm's suppliers to ensure them to establish effective risk mitigation plans *(Richter, 2018).* The message included customs data fields which ware likely to be required post Brexit. The firm's 2020 annual report ensured that although Brexit will necessitate additional administrative work and reduced industrial flexibility, the continuity of the firm's operations and supply chains are not materially threatened (Airbus, 2021).

8.3. Boeing 737MAX: What are the financial and regulatory implications?

In addition to COVID-19, Boeing faced an additional challenge in 2020. On October 29th 2018 a fatal crash involving a Boeing 737 Max aircraft operated by Lion Air Indonesia resulted in the loss of all 189 occupants on the plane. Indonesia's National Transportation Safety Committee promptly instigated an investigation to identify the cause of the crash *(Boeing, 2019)*. Irregularities in the flight data of the plane involved in the crash of Lion Air flight 610 caused litigations to pile up against Boeing. Not long after this fatal crash, on March 10th, 2019, another flight involving a Boeing 737MAX crashed, leaving none of the 157 occupants alive. The timing and remarkable flight patterns of both planes involved in the crashes raised the question in what way the aircraft manufacturer was to blame for the accidents. In short Boeing was under time constraints and **financial pressure** to release its new 737MAX in order to compete with Airbus' A320neo. This caused the company to not disclose essential information with regards to a key aircraft part. The pilots of the planes involved in the crash regrettably were not aware of this, which ultimately led to the crash of the planes. The crashes resulted in the grounding of essentially all 737MAX aircraft worldwide.

In January 2021, Boeing was charged with fraud conspiracy and agrees to pay a settlement of 2.5 billion dollars (U.S. Department of Justice, 2021). The company admitted in court of omitting essential information to the FAA. The Federal Aviation Administration is involved in regulating all matters involving civil aviation in the United States. Interestingly the US Department of Justice stated that an independent compliance monitor was not necessary given the facts that, among others, the misconduct was not pervasive across the organisation (U.S. Department of Justice, 2021).

Not only Boeing was scrutinized for these catastrophic events. Given the increasing complexity of aircraft manufacturing, a skill gap is widening between the regulators and the industry itself. Sgobba (2019) argues for a shift from prescriptive requirements to performance requirements in the aircraft regulator industry. The author is a proponent of qualitative performance requirements and the use of hazard analyses during design. Prior to these accidents Leveson et. al. (2014) Argue that traditional aircraft safety assessment processes fail to account for important causes of aircraft crashes. From an engineering perspective the authors argue that the strongly automated nature of modern aircraft designs demands a more integrated safety evaluation approach with direct implementation of software and human factors. A determining factor of both crashes was a design feature of the Boeing 737MAX to feel and handle the same as its predecessor.

Critique on aircraft regulatory control is not a new phenomenon and not one only expressed by engineers. Opponents of governmental policy have stated that since the FAA is not financially liable for the failure of its own imposed system, it is inefficient as a regulatory agent. (Cleveland & Price; 2003) Furthermore the crashes have often been claimed by the media as a key example of the detrimental effects of "**regulatory capture**", where regulatory agencies act in the interests of those who it is supposed to regulate (The Economist, 2019). The crash of those two 737MAX airplanes caused significant damage to the reputation of Boeing. The direct financial impact of the 737MAX groundings is reported by Boeing to run north of 20 billion USD, mostly consisting of costs related to compensations to customers for having their planes grounded (Isidore, 2020). The company firmly acknowledged this in their annual report of 2019. Boeing Commercial Airplanes (BCA) had a loss from operations of 1.975 billion US dollars in 2019 compared to earnings from operations of 11.897 Billion US dollars in 2018. Boeing stated that at year end 2019 "the 737 MAX grounding has not resulted in significant order cancellations".

Its total backlog, which is the estimated future transaction prices where the company can assure with reasonable certainty that the transaction to customers will take place, decreased from 408,140 million USD at year end 2018 to 376,593 million USD at year end 2019. Boeing however stated that this decrease is primarily due to "deliveries in excess of new orders and a reduction in backlog related to orders from a customer that experienced liquidity issues". The financial markets reacted fiercely on the news of the groundings. Boeing lost 40B USD market capitalization in March of 2019 (Wattles, 2019). It is common knowledge that **volatility in share prices** is heavily influenced by exogenous and endogenous shock affecting a company, in both directions. Aircraft manufacturers are especially vulnerable to those events. An extreme example of this phenomenon again occurred in the aircraft industry. In 1981 Lockheed announced the termination of its L-1011 commercial aircraft, after accumulating heavy losses. The day following the announcement the share price jumped a staggering 18% (Parayre, 1995). Which is consistent with empirical evidence on the effect of stock prices regarding project termination announcements cited in chapter 5 of this work.

