



CATÓLICA
LISBON
BUSINESS & ECONOMICS



The Performance Effect of Business Model Change in the Airline Industry: Evidence from Low-cost Carriers

Fabian A. Baltheiser

Dissertation written under the supervision of Prof. Raffaele Conti

Dissertation submitted in partial fulfilment of requirements for the International MSc in Management with a major in Strategy & Consulting, at Universidade Católica Portuguesa and for the Master of International Business, at Smith School of Business, 09.05.2018.

The Performance Effect of Business Model Change in the Airline Industry: Evidence from Low-cost Carriers

Fabian A. Baltheiser

Abstract

After the deregulation of the airline industry in the 1980s and 1990s, airlines competed based on two distinct business models, the low-cost carrier and full-service carrier model. Today, a clear differentiation between the two business models is no longer possible, as airlines have departed from these traditional models. Although this convergence trend is gaining increasing attention in literature, its impact on airline profitability remains mostly unstudied. To fill this gap, I develop a framework to measure and clearly distinguish between the business models. Using data on 10 low-cost carriers from the United States and Europe in the period from 2007 to 2016, I assess the effect of business model changes on profitability and further highlight the business model convergence trend. I find that the convergence of business models in the airline industry is evident, despite the fact that quite often adhering to the traditional low-cost business model proves to be beneficial in several aspects. In some cases, however, departing from the original model can also lead to a performance increase.

Keywords: Airlines, Low-cost Carrier, Business Model, Convergence

Resumo

Após o período de desregulação da indústria de aviação nas décadas de 80 e 90, as companhias aéreas competiram com base em 2 diferentes tipos de modelos de negócio, o modelo de transportadora *low-cost* e o de transportadora de serviço completo. Hoje em dia, já não é possível fazer uma clara distinção entre os dois modelos, uma vez que as transportadoras se afastaram destes modelos tradicionais. Apesar da tendência para a convergência ter ganho relevância na literatura, o seu impacto na rentabilidade do sector aéreo continua, em grande parte, por ser estudado. Para colmatar esta lacuna, desenvolvo um sistema para medir e claramente fazer a distinção entre os modelos de negócio. Usando dados de 10 transportadoras *low-cost* dos Estados Unidos e da Europa no período de 2007 a 2016, avalio o efeito que as diferenças de modelos de negócio têm na rentabilidade e realço a tendência de convergência em modelos de negócio. Observo que a convergência de modelos de negócio na indústria de aviação é evidente, apesar de que aderir ao modelo tradicional *low-cost* prova, frequentemente, ser benéfico em vários aspetos. Em alguns casos, no entanto, afastar-se do modelo original pode também levar a um aumento da *performance*.

Palavras-chave: Companhias Aéreas, Transportadora *Low-cost*, Modelo de Negócio, Convergência

Acknowledgements

I would first like to thank my thesis advisor, Professor Raffaele Conti, for his guidance and support throughout my master thesis. Whenever needed, Professor Raffaele Conti promptly provided me with insightful comments and valuable advice on my master thesis. I am also grateful for the support of all Católica university staff, with a special mention to my former Teaching Assistant, Hugo Castro Silva, who answered all of my questions regarding RStudio.

I would like to thank my family and all my friends for their encouragement and tremendous support throughout my studies. They helped me to overcome all the challenges along the way and are the protagonists in some of my most memorable experiences. Most importantly, I want to express my gratitude to my parents, who gave me the opportunity to study in four different countries and travel the world. I am very grateful for having all of you in my life.

This work would have not been possible without the support of the following people. I especially want to thank my girlfriend, Johanne Arnet, and Sebastian Stadler for their valuable input, discussions and corrections. Finally, a special thank you to Sophia Kuther for the inspiring conversations and delivering my thesis in person, and Inês Franco for her support in translating my abstract to Portuguese.

“There is no flying without wings” French Proverb

Fabian Baltheiser

Copenhagen, 09.05.2018

Table of Contents

- 1 Introduction 1**
- 2 Literature Review and Airline Industry Overview 3**
 - 2.1 General Business Model Framework.....3**
 - 2.2 Separating Business Model and Strategy4**
 - 2.3 Business Model Changes and Business Model Innovation5**
 - 2.4 Business Models in the Airline Industry.....6**
 - 2.5 Business Model Innovation and Convergence in the Airline Industry8**
 - 2.6 Airline Industry Market Development10**
- 3 Methodology 11**
 - 3.1 Business Model Framework and Variable Operationalization 11**
 - 3.2 Data Collection and Sample.....12**
 - 3.3 Dependent Variables13**
 - 3.4 Independent Variables14**
 - 3.5 Control Variables18**
 - 3.6 Research Design.....20**
- 4 Descriptive Statistics and Results 22**
 - 4.1 Descriptive Statistics.....22**
 - 4.2 Regression Model Results25**
 - 4.2.1 Discussion of Results: In-flight Entertainment27
 - 4.2.2 Discussion of Results: Baggage Fees28
 - 4.2.3 Discussion of Results: Cargo Transportation.....29
 - 4.2.4 Discussion of Results: Cabin Set-up30
 - 4.2.5 Discussion of Results: Global Distribution System30
 - 4.2.6 Discussion of Results: Fleet Uniformity31
 - 4.2.7 Further Discussion.....31
- 5 Conclusion..... 33**
- References 35**
- Appendices 41**

List of Figures

Figure 1: Business Model vs. Strategy.....5
Figure 2: Aggregated Worldwide Airline Industry Revenue and Average Operating Margin.....10
Figure 3: Network Systems.....15
Figure 4: Aggregated Revenue and Average Operating Margin of Airlines in the Data Sample.....23
Figure 5: Purity – Adherence to the Traditional LCC Model.....24

List of Tables

Table 1: Comparison of FSC and LCC Business Model.....7
Table 2: Variable Operationalization Results.....14
Table 3: Summary Statistics.....22
Table 4: Business Model Categorization Overview (2007, 2016).....25
Table 5: Regression Results.....26

Abbreviations

BM	Business Model
BMI	Business Model Innovation
CPI	Consumer Price Index
EBIT	Earnings Before Interest and Tax
EU	European Union
FFP	Frequent-flyer Program
FSC	Full-service Carrier
GDS	Global Distribution System
GDP	Gross Domestic Product
GFC	Global Financial Crisis
IATA	International Air Transport Association
IPO	Initial Public Offering
km	Kilometer
LCC	Low-cost Carrier
OLS	Ordinary Least Squares
SEC	United States Securities and Exchange Commission
US	United States
UK	United Kingdom
VIF	Variance Inflation Factor

1 Introduction

The passenger airline industry was historically dominated by a single business model, the full-service carrier (FSC) model. After the deregulation of the industry in the 1970s in the United States (US) and later in the 1980s in Europe, the first low-cost carriers (LCCs) disrupted the industry (Diaconu, 2012; Graham & Shaw, 2008). Whereas FSCs offered much more than just transportation from A to B, LCCs built their business purely on this transportation aspect, eliminating frills such as on-board entertainment, complimentary meals and free checked baggage (Belobaba et al., 2016). Over the years, the LCC business model became increasingly popular across the world. While LCCs steadily expand their market share and the aviation market gains importance in general, a business model convergence trend has become noticeable. Increasingly, airlines blend attributes of the two competing business models together (Alamdari & Fagan, 2005). For example, the LCCs EasyJet, Ryanair, Vueling and Norwegian recently joined the airline alliance “Airlines for Europe”, which is atypical for LCCs (Airlines for Europe, 2018). Norwegian further entered the long-haul market, and the LCC JetBlue introduced its new *MINT* business class (JetBlue, 2018; Norwegian Air Shuttle ASA, 2013). Contrary to these changes, FSCs are increasingly taking on low-cost business model characteristics, by introducing checked baggage fees and reducing their overall in-flight service levels, as initially only done by LCCs (Vidović et al., 2013). Motivations for this behavior range from adapting to a changing market environment to increasing competition and imitation strategies (Hvass, 2008; Mason et al., 2011). Consequently, to sustain a competitive advantage, airline management needs to be wary of the business model hybridization and correspondingly adapt their business model or engage in business model innovation (Daft & Albers, 2013, 2015).

The field of business model convergence in the airline industry is becoming a more frequently discussed topic. While the subject finds increasing attention among scholars and practitioners, there is yet no sufficient analysis on how business model changes impact airline performance (Daft & Albers, 2015). Two opposing views on how business model changes affect airlines’ profitability exist (Alamdari & Fagan, 2005; Hvass, 2012). One study argues that LCCs that take on aspects similar to FSCs are at risk of losing profitability by giving up their cost advantage (Alamdari & Fagan, 2005). Furthermore, it can be argued that if the majority of airlines change towards a similar hybrid business model, overall airline profitability could potentially decrease due to the risk of creating a homogenous market environment. This new environment could then be disrupted again, such as the way it was by LCCs after the airline

market liberalization (Daft & Albers, 2015). On the contrary, Hvass (2012) argues that it is beneficial to blend specifications of both the traditional LCC and FSC model. Most importantly, airline managers could benefit from further analysis of the effect of business model changes on airline performance (Daft & Albers, 2015). Based on these two opposing views and the current market development, I address the following research question: *Is it beneficial for LCCs to change their business model specifications in light of the recent convergence trend?*

In the following sections, I present an empirical approach to investigate the outlined research question. After reviewing extant literature, I separate the two business models and then derive a new business model framework by synthesizing the general and airline-specific literature on business models. The constructed framework serves as the foundation for the data collection on 10 LCCs from Europe and the US between 2007 and 2016. To investigate the impact of business model changes on airlines' profitability, I develop two fixed effect regression models that highlight the effect of business model changes on both airline revenue and operating margin. To complete the research, I then outline and further analyze the airlines' business model changes to emphasize the recent convergence trend.

The results of the research show that the hybridization of business models in the industry is evident. I further find that airlines' business model changes have a significant effect on their performance. The impact is noticeable in both directions, when moving towards the more traditional LCC model, as well as when eliminating some of the traditional specifications commonly used by FSCs. The most significant positive impact on airline profitability is found in operating a single-class cabin and not engaging in cargo operations. An adverse effect on profitability is shown when not offering complimentary in-flight entertainment, and not being part of the Global Distribution System (GDS).

The thesis is structured in the following way. In chapter 2, I present an extensive literature review, including a general and industry-specific overview of business models and strategy. In this chapter, I further outline prior research about airline business model hybridization and industry convergence, as well as include a short overview of the industry market development. Subsequently, in chapter 3, I describe the derived business model framework, the data sample and the methodology used. Chapter 4 illustrates the convergence trend, analyzes the results of the regression models and provides further discussion. Chapter 5 describes the limitations of this study and concludes the thesis.

2 Literature Review and Airline Industry Overview

This chapter is segmented into three distinct parts. First, an in-depth literature review provides a comprehensive theoretical background of the business model (BM) and business model innovation (BMI) concepts. Based on extant research, I further distinguish between the terms BM and strategy. The chapter subsequently elaborates on the idea of BMI, before finally applying the concepts to the airline industry and providing a brief industry overview.

2.1 General Business Model Framework

Existing literature defines three broader areas in which scholars frequently categorize BMs (Wirtz et al., 2016). In the *organization-oriented* view, the BM represents the architecture or structure of the company (Al-Debei et al., 2008; Zott & Amit, 2007). The *technology-oriented* view recognizes technology as the core component of a BM, and consequently reduces the relevance of other aspects of the firm's BM (Eriksson & Penker, 2000). Recent developments show that scholars in the area of technology orientation see the BM as an increasingly holistic representation of the company (Wirtz et al., 2016; Zott et al., 2011). Lastly, the *strategy-oriented* view shows the integration of strategy into a BM (Chesbrough & Rosenbloom, 2002; Hamel, 2001). Contradictory to the notion of introducing strategy into the BM concept, scholars have gradually tried to separate the terms BM and strategy (Al-Debei et al., 2008; Amit & Zott, 2001; Casadesus-Masanell & Ricart, 2010). The BM definition by Teece (2010) combines essential factors from the three aforementioned areas and does not restrict the separation of the terms BM and strategy. In the author's words, a business model "defines how the enterprise creates and delivers value to customers, and then converts payments received to profits" (Teece, 2010, p. 173).

Numerous definitions of a BM exist in relevant literature. Scholars agree that there is hitherto no generally accepted view regarding the usage and definition of a BM (Al-Debei et al., 2008; Osterwalder et al., 2005; M. Porter, 2001; Teece, 2010). In 2016, the definition of a BM remained indistinct; though views in this field have been slowly aligning over the past years (Wirtz et al., 2016; Zott et al., 2011).

As outlined above, existing literature also shows inconsistency regarding the distinct components and contents of a BM. Wirtz et al. (2016) identified nine influencing components of a BM based on reviewing prior literature. Teece (2018) defined three principal components

based on studies by Osterwalder (2005) and Schön (2012). The three components consist of the *Value Proposition* with the subcategories Product & Service, Customer Needs, and Geography; the *Revenue Model*, which includes Pricing Logic, Channels, and Customer Interaction; and the *Cost Model*, which overarches Core Assets & Capabilities, Core Activities and Partner Network. Wirtz et al. (2016) point out that the purpose of BMs is rarely stated in literature. As a general conclusion, a BM aims at promoting an understanding of the entire company as well as the continuous development of the BM itself, while assuring the creation of a sustainable competitive advantage.

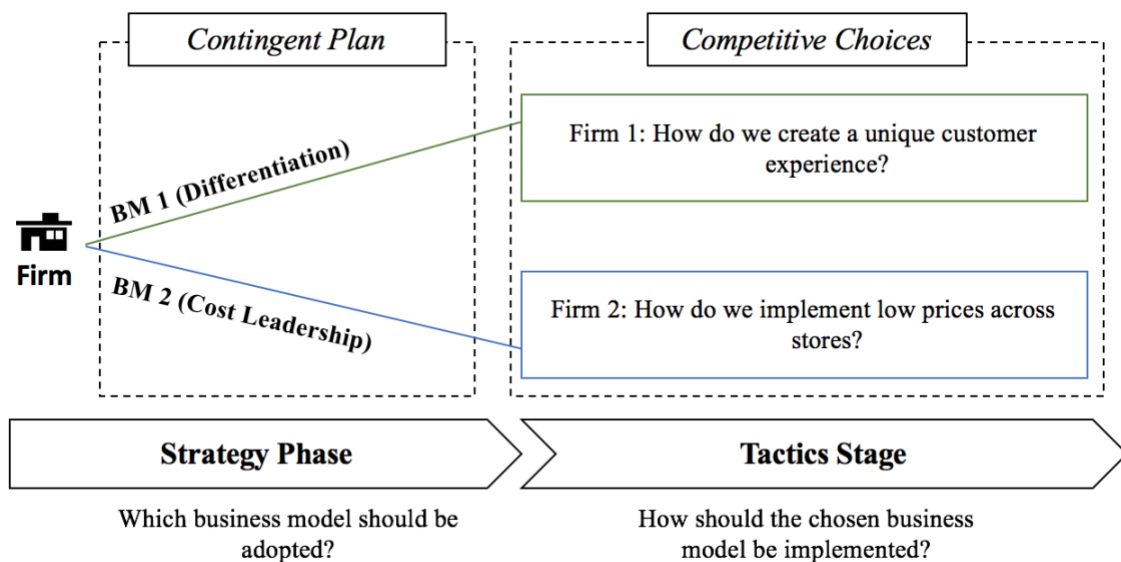
2.2 Separating Business Model and Strategy

Within the discussion about the typology and characteristics of a BM, the separation of the term BM from the term strategy is gaining increasing attention. Wirtz et al. (2016) state that many scholars over the last decade focused on clearly delimiting the term strategy from the BM concept. Although the two terms do intersect, they are not the same, which has been described by Al-Debei et al. (2008), Amit et al. (2001), Casadesus-Masanell & Ricart (2010) and Osterwalder (2004). Thus, the terms are often misapplied (Magretta, 2002). In their effort to separate the terms BM and strategy, Casadesus-Masanell & Ricart (2010) consider a BM as the logic of the firm, which describes the way the company operates and creates value for the stakeholders (see **figure 1.**). This is aligned with the definition by Teece (2010), in which customers are referred to as the principal stakeholders, as well as with the general understanding of a business model's increasing focus on value creation instead of value capture (Zott et al., 2011).

Although various views on what constitutes strategy exist in literature, according to Casadesus-Masanell & Ricart (2010), the term strategy refers to a set of different strategies the firm can choose from. This set is also referred to as a contingent plan. Outlining and executing a strategy is a preceding task, which then results in the selection of a distinct BM, to successfully achieve the mission of the firm (Casadesus-Masanell & Ricart, 2010; Dahan et al., 2010). A firm's implemented and therefore realized strategy subsequently aims at explaining the explicit choice of BM that the firm selected to compete in the market. Similarly, a widely accepted view by Porter (1996, p. 64) defines strategy as "...deliberately choosing a different set of activities to deliver a unique mix of value". As characterized by Porter (1985) firms can either adopt a *differentiation* or a *cost leadership* strategy. In their granular approach towards describing BMs, Casadesus-Masanell & Ricart (2010) define tactics as the competitive choices the firm has

within the selected BM. Tactics will ultimately determine how much value the firm will be able to create and extract from the chosen BM (Casadesus-Masanell & Ricart, 2010).

Figure 1: Business Model vs. Strategy (Source: author's own contribution, based on information from Casadesus-Masanell & Ricart (2010) and Porter (2001))



2.3 Business Model Changes and Business Model Innovation

Two prevailing views towards BMs exist among scholars in the BMI field: a *dynamic* or *transformational* view and a *static* view (Demil & Lecocq, 2010; Putten & Schief, 2012). The perspective of the dynamic view argues that BMs do not persist forever. Firms need to regularly reassess and align their BM to create internal consistency and to adjust to a constantly changing environment (Demil & Lecocq, 2010). The static view describes the BM as a value-creating activity set at a particular point in time and assumes that the BM's components stay constant over time (Putten & Schief, 2012). Research suggests that, whereas the static view prevails in extant literature, a dynamic view must also be adopted (Demil & Lecocq, 2010; Putten & Schief, 2012). Changing elements of the BM often has a significant impact on firm performance, especially when specific drivers, such as globalization or deregulation are changing the market environment (Casadesus-Masanell & Ricart, 2010; Demil & Lecocq, 2010; Voelpel et al., 2004).

An integral aspect of BMI is its increasing popularity as an alternative to product or process innovation due to cost and time savings (Amit & Zott, 2012; Chesbrough, 2007). According to a study by the Boston Consulting Group (2009), BMI has been proven to be more successful

than traditional product or process innovation over time. Research further suggests that BMI supports gaining a sustainable competitive advantage, typically through radical innovation rather than incremental or continuous change (Voelpel et al., 2004). Firms increasingly see BMI as a way of competing, and therefore as a potential source of gaining a competitive advantage (Markides & Charitou, 2004; Zott et al., 2011). For example, even though companies such as Dell or Southwest Airlines were not directly involved in technological innovation, by recombining different organizational and distribution systems, they created a new source of competitive advantage (Teece, 2010). Literature further suggests that BMI can potentially disrupt established competitors (Markides, 2006). Sustaining a competitive advantage poses an increasingly challenging task in today's complex and fast-changing business environment (Economou & Chatzikonstantinou, 2009).

A further salient point of BMI is the cognitive ability of managers to understand the potential value benefit resulting from changing specifications of the old BM or switching to a new model (Chesbrough, 2010). Teece (2010) also states that certain barriers against changing the BM exist, as it can be seen as a paradigm change to the entire firm. Independent of its success and degree of innovation, a BM is furthermore always exposed to specific market threats, such as imitation and commoditization (Tucker, 2001). It is therefore crucial to generate a sophisticated interaction between different BM components in order to make it more difficult for competitors to imitate (Porter & Siggelkow, 2000).

2.4 Business Models in the Airline Industry

Four different airline types based on distinct BMs exist within the airline industry: FSCs, LCCs, regional airlines and charter airlines (Doganis, 2006; Hunter, 2006; Lawton, 2002). This thesis focuses on LCCs, including a brief description of FSCs to exemplify BM convergence; however, it omits regional airlines and charter airlines entirely.