Bear in mind the aforementioned financial data was before the COVID-19 pandemic, it is included in this work to give a perspective of the financial situation of Boeing before the global aviation industry faced an unprecedented crisis. Boeing mentioned the liquidity constraints certain of its customers are facing. Cioroianu et al. (2021) identified how undiversified and publicly listed airlines, (i.e. those operating primarily Boeing fleets), are exposed to "significant reputational and price contagion effects". In other words, the reputational backlash of the Boeing 737-MAX groundings significantly influenced their share prices. The impact this contagion has on the airline's liquidity and thus indirectly on Boeing's ability to maintain customers with enough cash to fulfil their orders remains to be studied.

The whole 737MAX controversy was widely criticized by the general public as an example of how fierce competition in the aviation industry could lead to catastrophic events. Finally, this clearly illustrates the extensive repercussions a corporate blunder can have across a whole industry on the operating results and ultimately, the financial situation of a firm.

8.4. Carbon emissions

Travel by air is undeniably a polluting way of transport and contributing to a major part in global greenhouse gas emissions. The reduction of carbon emissions and the all-out decarbonisation of aircraft fleet is future objective aircraft manufacturers are increasingly starting to incorporate in their sustainability policy. While nudging travellers to reconsider other and less environmentally taxing ways of transport is an objective worth promoting, air transport is undeniably a necessary component of global connectivity. As previously mentioned, aircraft manufacturers have made considerable progress in reducing carbon output of their products by designing more fuel-efficient jet engines and lighter aircraft materials. The engine technology is expected to reach its efficiency limit, however. This has prompted new and revolutionary designs in electric aviation propulsion, which although currently still slow and cumbersome, could be expected to fill in a particular niche in the not-so-distant future and prove to be worthy replacement of conventional jet propulsion in the distant future.

9. Future opportunities: recovering from a crisis

As the aviation is arguably facing its most significant challenge in its history, industry specialists have focussed on estimating how the market will recover in the near- and long-term future. As previously argued in the financial overview, in the short-term, aircraft manufacturers are mainly concerned with securing their liquidity in order to safeguard their relationships with debtors and investors. Naturally, the impact the pandemic has had on the aviation industry in general and aircraft manufacturers specifically has received little academic attention as of the time of writing. To further obtain insights on this topic I attended a webinar hosted by McKinsey consultants who are working extensively in the industry and are aiming to offer airlines solutions on how to tackle this unprecedented situation. As a major customer of Boeing and Airbus, the business environment and financial situation of airlines and those of constructers are undeniably intertwined.

9.1. Short term: managing liquidity

The ongoing vaccination efforts as of the first quarter of 2021 have re-opened the possibility of non-essential travel by planes in an ever-increasing part of the globe. It can be argued that whole aviation industry is heading towards a structural transformation that is comparable in impact to the shockwave that went through the banking sector following the financial crisis in 2008. The expected timeline of a full recovery is difficult to determine and depends on a number of factors, however sources seem to agree to the key role leasure travel takes on in driving the road to recover (Luman & Soraka, 2021), (Bouwer et al., 2021). As is outlined in the previous chapter, an immediate concern of aircraft manufacturers as of 2021 is retaining a reasonable level of cash on the balance sheet to maintain current operations.

9.2. Long term: towards clearer skies

9.2.1. Historical precedents

The financial crisis of 2008 and to a lesser extent, the slump in air travel demand following the September 11 attacks, provide a valuable precedent to investigate how aircraft manufacturers cope with uncertainties. Following the global economic downturn, airlines saw their demand decrease as travellers were more reluctant to go on trips. Although air travel is projected to resume its long term growth path after the pandemic, the financial situations of airlines is in dire straits. This results in difficult relationships between aircraft manufacturers and airlines. The manufacturers have to balance