Pacific Southwest Airlines was the first to introduce the low-cost airline BM, which was later copied by Southwest Airlines in 1971. Today the LCC model is one of the most prevalent within the airline industry (Diaconu, 2012) and will hereafter be referred to as the traditional LCC business model. The Airline Deregulation Act, which was signed into law in the US in 1978, opened the previously protected industry to new competition. Southwest Airlines quickly gained market share. New airlines then started populating the space, competing with the incumbents by offering a different approach to air travel (Diaconu, 2012; Pels, 2008). A similar

legislation change by the European Union (EU) to promote trade between 1988 and 1997 opened the entire route market within the region to all airlines. This opening evidentially led to the gradual increase of LCCs within the industry (Graham & Shaw, 2008). Over the years, the traditional low-cost model evolved to a *static* BM, outlining a well-defined and coherent set of choices and offering the potential for superior business performance (Demil & Lecocq, 2010).

FSCs enjoyed a dominant position in the aviation market for many decades. They, however, failed to prepare for a deregulated market and the rapid adoption of the LCC model (Franke, 2007). Whereas the FSC business model focuses on a differentiation strategy; the LCC BM adopts a cost leadership strategy (Alamdari & Fagan, 2005; M. E. Porter, 1985). The operation cost of the average LCC is 51% lower compared to that of FSCs (Doganis, 2006). LCCs achieve a cost advantage by focusing on two main operational aspects: a higher seating density and higher aircraft utilization. LCCs typically operate a single-class cabin aircraft with a seat pitch of 71-74cm, whereas FSCs’ mixed-class aircraft have an average seat pitch of 79-81cm. LCCs therefore have on average a higher seating density. By targeting secondary airports with point-to-point flights rather than utilizing a hub-and-spoke network, LCCs can turnaround airplanes faster and achieve a higher aircraft utilization rate. LCCs further save costs by not transporting cargo nor including complimentary in-flight services. In 2003, the daily utilized hours per Boeing 737-300 for the LCC EasyJet were at 10.3h compared to 6.9h for the FSC British Airways (Doganis, 2006). **Table 1** provides a short overview of the major differences between FSCs and LCCs. A detailed description of the individual BM specifications will follow in **section 3.4**.

Table 1: Comparison of FSC and LCC Business Model (Source: adapted from Hunter (2006))

Characteristics	Full-service Carrier	Low-cost Carrier
Strategy	Differentiation	Cost minimization
Scale	Large	Smaller, but also major players (Ryanair, EasyJet, Southwest)
Business Model specifications	Hub-and-spoke (network) system; short-, medium-, and long-haul routes; multiple aircraft types; low utilization; tickets sold through third parties; complimentary catering and in-flight entertainment	Point-to-point flights; short sector length; fleet uniformity; high utilization; short turnaround time; direct ticket sales; charge for catering and in-flight entertainment
Market & Competition	Competing with other FSCs (based on service quality) and increasingly with LCCs	Focusing on low-cost travel sector, competing with other LCCs and FSCs

2.5 Business Model Innovation and Convergence in the Airline Industry

The increasing competition within the airline industry caused by the rapid expansion of LCCs with low airfares threatened the FSC BM. Consequently, FSCs were forced to adjust their BM to stay competitive (Vidović et al., 2013). Some FSCs went as far as competing through the establishment of LCC subsidiaries (Gillen & Gados, 2009). Singapore Airlines successfully launched the LCC subsidiary Silk Air in 1989 (Markides & Charitou, 2004). However, multiple failures such as those of Delta Airlines and Continental Airlines to copy the traditional BM (Porter & Siggelkow, 2000) illustrate the challenge in moving towards a dual BM (Markides & Charitou, 2004). As Santos et al. (2009) discuss, FSCs that were trying to integrate a low-cost subsidiary failed due to their inability to understand the complex interaction of activities and the cost minimization aspect, thus not generating profits. Most of these examples describe failures; nonetheless, experimenting with new configurations of BM aspects is essential for BMI. Only by doing so, is the company able to collect relevant data and get ahead of its competitors, and eventually develop the capabilities necessary for BMI (Chesbrough, 2010).

As outlined above, the LCC BM was static for a long time, delivering a cost advantage based on a well-chosen combination of activities. The static BM was challenged by FSCs progressively trying to adopt LCC BM specifications, thereby eroding the LCCs profitability (Demil & Lecocq, 2010). During the global financial crisis (GFC) in 2008 - 2009, a decline in revenues and low profitability further led LCCs and FSCs to adapt their BM to current market conditions, which consequently resulted in the emergence of hybrid BMs (Vidović et al., 2013). A hybrid model is classified as taking on aspects of both the traditional LCC and FSC model (Klophaus et al., 2012). As Hvass (2008) points out, BMI in the airline industry is comprised of two possibilities: through innovation (proactive) or imitation (reactive). The latter often describes a firm's defensive tit-for-tat strategy to protect the airline against competitors' changes. An example of the reactive approach is Southwest's adoption of a frequent-flyer program (FFP) in response to LCC competitors introducing such loyalty programs in order to retain customers (Peterson, 2004). By executing a proactive approach, such as through technological innovation, more often a new source of competitive advantage can be established (Teece, 2010). Several changes in the past years among airline BMs led to the emergence of hybrid BMs. On the one hand, LCCs adopted higher service levels as seen in the FSC BM. The most common examples include offering transfer flights based on codeshare agreements with

partner airlines, using the GDS, offering complimentary catering and in-flight entertainment, as well as offering FFPs (Klophaus et al., 2012; Vidović et al., 2013). A report by Sabre Airline Solutions (2010) further states that LCCs are increasingly taking on hybrid BMs by experimenting with long-haul routes, new services, and partnerships. On the other hand, FSCs abandoned free in-flight entertainment and complimentary catering on distinct routes, added increased flexibility to airfares and started selling tickets directly on their websites (Štimac et al., 2012).

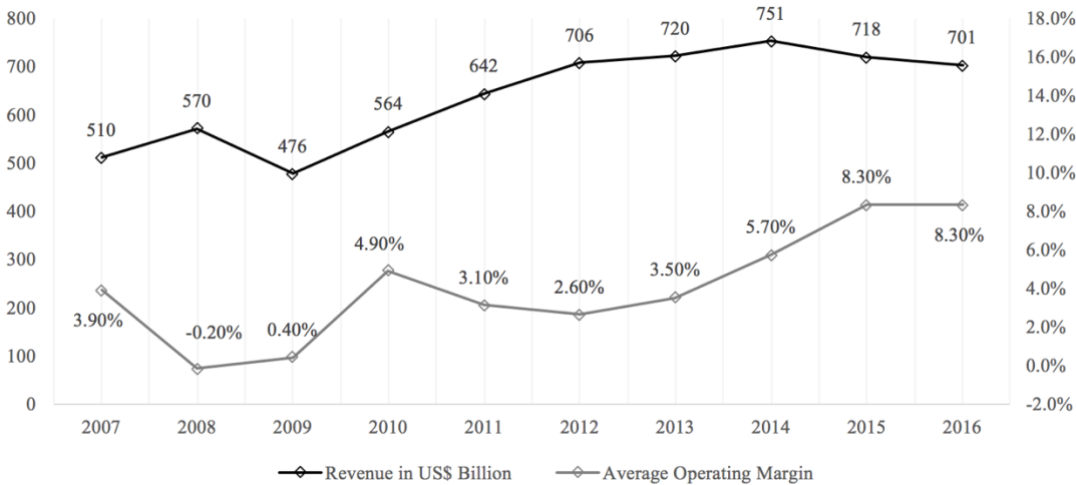
Although the field of airline BMs hybridization is not thoroughly researched yet, scholars agree that the traditional LCC model is outdated. LCCs changed parts of their BMs to sustain their cost advantage and adjust to a changing market environment, as examined in various studies. An overview of prior research in the field of BM convergence is shown in **appendix I**.

Scholars in the field of LCCs suggest a new categorization for the model. According to Vidović et al. (2013), only Ryanair still holds on to the *traditional (pure)* LCC model. Whereas low-cost airlines such as Wizz Air adhere to more than 80% of the traditional aspects and are therefore still considered *real* LCCs, EasyJet already evolved towards a *hybrid* LCC model and airlines such as Norwegian and FlyBe are categorized as *hybrid* FSCs. Lastly, Air Berlin is classified as a FSC, as the airline only holds on to 30% or less of the traditional LCC aspects. I will later use these new classifications of LCCs to describe the airlines in the data sample and illustrate my findings on the convergence trend. Literature consequently suggests that further research should be conducted to assess how BM changes impact an airline's profitability (Daft & Albers, 2013, 2015). In an earlier study by Alamdari & Fagan (2005), the authors conclude that by adhering to the traditional LCC BM, airlines could potentially ensure greater profitability. Growing similarity among airlines, however, could cause an environment which could be easily disrupted by a new model and thereby erode profitability of the incumbents (Daft & Albers, 2015). While Ryanair, with its ultra-low-cost model, adheres to the traditional LCC model and remains one of the most profitable airlines in Europe, the self-proclaimed hybrid carrier Air Berlin recently filed for bankruptcy (Airberlin, 2018; Daft & Albers, 2015). Practitioners, as well as scholars, continuously raise suspicion about the airline hybridization development, even though empirical evidence for the ongoing convergence in the airline industry has been found (Daft & Albers, 2015).

2.6 Airline Industry Market Development

The passenger air transportation market is fueled by the rising importance of connectivity, with forecasted steady growth rates of 2.3% in North America and Europe; additionally, global passenger numbers are predicted to almost double from 4.0 billion in 2017 to 7.8 billion in 2036 (International Air Transport Association, 2017a). LCCs were able to expand their market share in Europe from only 16.5% in 2003 to 39.2% in 2015 (CAPA Centre for Aviation, 2015a; OAG Worldwide Aviation Services, 2015a). Similarly, though with slower growth representing a more mature market, American LCCs expanded their market share from 21% in 2003 to 30.6% in 2015 (CAPA Centre for Aviation, 2015b; OAG Worldwide Aviation Services, 2015b). In 2017, the three most prominent American LCCs, Southwest, Spirit Airlines, and JetBlue accounted for 27% of the total domestic US airline market, indicating a consolidated market (United States Bureau of Transportation Statistics, 2018). An overview of the aggregated worldwide airline industry revenue and the average operating margin is given in **figure 2**.

Figure 2: Aggregated Worldwide Airline Industry Revenue and Average Operating Margin (Source: adapted from International Air Transport Association, (2017b))



Both industry revenues and the operating margins suffered tremendously during the financial crisis. Since then, revenues have been growing, whereas the operating margin faced a decrease in 2011 to 2013 after an initial rebound in 2010. In more recent years, the operating income stagnated, however, showing a slight downward trend. The average operating margin shows a new high of 8.3% in 2015 and 2016. Overall, the airline industry can be seen as a low-margin and high-risk industry with an average net profit of only US\$ 8.45 per passenger in 2017 (International Air Transport Association, 2017b).

3 Methodology

In the following chapter, I outline the empirical approach followed in this thesis. First, I derive an airline-specific BM framework by synthesizing general and industry-related literature on BMs. The developed framework serves as the foundation for operationalizing variables and collecting relevant data. Subsequently, I will describe the dataset and its dependent, independent and control variables. Lastly, I outline the longitudinal research setting and the fixed effects regression models that were used to find empirical evidence to answer the research question.

3.1 Business Model Framework and Variable Operationalization

To operationalize the variables included in this study, I compile a BM framework following an approach similar to Soyk et al. (2017). The process is briefly described in this section and outlined in greater detail in **appendix II**. I use the BM and BM component definition by Teece (2010, 2018) to methodically explain and describe the particular activity set and organizational design of any company, irrespective of the industry context. The general concept is then compared to the two leading generic airline BM definitions by Daft & Albers (2015) and Mason & Morrison (2008). This method allows for the distinct separation between BM and strategy. Subsequently, I choose the airline BM definition by Daft & Albers (2015) because its dimensions (or components) provide a better fit to the components of the industry-unspecific BM framework. The BM components outlined by Daft & Albers (2015) are further described using 36 items. A detailed explanation of all these components is done in the study by Daft & Albers (2015) and is therefore not described here. Due to the limited publicly accessible data within the industry, it is not possible to collect data on all components and items. Access to paid databases is also not feasible within the scope of this thesis. As such, in order to derive a suitable BM framework, the BM components defined by Daft & Albers (2015) function as a general guideline. The distinct BM specifications (or items) of LCCs and FSCs defined by Belobaba et al. (2016) and Hunter (2006) are then attributed to the components. The resulting framework with its 14 items and three main components serves as the foundation for the variables chosen (see **table 2** in **section 3.4**).

3.2 Data Collection and Sample

The sample in this longitudinal research setting comprises data of 10 LCCs from Europe and the US between 2007 and 2016. Similar to the research of Alamdari & Fagan (2005) and Hvass (2012) a deciding factor for this study was that the data is publicly available on the internet. Data collection within the airline industry is challenging for many reasons. Due to different reporting standards across countries, it is difficult to acquire the same operational and managerial data for all airlines. Initially, for better comparability, I planned on investigating only LCCs headquartered in the European market. However, as many airlines are part of a holding group, data in annual reports is mostly aggregated and cannot be distinctly allocated to the different business units¹ (Daft & Albers, 2013). Consequently, I focus on LCCs in Europe and North America, because of similar growth rates and market maturity (as shown in **section 2.6**). The comparable level of deregulation in the US and Europe further indicate a similar environment for potential BMI, in contrast to other less developed markets such as Asia. The decision to select both European and American-based LCCs hence facilitates the analysis.

With the recent convergence trend, another potential issue is the BM classification of LCCs and FSCs. As already stated, throughout literature, multiple classifications of airlines and their respective BMs exist. To be consistent when choosing the airlines for the data sample and to eliminate a potential self-selection bias (Wooldridge, 2013), I follow the airline classification of governmental bodies in the US (Bureau of Transportation Statistics) and Germany (German Aerospace Center). Based on the 20 largest LCCs in Europe (German Aerospace Center, 2017), I then investigate which airlines are most suitable for the data sample following the reasoning outlined above. In the European market, six of the 20 leading LCCs offer enough publicly available data. Therefore, I select the following airlines: Ryanair, EasyJet, Norwegian/Norwegian International (combined, hereafter referred to as Norwegian), Vueling, Wizz Air, and Flybe. I further choose four US low-cost carriers following the same approach: Southwest Airlines, Spirit Airlines, JetBlue and Allegiant Air (United States Bureau of Transportation Statistics, 2018).

The dataset is compiled based on information from the airlines' annual reports, SEC Filings of the 10-K Form, the US Bureau of Transportation Statistics, the UK Civil Aviation Authority, airline websites, flight statistics websites and various press releases. It was only possible to

¹ For example, Lufthansa group with its business units Lufthansa Passage, Germanwings, Swiss, etc.

assess the required data from 10 airlines, thus restricting the depth of the study. To obtain a sizeable sample, I collect data for the last 10 years based on the most recent annual report or SEC 10-K filing available (2016). Different fiscal year periods for European and American airlines aggravate the comparison of data. Depending on the fiscal year of the distinct airline², I select annual reports from different years for the first year (2006/2007) and the last year (2015/2016) to minimize this effect. To collect data on the 14 specifications outlined in the BM framework, I primarily utilize the airline's annual reports and supporting press releases³. Additionally, I collect data on different financial aspects, such as operating revenue, operating profit, and costs. Further, I gather data on operational characteristics, such as fleet size, the number of employees, revenue passenger kilometers and available passenger kilometers, and passengers carried, amongst others. All financial (monetary) data is transformed into real 2010 values with the consumer price index (CPI) (World Bank, 2018). Further, I convert all monetary values to Euro (€) with the average exchange rate of the domestic currency (based on the airline's headquarters) for each year. All operational data with imperial length units was further converted to the metric system. The final dataset used in the models shows no missing values, representing a complete dataset.

3.3 Dependent Variables

To investigate whether it is beneficial for a LCC to change its BM, it is essential first to determine indicators of airline success. Throughout literature, various measures of airline BM success exist, such as net profit, operating profit, market share, or customer satisfaction (Alamdari & Fagan, 2005; Hvass, 2012). Performance indicators, such as the operating margin, are further used to describe the success of an airline (Alamdari & Fagan, 2005; Mason & Morrison, 2008). This thesis proposes two dependent variables, the operating revenue and the operating margin. Thus, I can first analyze the impact of the distinct BM specifications on operating revenue and compare it with the estimated effect on the operating margin. To follow a normal distribution, the operating revenue is transformed with the natural logarithm. The variable is displayed as “log(op_rev)”. The operating margin is calculated in the following way and is represented as “op_margin”.

² Depending on the airline, fiscal years start between January 1st, April 1st and October 1st.

³ Some of the press releases and official company statements regarding Wizz Air were translated from Hungarian to English to obtain data on the company before its IPO in March 2015.

$$\text{Operating margin} = \frac{\text{Operating profit (EBIT)}}{\text{Operating revenue}}$$

The variable operating margin elicits a challenge, as the highly volatile fuel cost is included in the calculation of the Earnings Before Interest and Tax (EBIT). As described in the study by Hvass (2012) these price fluctuations potentially mask successful BMs. It is however not possible to find financial data which did not account for the cost of fuel for all airlines in the data sample.

3.4 Independent Variables

As I am interested in measuring the impact a change in BM specifications has on LCC performance and highlight the BM convergence, I collect information on the 14 items of the previously defined LCC BM framework. **Table 2** provides an overview of the independent variables. A detailed description follows in the text below.

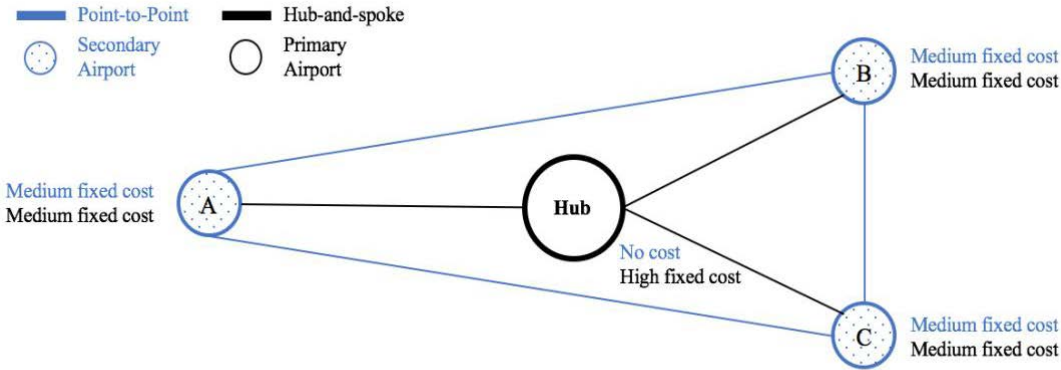
Table 2: Variable Operationalization Results (Source: author's own contribution)

Component	Item	#	Variable	Measurement and Scale
Value Proposition	<i>Product & Service</i>	Point-to-Point flying, "No frills" system	1 Network	(0 = Hub-and-Spoke, 1 = Only Point-to-Point)
			2 No_entertain	(0 = Free Entertainment, 1= Paid entertainment)
			3 No_catering	(0 = Complimentary Catering, 1= No complimentary catering)
	<i>Customer Needs</i>	No cargo transport, Single-class cabin,	4 No_cargo	(0 = Cargo transport, 1 = No cargo transport)
			5 Sing_class	(0 = No single-class cabin, 1 = Single-class cabin)
	<i>Geography</i>	Only short-haul flights (<4000km)	6 Short_haul	(0 = Short and long-haul, 1 = Short-haul only)
Revenue Model	<i>Pricing Logic</i>	Cheap one-way fares,	7 Low_fare	(0 = No low fares, 1 = Low fares)
		Fee for checked bags	8 Bag_fee	(0 = No bag fee, 1 = bag fee)
	<i>Channels</i>	Only online and direct booking via airline's website	9 No_gds	(0 = Use of GDS, 1 = No GDS)
			10 Website	(0 = No direct website booking, 1 = Direct booking on website)
	<i>Customer Interaction</i>	No customer loyalty programs	11 No_ffp	(0 = Use of FFP, 1 = No FFP)
Cost Model	<i>Core Assets & Capabilities</i>	Fleet uniformity, high aircraft utilization	12 Fleet_uni	(0 = Multiple aircraft types, 1 = Single aircraft type/family)
	<i>Core Activities</i>	N/A	<i>Excluded</i>	
	<i>Partner Network</i>	No codeshare	13 No_codeshare	(0 = Codeshare, 1 = No codeshare)
		partnerships, no alliance membership	14 No_alliance	(0 = Alliance, 1 = Not member of an alliance)

All variables are measured using the same scale, dichotomous (binary) dummy variables that can take on the values 0 or 1, thereby indicating that the specification is present according to either the traditional LCC model (1) or FSC model (0). All dummy variables are coded in such a way that 1 represents the traditional LCC BM, whereas 0 represents a FSC model.