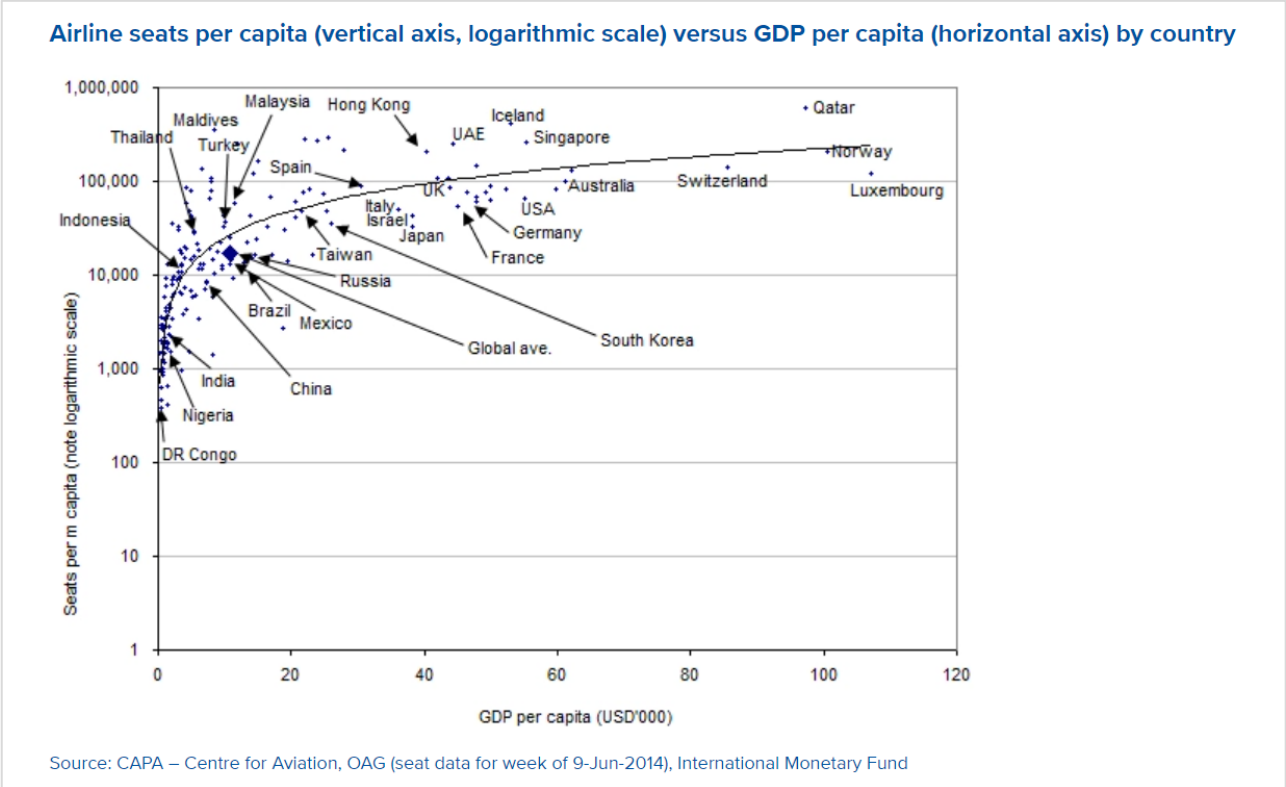
between pushing airlines to fulfil their financial obligations, therefore securing payment for the planes they ordered pre-pandemic and maintaining smooth business ties with said airlines for the years to come.

Due to the very nature of a pandemic, the drop in demand for airline tickets was of an unprecedented scale, eliminating all but the most essential types of travel. The scale of the decrease in demand is unseen in recent history but the dynamics of the effects of the pandemic on aircraft production are essentially the same as those observed in the aforementioned previous crises, i.e. decreased demand for passenger seats. History has proven that air travel recovered quickly after 2008 excluding perhaps business travel which never fully recovered from the financial crisis. International business travel for the period 2000 to 2019 grew with a sluggish average growth rate of 0.2% (Hancock & Georgiadis, 2021).

9.2.2. The role of emerging markets

While critically analysing corporate strategy and industry performance metrics can prove insightful in short term forecast, the amount of uncertainty involved yields them less suitable for long term predictions. To gain insight into the long-term future of the aviation industry, the economic situation of a certain country can provide valuable information.