1. Network. This variable describes whether the airline operates a point-to-point system, only providing direct flights between predominantly secondary airports, or a hub-and-spoke system. With a hub-and-spoke system, primary airports serve as central hubs for the airline to transfer passengers and their baggage to connecting flights (Belobaba et al., 2016). As Doganis (2006), Mason et al. (2011) and Pels (2008) point out, a BM solely based on point-to-point operations offers many advantages, including a significant cost-advantage and simplified revenue management. The differences between the two systems are illustrated in **figure 3**. In line with the BM convergence trend, a study by Daft & Albers (2015) discovered that between 2004 and 2012, 15 out of the 26 airlines in the research added hub-and-spoke elements to their operations. In the realm of this thesis, the “network” variable is defined as airlines that either operate a pure point-to-point system (1) or blend it with hub-and-spoke elements (0).

Figure 3: Network Systems (Source: author’s own contribution, adapted from Pels (2008))



2. No_entertain and **3. No_catering.** The traditional LCC model introduced the no-frills system. This new approach includes a complete elimination of complimentary amenities and services, such as in-flight entertainment, complimentary snacks and beverages, as well as free checked baggage (Belobaba et al., 2016). By unbundling these services, LCCs can offer low airfares and generate ancillary revenues through selling the formerly included services separately. The omission of complimentary in-flight entertainment and catering are a major cost reduction in the LCC BM. Recently, many LCCs nonetheless diverged from the no-frills system

and improved their complimentary in-flight services. Norwegian, for example, offers free Wi-Fi on almost all of its European flights and more recently also on trips to the US and the Caribbean, after introducing its long-haul service (Norwegian Air Shuttle ASA, 2018). Contrary to this trend, FSCs are increasingly trying to reduce their service costs by partly adopting a no-frills system (Belobaba et al., 2016).

4. No_cargo. Whereas cargo transportation can contribute to airline revenues, loading and off-loading have a negative impact on the cost optimization aspect of LCCs (Gillen & Gados, 2009). The freight activities adversely influence the short turnaround times of airplanes which leads to a lower aircraft utilization (Doganis, 2006). Moreover, also in the LCC long-haul business, scholars in the field argue that cargo operations could have a negative impact on business performance (Soyk et al., 2017) despite significantly increasing revenues (McKinsey&Company, 2013). Most LCCs hence do not engage in cargo operations. Contrary to that, Daft & Albers (2013) outline that three out of four airlines in their study changed from not carrying freight to introducing cargo operations between 2003 and 2010.

5. Sing_class. A single-class cabin means that there is no differentiation between classes in the traditional LCC model. By operating an all-economy class, airlines have a higher seat density, which reduces the operating cost per passenger (Alamdari & Fagan, 2005). Herein, the convergence trend is also noticeable. While the LCC JetBlue introduced its business class on selected routes (JetBlue, 2018), FSCs such as Lufthansa outsourced part of its route network to its LCC subsidiary Germanwings, thereby commencing business class service on these routes (Daft & Albers, 2015).

6. Short_haul. According to Eurocontrol (2011), flights with stage lengths longer than 4000km⁴ are considered long-haul flights. In this thesis, all flights shorter than 4000km are categorized as short-haul flights. To serve both short-haul and long-haul markets, different aircraft types are more efficient (Belobaba et al., 2016). However, this is not in alignment with the cost minimization strategy of LCCs as outlined in the description of the variable “fleet_uni”. As a result, LCCs typically only operate short-haul fleets. In the data sample, only Norwegian started to offer long-haul flights. However, the industry is changing, as an increasing number

⁴ The stage length describes the distance the aircraft travelled between take-off to landing (Airlines for America, 2018).

of LCCs, such as Eurowings, Westjet and WoW Air, recently started operating long-haul flights (Soyk et al., 2017).

7. Low_fare. Cheap one-way fares are based on the no-frills concept, network system and general cost minimization aspect of LCCs, which have been described before.

8. Bag_fees. Also in alignment with the LCC no-frills system, LCCs charge a fee for checked baggage. This ancillary revenue contributes to LCCs' ability to offer low-cost fares (Alamdari & Fagan, 2005). More recently, Ryanair went beyond the regular baggage fee by charging passengers for the guarantee to bring cabin baggage on board the aircraft⁵ (Ryanair, 2018). Alternatively, LCCs such as Southwest, have been diverging from the low-cost model by taking on a differentiation strategy by offering free checked bags. In a recent study, baggage fees were proven, despite having a negative impact on demand, to be beneficial, as they reduce fares and thus offset the effect of higher ticket prices on demand (Scotti & Dresner, 2015).

9. No_gds. The Global Distribution System describes a computer reservation system that offers airlines access to sell tickets through third-party travel websites and travel agencies for a fee (Belobaba et al., 2016). Airlines use the GDS to expand their international reach and to penetrate the corporate market, as large corporations often use their own booking system or engage travel agencies for flight reservations (Sabre Airline Solutions Worldwide, 2010). As the costs for its usage are quite substantial, it is usually not inherent to the LCC model (Franke, 2007). LCCs show mixed behavior regarding paying for access to the GDS. Whereas EasyJet already started to tap into the corporate market in 2007, Ryanair recently ended its GDS partnership (Ryanair, 2017; Sabre Airline Solutions Worldwide, 2016).

10. Website Booking. Direct ticket bookings through the airline's website are the primary distribution channel used by LCCs. Allowing passengers to only book tickets via their website poses two significant cost advantages for the airline. Airlines do not have to pay GDS fees and tickets can be directly (electronically) distributed to the customer (Doganis, 2006).

11. No_FFP. Loyalty programs of airlines, commonly referred to as frequent-flyer programs were inherent only to the FSC model, as its introduction and operation increases costs

⁵ Ryanair restricts the amount of cabin baggage to 90 pieces per plane and charges €5 for a guaranteed space in the overhead compartment (Ryanair, 2018).

(Tomová & Ramajová, 2014). More and more LCCs are introducing FFPs, as part of a tit-for-tat-strategy to imitate competitors and lock-in customers (Hvass, 2008).

12. Fleet_uni. Fleet uniformity describes that airlines operate a fleet consisting of a single aircraft type or single aircraft family⁶. As outlined in the study by Alamdari & Fagan (2005), fleet uniformity based on the traditional LCC models is a major contributor to operational efficiency and poses financial benefits due to lower maintenance and overhead costs. Daft & Albers (2015) state that recently, FSCs have attempted to achieve operational efficiency similar to LCCs by adopting a uniform fleet on certain route networks. Contrary to this, LCCs are increasingly taking on a heterogeneous fleet to serve new route networks (Daft & Albers, 2015). A report by McKinsey&Company (2013) also shows that when a LCC adopts long-haul operations the airline loses fleet uniformity. This might have an impact on LCC profitability, as the cost advantage over FSCs gets diminished to only 13% from 30% to 50%.

13. No_codeshare. Codeshare agreements are often interchangeably used with the term interlining; these agreements describe the passenger's ability to book flights with partner airlines and connect through airports, without collecting and re-checking her/his baggage during the stopover (Belobaba et al., 2016). JetBlue already had 39 partner airlines in 2013 (Jean & Lohmann, 2016). EasyJet recently announced that it would also collaborate with airlines to offer connecting flights to the US and Asia, thereby acting as a feeder airline to the main hubs (EasyJet, 2018; Vidović et al., 2013).

14. Alliance. Similar to codeshare agreements, airline alliances offer synergies and benefits to its member airlines. Recently EasyJet, Ryanair, Norwegian, and Vueling joined the alliance *Airlines for Europe* with the objective of promoting interests of European passenger airlines (Airlines for Europe, 2018).

3.5 Control Variables

The research on innovation and BMs suggests that there are other meaningful determinants of firm performance. To control for an external effect of other time-variant variables that are related to the dependent variables, I include a series of control variables.

⁶ For example, the Airbus aircraft types A318, A319, A320, A321 all belong to the single-aisle A320 family (Klophaus et al., 2012).

Following the Schumpeterian perspective about the effect of firm size on innovativeness, Stieglitz et al. (2007) point out that firm size has an impact on the chance and degree of innovation in a firm. Furthermore, the size of a firm determines how the innovative rents are appropriated in an organization, therefore having a potential impact on firm performance. In this study, not controlling for firm size would further lead to a biased result, as larger companies with high profits are incorrectly weighted compared to small companies with lower profits. No one single measurement of firm size exists within airline literature. More so, the size of an airline is expressed by different variables, such as customers served, the number of employees, market presence, passengers-flown, and fleet size (Hvass, 2008). However, some of the determinants of airline size are difficult to measure due to data availability. For this analysis, I consider two variables, fleet size at the year-end and passengers carried. The reasoning behind this choice is that the larger the firm, the more passengers are transported. Further, the larger the firm, the more routes and customers are served and, therefore, the more airplanes are needed. However, one potential shortcoming of measuring fleet size at the year-end is that one does not account for different aircraft types. Consequently, a carrier with large airplanes could be smaller than an airline with small planes regarding fleet size but have a higher total seat capacity. I, therefore, decided to control for firm size based on the number of passengers.

The airline industry was further profoundly affected by the GFC in the years 2008 and 2009 (Jean & Lohmann, 2016; Vidović et al., 2013). To control for economy-wide demand in passenger travel, I include year controls for the observation period (Collins et al., 2011). Additionally, I control for firm age in my models. As Johnson et al. (2008) outlined in their study, younger firms are more likely to adjust their BM often in their pursuit of profitability. As all monetary values were adjusted with the CPI of the airline's respective country, I do not include any additional country-specific controls, such as gross domestic product (GDP) growth. Furthermore, airlines do not change their headquarters and are therefore based in the same country throughout the observation period. In order to follow a normal standard distribution, the variables "passenger" and "firm_age" were transformed with the natural logarithm to "log(passengers)" and "log(firm_age)".

3.6 Research Design

After having defined the dependent, independent and control variables, I construct the regression models to test my general research question. An observational study as presented in this paper poses considerable disadvantages compared to randomized experiments, due to the possibility of endogeneity caused by omitting variables (Allison, 2005). To circumvent this issue, I conduct a fixed effects regression analysis, thereby controlling for the unobserved time-invariant factors a_i (Wooldridge, 2013). As I want to investigate whether it is beneficial for airlines to change their BMs, I outline my two dependent variables “ $\log_{op_rev_{i,c,t}}$ ” and “ $op_margin_{i,c,t}$ ” for each firm i , in a country j and year t . By analyzing both variables, I then investigate which BM specifications (independent variables) have the most significant impact on revenue. I also explain how this effect influences airline profitability. In the models, I focus on the following independent variables: “network”, “no_entertain”, “bag_fee”, “no_cargo”, “sing_class”, “no_gds”, “fleet_uni”. I thereby cover all three main components of the BM framework. The variables “ $\log(\text{passengers})$ ” and “ $\log(\text{firm_age})$ ”, serve as controls to single out the effect of other factors impacting the airline’s revenues and operating margin and are captured in $E_{i,c,t}$. Finally, to further control for unobserved heterogeneity, I add a variable for year dummies, “YearControls”, to the model (Wooldridge, 2013). The fixed effects models are defined as:

Model (1)

$$\begin{aligned}\log(op_rev)_{i,c,t} &= \alpha + \beta_1(network)_{i,t} + \beta_2(no_entertain)_{i,t} + \beta_3(bag_fee)_{i,t} \\ &+ \beta_4(no_cargo)_{i,t} + \beta_5(sing_class)_{i,t} + \beta_6(no_gds)_{i,t} \\ &+ \beta_7(fleet_uni)_{i,t} + \gamma(E)_{i,c,t} + \rho YearControls_t + a_i + \varepsilon_{i,t}\end{aligned}$$

Model (2)

$$\begin{aligned}\log(op_margin)_{i,c,t} &= \alpha + \beta_1(network)_{i,t} + \beta_2(no_entertain)_{i,t} + \beta_3(bag_fee)_{i,t} \\ &+ \beta_4(no_cargo)_{i,t} + \beta_5(sing_class)_{i,t} + \beta_6(no_gds)_{i,t} \\ &+ \beta_7(fleet_uni)_{i,t} + \gamma(E)_{i,c,t} + \rho YearControls_t + a_i + \varepsilon_{i,t}\end{aligned}$$

A prevalent problem with regression analysis is multicollinearity (Kastalli & Van Looy, 2013). However, as Kastalli & Van Looy (2013) state, it is difficult to test multicollinearity in a fixed effects model. First, I outline the correlation coefficients of all seven independent variables and two control variables in **appendix III**. None of the variables in the model show correlation that lies above the conventional levels of suspecting extreme serial correlation (Dormann et al., 2013). Furthermore, the variance inflation factors (VIF) were calculated using the Ordinary Least Squares (OLS) estimator with the same independent and dummy variables as indicated in the models. The results in **appendix IV** show that the VIFs for the variables are below the threshold value of 10 (Wooldridge, 2013). Therefore, I do not suspect multicollinearity in the model. To rule out another potential issue, heteroscedasticity, I conducted the Breusch-Pagan test (Wooldridge, 2013). As the p-value is close to zero, I reject the null hypothesis of homoscedasticity and suspect heteroscedasticity in model (1). Therefore, I adjust the coefficients in model (1) with the robust standard errors (Arellano, 1987). The p-value is not close to zero in model (2). Thus, I do not reject the null hypothesis of homoscedasticity as it seems that the model is not affected by heteroscedasticity⁷.

⁷ Results of Breusch-Pagan tests: $p = .0019$ in Model (1), and $p = .3613$ in Model (2).

4 Descriptive Statistics and Results

In the following chapter, I first give an overview of the data statistics and then illustrate the convergence trend by highlighting airlines' BM changes over the years. Subsequently, I present and compare the results of the two regression models, before describing the significant findings in greater detail.

4.1 Descriptive Statistics

As previously outlined, the sample is comprised of panel data from 10 airlines over 10 years. **Table 3** shows the summary statistics.

Table 3: Summary Statistics (*Source: author's own contribution*)

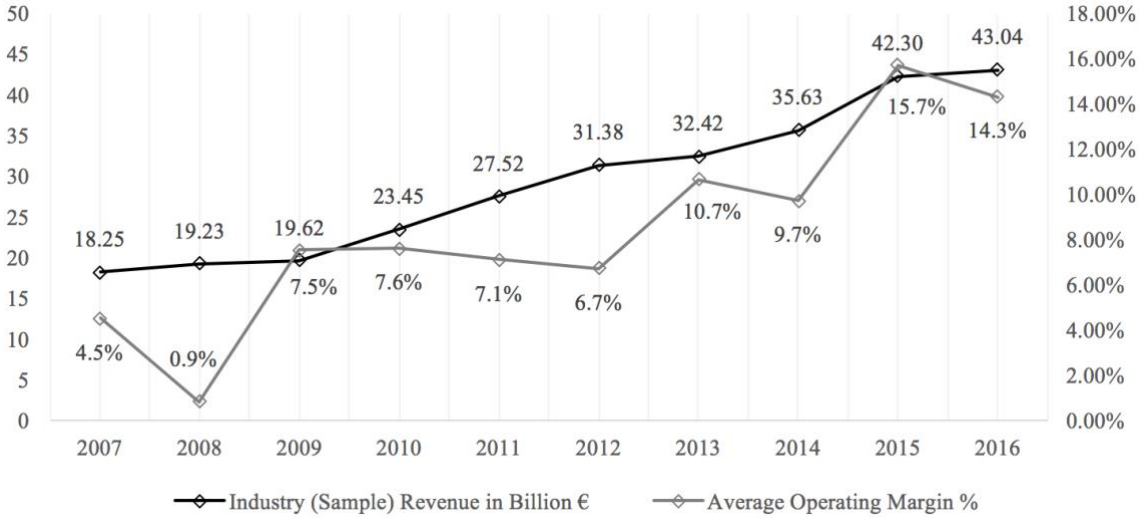
Statistic	N	Mean	St. Dev.	Min	Max
Dependent Variables					
op_rev	100	2,928,290,346.00	3,456,053,088.00	277,089,529.00	16,984,422,349.00
op_margin	100	0.08	0.08	-0.20	0.29
(EBIT)	100	318,601,220.00	543,368,284.00	-158,920,361.00	3,416,088,406.00
Independent Variables					
network	100	0.59	0.49	0	1
no_entertain	100	0.80	0.40	0	1
no_cargo	100	0.60	0.49	0	1
sing_class	100	0.88	0.33	0	1
bag_fee	100	0.83	0.38	0	1
no_gds	100	0.21	0.41	0	1
fleet_uni	100	0.59	0.49	0	1
Control Variables					
firm_age	100	20.70	11.22	3	45
fleet_end	100	164.43	178.21	17	723
passengers	100	3,370,902.00	3,375,938.00	326,500	12,472,000
Constructed Variable					
purity_index	100	0.72	0.21	0.29	1.00

Throughout the data sample, all variables indicate the same observation number (100). The airlines included in the sample are from two principal geographic markets, Europe and the US. The six European airlines have their headquarters located in different countries, including two airlines from the UK (EasyJet and Flybe), one airline from Norway (Norwegian), one Spanish airline (Vueling), one airline from Hungary (Wizz Air), and one airline with headquarters in Ireland (Ryanair). All other airlines (Southwest Airlines, Spirit Airlines, Allegiant Air, and JetBlue) are based in the US. The full data sample is shown in **appendix V**.

As illustrated in **table 3** and in more detail in the histogram in **appendix VI**, the dependent variable "op_rev" is skewed. Thus, the variable was transformed with the natural logarithm.

Southwest achieves the highest revenue of ~€17 billion in 2016. The airline also had the largest fleet with 723 airplanes in that year, and the highest number of passengers carried with approximately 12.5 million. Furthermore, the EBIT is outlined in the summary statistics as the variable that is used to calculate the second dependent variable “op_margin”. The dependent variable “op_margin” indicates that the average profitability in the industry is positive, however ranging from -20% to +29%. An overview of the cumulated revenue of all airlines in the data sample and the average operating margin is illustrated in **figure 4**.

Figure 4: Aggregated Revenue and Average Operating Margin of Airlines in the Data Sample (Source: author’s own contribution)



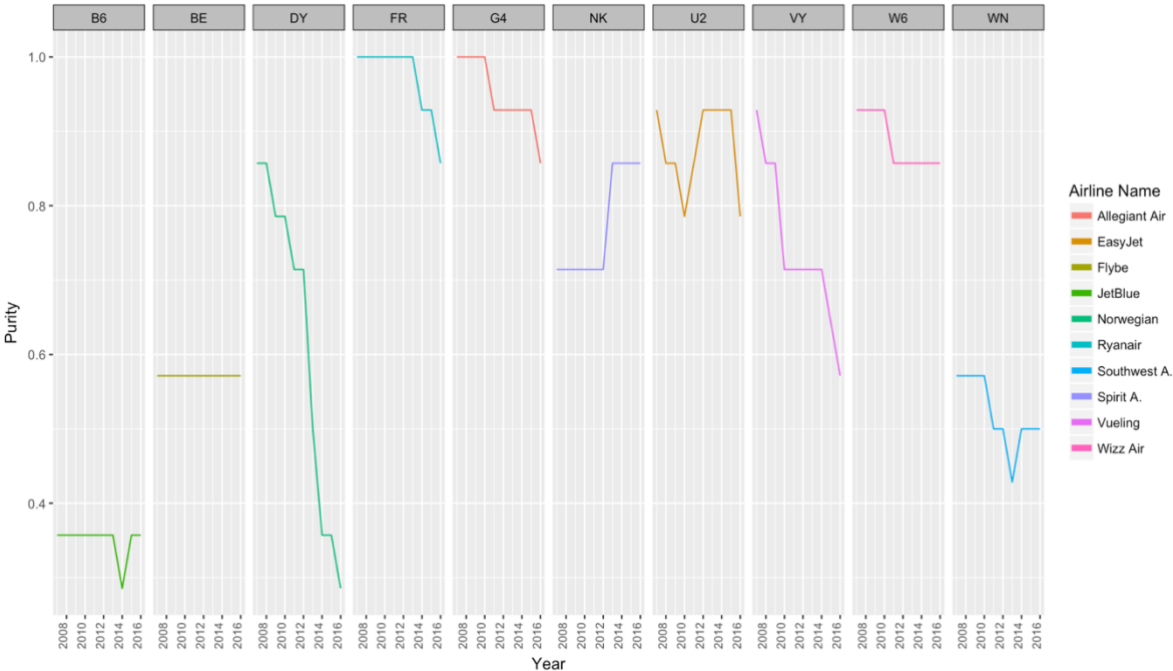
The independent dummy variables denote the airline’s adherence to the traditional BM specifications throughout the years. In the data sample, more airlines operate a point-to-point system rather than blending it with a hub-and-spoke system (Mean = 0.59), and almost none of the airlines offer complimentary in-flight entertainment (Mean = 0.80). Moreover, the summary table shows that most airlines do not carry cargo (Mean = 0.60) and adopted a single class (Mean = 0.88). Further, the majority of airlines charge for checked bags (Mean = 0.83) and only a few LCCs in the sample do not use the GDS (Mean = 0.21). Lastly, most LCCs operate a uniform fleet (Mean = 0.59). The control variables were also transformed with the natural logarithm to follow a normal distribution (see histograms in **appendix VII** and **appendix VIII**). The oldest firm in the sample is Southwest, whereas the youngest is Vueling. Wizz Air operated the smallest fleet in 2007 with only 17 planes. However, with 326,500 passengers, Allegiant Air carried the least passengers in that year. Both airlines show high growth rates over the years, with fleet sizes of 79 and 84, respectively in 2016.