Figure 15: Airline capacity in relation to GDP



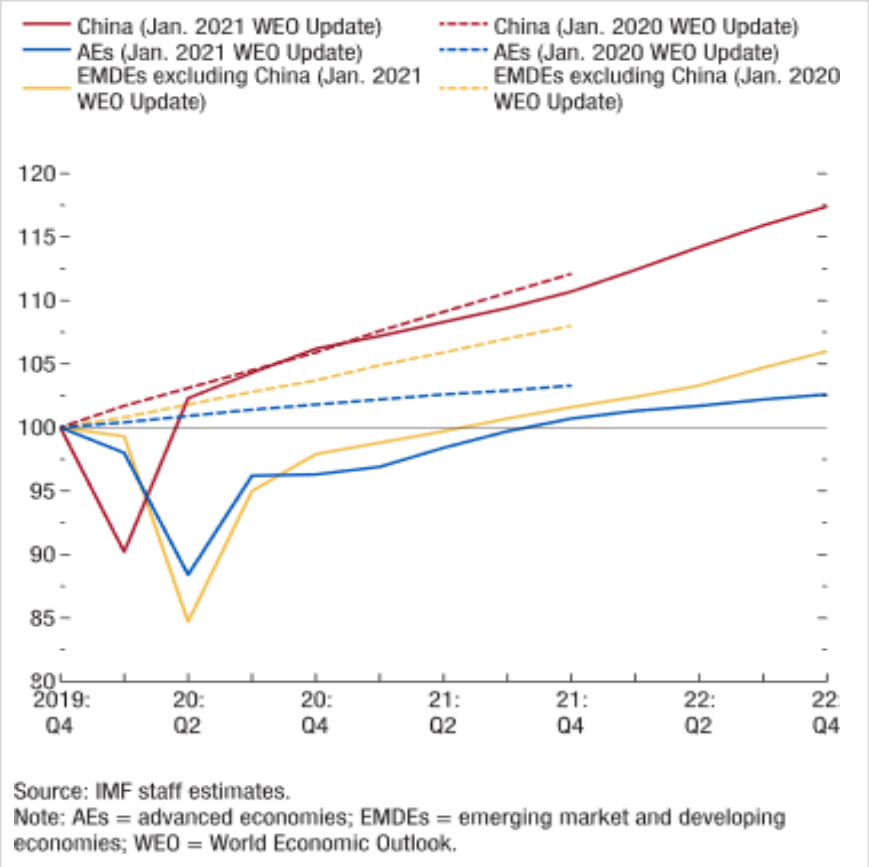
Source: CAPA – Centre for Aviation, OAG (seat data for week of 9-Jun-2014), International Monetary Fund

This graph has plotted the GDP per capita of several nations to the capacity of their airlines. We clearly see a strong correlation between the amount of wealth a country generates and the number of airline seats in that particular country. This correlation is intuitive and straightforward as wealthier citizens have higher disposable income that can go to discretionary spending such as travel. Furthermore, wealthier nations can provide a steadier business environment for airlines to operate in and thus offer an obvious choice for centres of operation for these airlines. An interesting metric of analysing the spending behaviour of consumers on plane tickets is the propensity of these consumers to travel. Airbus published a comprehensive data set accessible to anyone interested. This **Global Market Forecast** comprises a forecast of estimated increase in travel from the period of 2019 to 2038, subdivided per geographic regions (Airbus,2019a.). Evidently, this dataset was compiled before the COVID-19 pandemic. However, it could be argued that, with insider sources claiming air travel will return to pre-pandemic levels by 2024 (Bouwer, et al., 2021), the dynamics driving this growth in the very long term are expected to hold.

Taking a critical look at figure, 14 one could argue that in the long run airline capacity will increase naturally with the GDP of these countries. The Center of Aviation (2014) further confirms this observation can be extended towards the regional level as well. The cluster of countries with low to medium airline capacity include countries which we will consider *emerging markets* from now on. These countries often have significant populations and are geographically large. These factors naturally facilitate the development of airlines offering domestic flights to accommodate this potentially lucrative market.

A stylized fact among macro-economists worldwide is that developing countries will continue to make up an increasingly large share of global economic output in the following decades. This thought is backed up by the following graph sourced from IMF forecast. Following the global downturn after the COVID-19 pandemic, which hit emerging and developing economies comparatively hard, output dropped a staggering 15 percent in the second quarter of 2020 compared to pre pandemic levels. These economies however are expected to bounce back faster than more advanced economies according to IMF forecasts. They are expected to reach pre-pandemic levels of output as early as the second quarter of 2021.