To investigate the adherence of the airlines in the sample to the traditional LCC model over time, I first calculate the BM purity following the approach developed by Hvass (2008). The constructed variable “purity” considers all 14 independent variables outlined in **section 3.4**. The variable is calculated in the following way:

$$Purity = \frac{\sum \text{Dummy business model variables}}{\sum \text{Dummy traditional LCC business model variables}}$$

The results show that airlines adhere on average to 72% of the BM specifications of the traditional LCC model. To contribute to recent literature on BM convergence, the results of the purity variable are outlined in more detail in **figure 5**. The purity ranges from 29% (Norwegian (2016) and JetBlue (2014)) to 100% (Allegiant (2007 - 2010) and Ryanair (2007 - 2013)), thus indicating that all traditional LCC BM specifications are inherent to the airline in that year. The biggest change is noticeable for Norwegian, which changed from a purity of 86% in 2007 to only 29% in 2016. In contrast, Flybe did not change any aspects of its BM over the years.

Figure 5: Purity – Adherence to the Traditional LCC Model (Source: author’s own contribution)



Airlines were further categorized based on the classification scheme⁸ by Vidović et al. (2013) described earlier, to outline the modifications and convergence in the industry at the beginning and end of the observation period. **Table 4** illustrates the categorization and the changes of airline BMs. Across all airlines in the sample, the traditional BM adherence decreased from 79% in 2007 to 65% in 2016. According to the BM purity values, five airlines reduced their BM purity, whereas four airlines remained stagnant. Only Spirit Airlines reversed some of its changes and reverted to a more traditional LCC model. I conclude that the data I collected supports the literature on BM convergence in the airline industry.

Table 4: Business Model Categorization Overview (2007, 2016) (*Source: author's own contribution*)

Name (IATA code)	Business Model 2007	Business Model 2016	Change
JetBlue (B6)	Hybrid FSC	Hybrid FSC	⇒
Flybe (BE)	Hybrid FSC	Hybrid FSC	⇒
Norwegian (DY)	Real LCC	FSC	↓
Ryanair (FR)	Traditional LCC	Real LCC	↓
Allegiant Air (G4)	Traditional LCC	Real LCC	↓
Spirit (NK)	Hybrid LCC	Real LCC	↑
EasyJet (U2)	Real LCC	Hybrid LCC	↓
Vueling (VY)	Real LCC	Hybrid FSC	↓
Wizz Air (W6)	Real LCC	Real LCC	⇒
Southwest (WN)	Hybrid FSC	Hybrid FSC	⇒

4.2 Regression Model Results

To derive conclusions about the research question stated in this thesis, I subsequently analyze the models outlined in **section 3.6**. First, I show a general overview and description of the results of the two models. Next, I provide a more detailed summary and interpretation of the significant findings of the fixed effects models. **Table 5** shows the results of the models with both dependent variables. Model (1) illustrates the fixed effects model with the dependent variable operating revenue, using the robust standard errors. Model (2) represents the fixed effects model with the dependent variable operating margin. The sample includes all 10 airlines for 10 years, therefore resulting in 100 observations. Each line of the independent variables displays the slope coefficients of all models. The standard errors are presented in parentheses

⁸ Purity Index Categorization as follows: Traditional LCC 100%, Real LCC > 80%, Hybrid LCC > 70%, Hybrid FSC > 30%, FSC ≤ 30%.

next to the coefficients. The significance levels of 10%, 5%, and 1% are indicated by *, **, *** respectively.

Table 5: Regression Results (Source: author's own contribution)

	<i>Dependent variable:</i>	
	log_op_rev Fixed Effects ¹ (1)	op_margin Fixed Effects (2)
<i>Independent Variables</i>		
network	0.103 (0.078)	0.014 (0.030)
no_entertain	-0.144** (0.070)	-0.050** (0.025)
bag_fee	0.128* (0.067)	0.062 (0.044)
no_cargo	0.062 (0.040)	0.054* (0.028)
sing_class	0.056 (0.038)	0.096*** (0.026)
no_gds	-0.061 (0.047)	-0.046** (0.022)
fleet_uni	-0.068*** (0.023)	-0.012 (0.015)
<i>Control Variables</i>		
log(firm_age)	0.095 (0.148)	0.224*** (0.052)
log(passengers)	0.869*** (0.150)	-0.026 (0.039)
Year Dummies	Yes	Yes
Observations	100	100
R ²	0.967	0.660
Adjusted R ²	0.954	0.533
F Statistic	115.896*** (df = 18; 72)	7.768*** (df = 18; 72)

Note: ¹Using *robust standard errors*

*p<0.1; **p<0.05; ***p<0.01

Model (1) shows that only three of the seven chosen BM specifications have a significant impact on the operating revenue. What is more, adhering to the traditional model more often has an adverse effect on the operating income than a positive impact. Only the variable “bag_fee” shows a significant positive effect on airline revenue. Not offering in-flight entertainment reduces the operating income significantly. Additionally, by adopting a uniform fleet, the coefficient significant at the 1% level shows that airlines experience a reduction in airline revenue. The coefficients of the variables “network”, “no_cargo” and “sing_class” all indicate an increase in revenues when adhering to the traditional model, however this effect is not statistically significant. Lastly, the coefficient of the variable “no_gds” shows that airlines that do not use the GDS have a lower revenue (not significant). After the initial analysis of model (1), it is not possible to derive an overall conclusion of whether LCCs should change their BM or not. By comparing these results to the coefficients of model (2), a more meaningful interpretation of the results is possible. My findings show that operating only a point-to-point

network does not have a statistically significant impact on profitability. The variable “no_entertain” shows that not only does the revenue decrease without complimentary in-flight entertainment, but also airline profitability. Although the variable “bag_fee” does affect airline revenues significantly, model (2) shows that charging for bags does not have a significant effect on profitability. Not transporting cargo, however, shows a positive impact on the operating margin (significant at the 10% level). The variable “sing_class” shows a similar positive result. Further, the variable “no_gds” does not significantly influence operating revenues. It does, however, decrease the operating margin significantly. A reverse effect is noticeable for the variable “fleet_uni”. Operating a uniform fleet has a significant adverse effect on operating revenue, but does not have a significant impact on the operating margin.

The coefficient of the control variable “log(firm_age)” shows that the age of the airline does not significantly affect revenues, but has a significant impact on profitability. These findings are in line with the research outlined above, as younger firms are still adjusting their operations to reach the efficiency of incumbents. The variable “log(passengers)” has a significant effect on airline revenues. These results are in line with economic theory, as transporting more passengers most likely leads to higher revenues. Nonetheless, a higher passenger number does not allow for conclusions about the profitability of an airline, as shown in model (2).

The adjusted R² for model (1) shows that the variance of the independent variables explains 95.4% of the variance in the dependent variable "log_op_rev". The adjusted R² for model (2) shows that the variance of the independent variables explains 53.3% of the variance in the dependent variable "op_margin". In the following sections, I will discuss the significant coefficients of both models in more detail.

4.2.1 Discussion of Results: In-flight Entertainment

According to model (1), not offering free in-flight entertainment reduces the operating revenue of airlines, ceteris paribus, by 13.4%⁹ on average. The coefficient is significant at the 5% level. Model (2) also shows an adverse effect; a lack of complimentary in-flight entertainment reduces the operating margin, ceteris paribus, by 5.0 percentage points on average. This effect is significant at the 5% level. In the data sample, only JetBlue offers free in-flight entertainment throughout the entire observation period, as shown in **appendix IX**. Two

⁹ Log-level model: The coefficient is calculated in the following way: $100*(e^{-0.144})-1 = -13.4\%$.

airlines, Norwegian and Southwest, changed from not offering free in-flight entertainment to offering complimentary in-flight entertainment. The benefits of this convergence trend are not only supported by the results of the fixed effects model, but recent literature also suggests that charging for services such as entertainment or food reduces customer satisfaction (Tuzovic et al., 2014). The authors point out that introducing additional fees in addition to the ticket price can result in the feeling of betrayal and anger for the consumer. Customers could potentially retaliate against the airline, at the extreme, by entirely avoiding the brand. As shown in the model, this effect has a potentially substantial impact on revenues and further affects the operating margin. As Alamdari & Fagan (2005) state, offering complimentary services is increasingly common across American LCCs; nonetheless, the study suggests that airlines are not achieving a price premium by including complementary services. It is not possible to prove with this thesis whether airlines in this sample can obtain a price premium. Even if they are not able to do so, they are superior at retaining customers due to the psychological effect outlined above. Compared to historically-used in-flight entertainment with seatback screens, the introduction and maintenance cost of complimentary Wi-Fi is much lower (Deloitte, 2017; Fitchard, 2015). Nowadays, passengers can use their own devices and connect to in-flight Wi-Fi with free access to videos and music on Norwegian and JetBlue flights. It can be concluded that the results in model (1) and (2) suggest that the benefits of adding complimentary onboard entertainment (in the form of Wi-Fi) are higher than the associated cost of its introduction and operation.