Figure 2 WEO Forecast

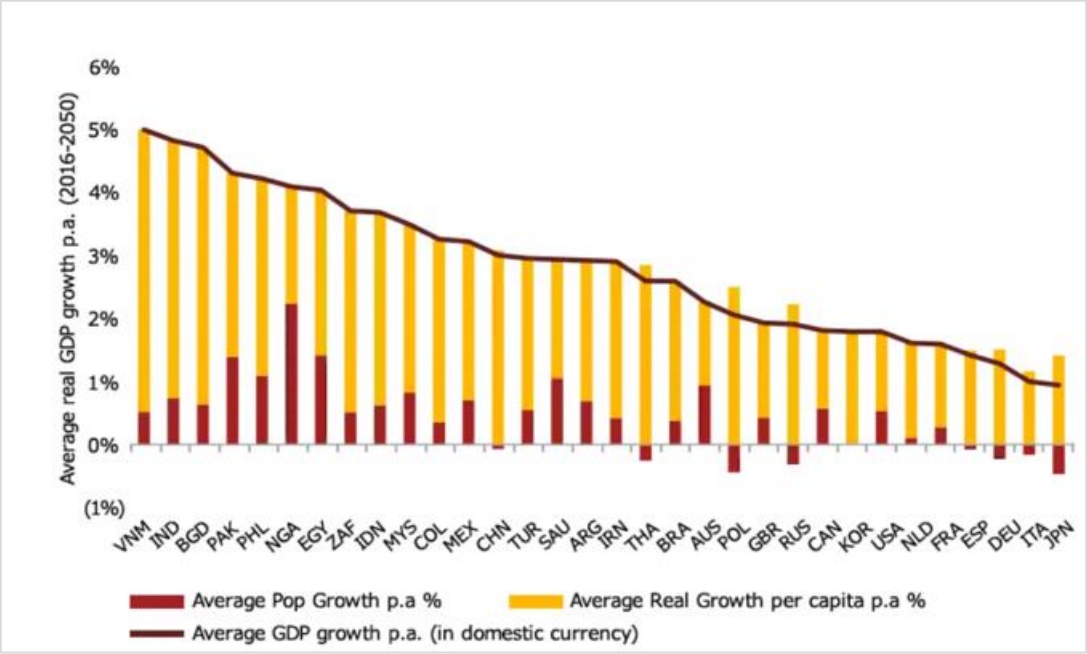


These figures make rise to the question in what way these countries will provide a lucrative market to airlines and thus indirectly to aircraft manufacturers.

In the very long run, the global economic order is expected to change drastically, with countries which we now consider emerging markets topping the list of global economic output.

The following figure demonstrates the magnitude of changes to the economic output of emerging markets on the very long term. The list is topped by Asian countries such as Vietnam, India and Bangladesh. These countries will grow significantly in terms of real GDP and already have high populations that will continue to grow. These factors will give the aforementioned countries an edge in global economic power. Additionally, Airbus has claimed that increase in air travel has continuously outperformed global economic output growth, further underlining the importance of aviation in global connectivity.

Figure 16 Projected Real GDP growth p.a., 2016-2050



Source: 3 PwC, 2017

9.2.3. A new market

The following table was sourced from Airbus' Global Market Forecast 2019-2038. It provides an overview of the *total* global volume of new aircraft to be delivered in the period from 2019-2038. This is a gigantic market, with Asia comprising a large portion of the future potential for new aircraft deliveries. The table further illustrates the importance of small aircraft in driving the global aviation demand. Airbus' methodology in calculating this forecast comprised a number of historical and operational characteristics regarding airline fleet demand. For example, prior fleet operations, expected future routes, aircraft retirement perspectives, demand distribution etc. (Airbus, 2019).

In addition, the following table further illustrates the importance of small aircraft in driving the global aviation demand. This in line with the observations detailed in chapter 6 regarding the aspirations of Airbus and Boeing on acquisitions and partnerships with smaller companies who have a strong presence in this market. The geographic extent of emerging economic markets is further graphically elucidated by observing the global distribution of so called "Aviation Mega Cities" (Airbus, 2019). Besides an increase in absolute number of those cities across the entire world, a significant portion of those new aircraft hubs is situated in these new markets. The maps can be consulted annexed to this work.

Table 8 Total expected deliveries of new aircraft, 2019-2038

	AFRICA	ASIA-PACIFIC	CIS	EUROPE	LATIN AMERICA	MIDDLE EAST	NORTH AMERICA	TOTAL
SMALL	960	12,765	1,298	5,760	2,400	1,630	4,911	**29,724**
MEDIUM	188	2,168	125	1,035	189	473	696	**4,874**
LARGE	101	1,391	75	639	95	1,097	362	**3,760**
TOTAL	**1,249**	**16,324**	**1,498**	**7,434**	**2,684**	**3,200**	**5,969**	**38,358**

NEW PASSENGER AIRCRAFT DELIVERIES BY REGION

Source: Airbus, 2019a

10. Conclusion and findings

This thesis helps illustrate how aviation industry market forces and governmental policy are undeniably intertwined. Consequently, regulations and institutions contribute significantly to shaping the future of strategic decision making among aircraft manufacturers. History has proven that both firms are often operating at the fringes of legality with regards to anti-trust laws and other fair-trade agreements. Furthermore, a detailed overview of both firm's product portfolio remains inconclusive in determining which firm offers superior products as the demand and pricing thereof is largely influenced by customer's, i.e. airlines and government defense departments, preferences, relations with the firms and said customers strategical and political incentives. Boeing faced the pandemic in a significantly disadvantaged position due to the groundings of its popular 737MAX aircraft. While the plane has resumed flight after a series of modifications were made, the financial and reputational fallout of this event is expected to linger in the future. With civilian passenger aircraft demand, in most regards, in a slump for at least several years, competition among manufacturers is expected to intensify with the resulting price cutting incentivizing airlines to invest counter cyclically.

In addition, the expected long term growth path in civil aviation is forecasted to recover in a couple of years, depending on the evolution of the pandemic. Experts are observing a trend in increasing demand for smaller aircraft. Airbus is well positioned to benefit from this potentially very lucrative market since it did not suffer any reputational problems with its A320neo family. Furthermore Airbus is arguably ahead in the development of a new mid-market aircraft, bridging the gap between narrow-body and wide body offerings from both firms. It remains to be seen if the market is significant enough to enable both firms to recoup their investment. It can be argued that Airbus has learned from its mistake in developing a new and ambitious plane that was ill-suited for the evolving demands of airlines, as was the case with the A380. Aviation data analysis has come a long way since the inception of the A380 and manufacturers are expected to be able to better gauge the demand for a specific type of aircraft and adjust their investment projects accordingly.

While considerable progress has been made by competing firms in development, production and marketing of narrow-body jets aimed at short and medium distance flights, the duopoly's global market share in the wide-body aircraft segment remains unchallenged and is not expected to be materially threatened by competitors in the following decade. Capitalizing on the forecasted increasing global demand in air travel in the distant future, the duopoly could very well be transformed in a triple-oligopoly with Chinese manufacturer, Comac, in partnership with Russian firms, as prime contender for this third spot.

As said, the aircraft market is highly politically influenced and while cost-efficiencies might induce global airliners to partner with aircraft manufacturers based in newly-industrialized nations, international aircraft certification procurement and reputational issues are expected to be a significant hurdle for these new firms.

11. Limitations and challenges

As discussed in chapter 3 regarding methodology, the method of archival research for business and management studies has its inherent flaws. The amount of grey literature processed in this work proves a significant challenge in determining its reliability. A significant portion of literature was sourced from Boeing and Airbus' websites and the firms naturally tends to be biased towards their offered products and services, which poses additional challenges in providing an objective and critical analysis. Financial statements are expected to provide an independent and accurate representation of the business reality, however.

As is common in economic analysis, reports on market forces in aviation industry, especially future predictions, are based on a number of assumptions. These assumptions are naturally bound to uncertainties. Airbus (2019) cites cyclical evolutions, product performance risk, competition and consolidations as a number of these uncertainties.

This work does not include an econometric analysis. Possibilities for research using this method are wide and are continuously used by advisors to both airlines and manufacturers. They often have access to large and industry-tailored databases which are challenging for outsiders to get access to.

12. Further research and policy implications

The wide scope and at times descriptive nature of this thesis allows for plentiful further explanatory academic research surrounding a broad range of subjects. A number of potential topics for further research are discussed below.

A key theme this work explores is the interactions between public institutions and economic agents such as manufacturers and airlines. Scholars have addressed the issue of regulatory capture in the aviation industry and argue for a more comprehensive aircraft certification procedures to mitigate the risk of another event comparable to the 737MAX crashes.

Additionally, the ongoing trend of consolidations occurring in the aircraft industry is of interest to scholars interested in **M&A synergies**. Further elucidation of the benefits accruing from joint ventures in aviation could provide resourceful insights in assessing the impact of comparable synergies in other high-tech industries. Renowned scholars have conducted extensive theoretical and empirical research on the welfare benefits of corporate subsidies in advanced economies, in particular the Airbus case has received considerable attention. With the emergence of aircraft industries in newly industrialized nations, this research could be renewed to study whether similar subsidies and contributions could generate welfare benefits in these types of economies.

From a financial perspective this work assesses the current financial situation but does not offer a comprehensive overview of the historical financials of both firms. A **longitudinal research on** financial ratios could prove beneficial in gaining a further understanding of the financial management of Boeing and Airbus.

In a similar fashion as to what occurred to financial institutions in the financial crisis, the leverage ratios of airlines proved to be unsustainable when faced with an unprecedented crisis such as a pandemic. Industry experts have raised the question of whether a policy aimed at **regulating or voluntarily incentivizing cash-buffers f**or airlines could stabilize a future and potentially similar exogenous shock. A regulatory framework in a similar fashion to the Basel Accords in the financial industry, tailored to the airline industry could be of particular interest for scholars and industry regulators. The possibilities of future research are not limited to scholars in economics and business. The wide range of ongoing legal procedures could provide additional research material for scholars in international trade law.

Finally, a number of data sets exist on the future expected aircraft demand. These could provide useful tools in statistical and econometric analysis of what drives individuals to travel in a particular country.

For example, a comparison of RPK of a particular country to a number of economic metrics could be useful for airlines in gaining insights on what particular geographic market to position themselves.

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14. Appendices

i. Backlogs

a. Airbus backlog

Boeing Backlog	2020		2019	
Division	*in Million USD*		*in Million USD*	
Commercial Airplanes	281,588.00	77%	376,593.00	81%
Defense, Space & Security	60,847.00	17%	63,691.00	14%
Global Services	20,632.00	6%	22,902.00	5%
Unallocated items, eliminations and others	337.00	0%	217.00	0%
Total	**363,404.00**		**463,403.00**	

Source: Airbus, 2021

b. Boeing backlog

Airbus Backlog	2020		2019	
Division	*in MEUR*		*in MEUR*	
Airbus	324,675.00	87%	424,082.00	90%
Airbus Helicopter	15,782.00	4%	16,627.00	4%
Airbus Defense and Space	33,505.00	9%	32,263.00	7%
Eliminations	-835.00	0%	-1,484.00	0%
Total	**373,127.00**		**471,488.00**	

Source: Boeing, 2021

ii. Aviation mega cities

a. 2018

The following maps were created with datawrapper based on data sourced from Airbus' global market forecast.

Aviation Mega Cities in 2018

Cities with more than 10,000 daily long-haul passengers (flight distance > 2,000nm excluding domestic traffic)

Source: Sabre, Airbus • Created with Datawrapper

b. 2038

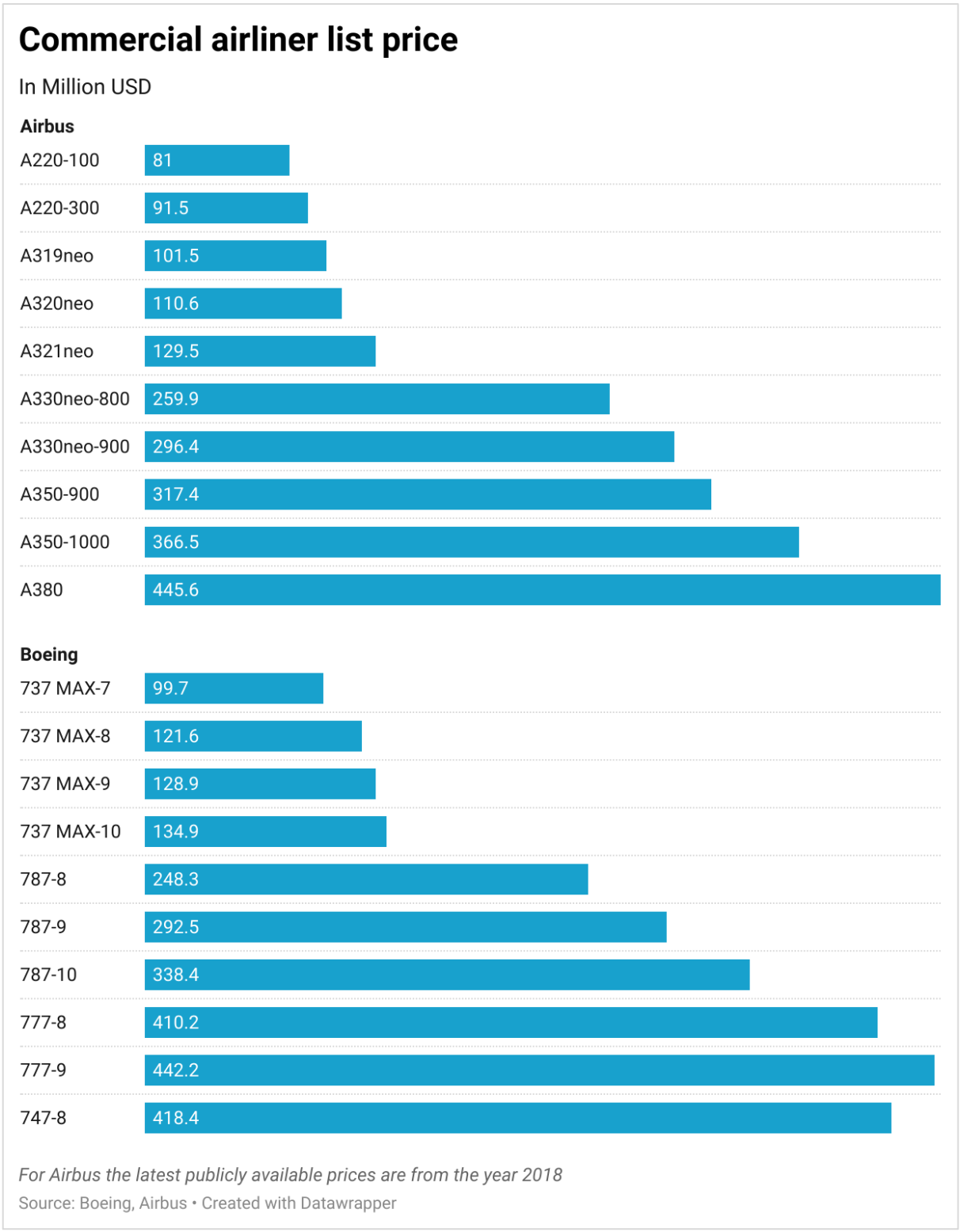
Aviation Mega Cities in 2038

Cities with more than 10,000 daily long-haul passengers (flight distance > 2,000nm excluding domestic traffic)

CAGR based on non-oriented leg RPKs values

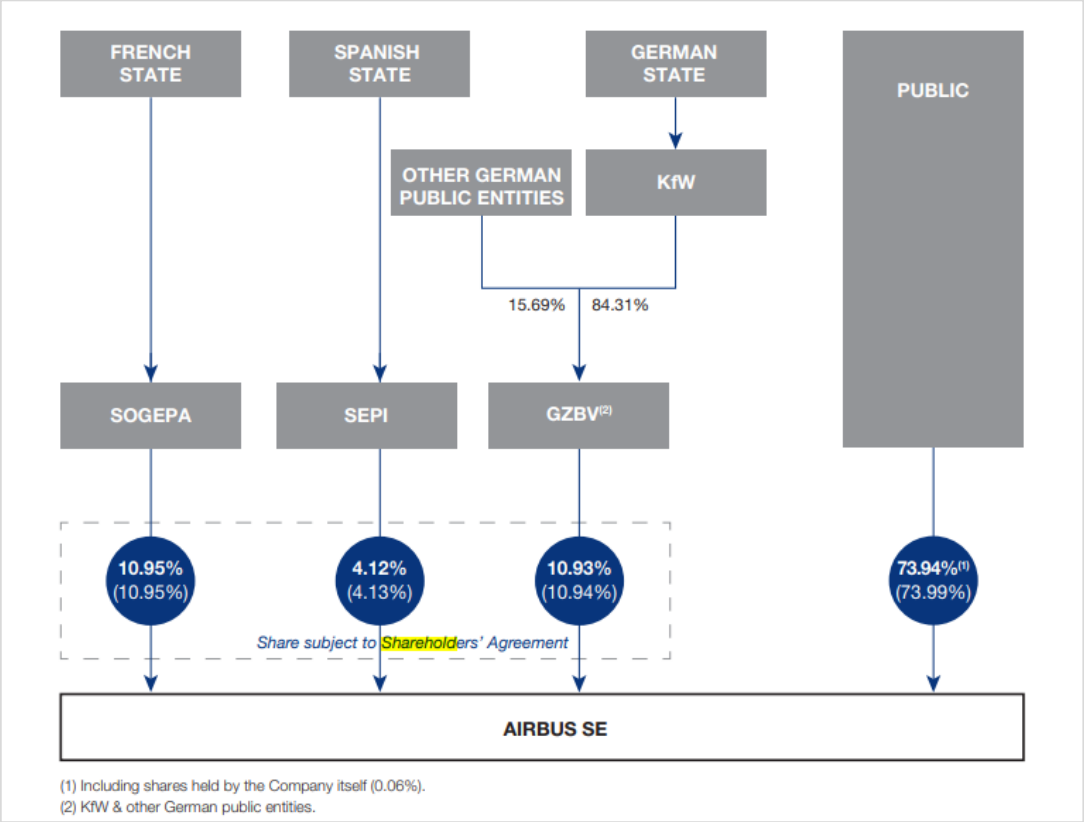
Source: Sabre, Airbus • Created with Datawrapper

iii. Aircraft pricing



iv. Ownership Structure

Airbus



Source: Airbus, 2021

Boeing

Top 10 Owners of Boeing Co

Stockholder	Stake	Shares owned	Total value ($)	Shares bought / sold	Total change
Newport Trust Co.	7.91%	46,144,200	10,812,047,502	-3,406,737	-6.88%
The Vanguard Group, Inc.	6.89%	40,197,733	9,418,730,819	+1,333,171	+3.43%
SSgA Funds Management, Inc.	4.61%	26,913,345	6,306,065,867	+1,041,583	+4.03%
BlackRock Fund Advisors	4.07%	23,750,206	5,564,910,768	+460,136	+1.98%
Loomis, Sayles & Co. LP	2.00%	11,651,742	2,730,119,668	-238,464	-2.01%
Fidelity Management & Research Co...	1.61%	9,374,890	2,196,630,476	+4,381,432	+87.74%
Geode Capital Management LLC	1.37%	7,988,325	1,871,744,431	+363,662	+4.77%
Capital Research & Management Co....	1.06%	6,196,714	1,451,952,057	-1,009,684	-14.01%
Northern Trust Investments, Inc.(...	0.89%	5,188,112	1,215,626,523	-1,217	-0.02%
T. Rowe Price Associates, Inc. (I...	0.76%	4,425,674	1,036,979,675	-221,300	-4.76%

Source: CNN, 2021