4.2.2 Discussion of Results: Baggage Fees

Charging for a checked bag seems to significantly increase revenues on average, *ceteris paribus* by 13.7%¹⁰. However, model (2) does not show a significant effect of charging for baggage on the operating margin. Therefore, I conclude that charging a fee for checked bags is generally beneficial for airline revenues. Nevertheless, it seems that most of this benefit is not transferred to airline profitability. My results support the findings of a study by Scotti & Dresner (2015) which highlights that unbundling airfares and baggage fees is beneficial for airline revenues. As the authors state, unbundling the fare and baggage fee results on average in only a \$0.11 lower fare for every \$1 increase in baggage fees. Further, the passenger reduction for

¹⁰ $100 * ((e^{0.128}) - 1) = 13.7\%$

every \$1 increase in ticket prices is nine times higher than the passenger reduction of \$1 increase in baggage fees (Scotti & Dresner, 2015).

All airlines in the investigated data sample in this thesis, except for Southwest, charged a fee for checked luggage in 2016 (see **appendix X**). JetBlue, which previously included baggage, changed to an unbundling strategy in 2013. One can see that the trend towards charging bag fees is characteristic of the traditional LCC model, despite the increasing hybridization of BM characteristics. However, my analysis suggests that the revenue gain does not necessarily translate into a higher operating margin. I find empirical evidence for the suggestion for further research raised by Scotti & Dresner (2015) about the impact that baggage fees have on airline success. While it seems that checked bags can increase airline revenues quite substantially, a possible explanation is that passengers bring more cabin luggage instead of paying for checked bags. This thereby leads to congestion during the boarding process, increasing turnaround times and flight delays (Scotti & Dresner, 2015). The recent introduction of a fee for cabin baggage by Ryanair (Ryanair, 2018) could mitigate this issue and increase airline profitability.

4.2.3 Discussion of Results: Cargo Transportation

The results show that whether an LCC is carrying cargo or not does not significantly influence the airline's revenue. Not transporting cargo, however, increases the operating margin of an airline, *ceteris paribus*, by 5.4 percentage points on average (significant at the 10% level). The literature pointed out earlier supports this result; freight transportation increases costs and decreases aircraft utilization. An overview of the changes in cargo transportation is given in **appendix XI**. A glance at the data sample shows that whereas JetBlue stopped carrying cargo, Vueling recently added cargo operations. A report by McKinsey&Company (2013) suggests that on long-haul flights, cargo can increase the airline's revenue by 5-20% per flight. However, according to the regression model, this proposition is not supported for short-haul flights¹¹. I conclude that revenue gains are only marginal, as fewer passenger flights can be conducted due to the cargo loading and unloading activities. Even though the coefficient in model (1) suggests such a result, a valid conclusion cannot be derived¹², as it is not significant and has a high standard error. Since the associated costs of introducing cargo transportation and operational

¹¹ All airlines in the data sample, except for Norwegian, exclusively operate short-haul flights.

¹² The coefficient = .062 (not significant) and the standard error = .058.

efficiency loss negatively impact the profitability, thereby offsetting any potential revenue gain, cargo activities are not beneficial to the LCCs business.

4.2.4 Discussion of Results: Cabin Set-up

During the observation period, JetBlue and Norwegian changed from a single-class cabin with only economy seats to a mixed-class cabin set-up, by adding business class seats. Spirit Airlines, on the contrary, abandoned its mixed-class and has been operating a single-class cabin since 2013. An overview of the changes is given in **appendix XII**. Model (1) does not show any significant impact of a single-class on revenues, nevertheless the model suggests a slight increase in revenue with a single-class cabin set-up. Airlines with a single-class cabin achieve higher revenues by having a higher seating density, as well as a greater aircraft utilization due to faster turnaround times. However, LCCs with differentiated classes can potentially achieve a higher per seat revenue. Model (2) illustrates that operating a single-class cabin, *ceteris paribus*, increases the operating margin by 9.6 percentage points on average, significant at the 1% level. As outlined above, the operating costs per passenger are lower with a single-class cabin. Further, the model suggests that the potential revenue gain of a mixed-class cabin is offset by the higher seating density of a single-class aircraft. Overall, whereas revenues remain mostly unaffected, it can be concluded that the single-class cabin set-up is more profitable for LCCs.

4.2.5 Discussion of Results: Global Distribution System

As shown in the **appendix XIII**, only five airlines distributed their tickets via the GDS in 2007. Moreover, Allegiant Air was the only airline not part of the GDS network in 2016. Many airlines justify the high fees of the GDS with the access to a new customer segment, the corporate market, and a greater international reach (Sabre Airline Solutions Worldwide, 2010). Therefore, it is possible that revenues could increase by integrating the GDS. Model (1) supports this effect, however the coefficient is not significant. Therefore, it cannot be concluded whether it is beneficial for an airline to distribute tickets through the GDS or not. While the effect on revenues is not significant, not being a member of the GDS has a significant negative impact on the operating margin. The margin is, *ceteris paribus*, on average 4.6 percentage points lower. This effect is significant at the 5% level. This is different from the expected result that the GDS would increase revenues substantially, but only slightly increase the operating margin, due to the high fees for ticket distribution, which can account for up to 17% of operating cost

(Alamdari & Fagan, 2005). Thus, it seems that reduced GDS fees made it more attractive for airlines to use the system.

4.2.6 Discussion of Results: Fleet Uniformity

Southwest Airlines has been operating a fleet solely consisting of Boeing 737s for a sustained period. When Southwest took over the regional airline AirTran in 2011, the company faced a challenge of how to integrate 88 Boeing 717s from the takeover (Southwest Airlines, 2011). As operating different aircraft types would lead to higher costs, the airline decided to sell the planes to a competitor within the next three years. By doing so, Southwest could maintain the cost advantage of operating a single-type fleet. The fleet type changes of all airlines in the data sample are outlined in **appendix XIV**. The results of the models support the behavior of Southwest Airlines. Whereas airlines with a homogenous fleet, *ceteris paribus*, have a significantly lower revenue of 6.6%¹³ compared to airlines with a mixed fleet, the profitability remains mostly unaffected. Even though LCCs with a heterogeneous fleet, such as Norwegian, might generate higher revenues by flying to long-haul destinations with its new Boeing 757s, in addition to their short-haul flights, the higher costs offset the revenue increase. A possible limitation of the analysis of fleet uniformity is that a sufficiently large airline could derive similar benefits even though the airline operates a mixed fleet. As long as the route network for a single aircraft type is large enough, the company will benefit from economies of scale (Klophaus et al., 2012).

4.2.7 Further Discussion

All significant findings in this thesis, except for the effect of the GDS, are supported in previous studies. Surprisingly, the choice of network does not have a significant impact on airline revenues or profits. Due to the few changes of the variable “network” in the data sample, this seems to be reasonable (see **appendix XV**). At the end of the observation period, five airlines operate a pure point-to-point system, whereas the other five blend their hub-and-spoke system with point-to-point operations. As outlined earlier, both systems have their cost advantages. Moreover, as research by Pels (2008) suggests, the benefits of both systems are highly dependent on competition, as well as customer demand and their willingness to pay on these routes.

¹³ Log-level model: $100*(e^{-0.068}) - 1 = -6.6\%$

Based on my findings, airline management should consider the cost advantage of not transporting cargo when solely operating short-haul flights. I further suggest that free in-flight entertainment, especially in the form of free Wi-Fi access, could result in higher profitability, due to the positive psychological effect and low introduction cost. Further studies should investigate whether the introduction of such services leads to a price-premium, as well as their cost implications in more detail. Charging for checked baggage could be beneficial, as a direct increase in revenues is noticeable. Nonetheless, as the revenue gain is not necessarily transferred to profits, the causality effect might be hidden from airline management. Ryanair was one of the first airlines to take measures against the fact that the revenue gain is lost due to a decrease in operational efficiency. However, by introducing a fee for carry-on luggage, this might cause other potential issues regarding customer demand and negative associations with the brand similar to the ones raised in the study by Tuzovic et al. (2014). Future studies should analyze the positive effect of using the GDS on profitability in more detail and investigate whether GDS providers decreased their fees over time. Lastly, consistent with existing research, this thesis suggests that operating a uniform fleet is more cost efficient. Nevertheless, the revenue gain by operating a mixed fleet offsets this benefit.

As Alamdari & Fagan (2005) already pointed out over a decade ago, airlines increase the capability of keeping costs low by adhering to the original LCC model. Whenever airline managers consider changes based on the results of this study, they should take into account the cost implication of the change, the individual market conditions, the potential of achieving a competitive advantage, and the speed by which competitors can imitate the changes (Alamdari & Fagan, 2005).

5 Conclusion

The BM convergence in the aviation industry is slowly becoming an increasingly interesting topic for scholars and practitioners. However, the impact on airline profitability has not been examined in detail. This thesis is a first attempt to assess how changes of distinct LCC BM specifications affect airline profitability. Overall, my findings indicate that adhering to the more traditional LCC model can positively impact airline profitability. Nevertheless, a departure from the traditional model can also be beneficial in specific areas. Therefore, it seems that blending aspects of both the LCC and FSC model (a hybridization of business models) is the best option for airlines. The study suggests that an airline that offers free-of-charge in-flight entertainment, no cargo transportation, a single-class cabin, and uses the GDS system achieves the highest profitability.

The study also presents some limitations that highlight the need for further research on this topic. The aforementioned endogeneity problems of an observational study cannot be eliminated entirely (Allison, 2005; Wooldridge, 2013). First of all, the selection bias cannot be fully ruled out, as the LCCs in this study are categorized by two different governmental bodies. The challenging part is not only finding a reliable source that classifies airlines across countries, but also gathering enough publicly available data on these airlines. Even though a study solely based on publicly accessible data in the airline industry is already a challenge, it would be beneficial for the analyst to further enlarge the data sample. Some of the variables included indicate only little variation throughout the observation period. Therefore, some events might have too much influence on the coefficients and reduce the statistical significance of the results. If other studies with more extensive data samples confirm the findings, the results would be more reliable. Furthermore, I also suggest to investigate other economic regions (such as Asia or the Middle East) to generate an understanding of how BM changes affect airline profitability in different markets and stages of market development. Studies should be frequently updated as the industry is in constant motion and growing similarity of BMs could erode the benefits of blending aspects for airlines (Daft & Albers, 2015).

In this study, qualitative and quantitative information were transformed into binary variables, thereby risking the loss of valuable information stored in the data. Although this transformation supported data comparison across the airlines in the sample, further studies should find a way of creating more meaningful variables. This could also reduce the effect of multicollinearity, which limited the efficiency of the applied models and variables included in

this thesis. Another potential issue with utilizing dummy variables was that I could not account for the degree of service level included in the variables. For instance, what exactly defines complimentary catering; free premium snacks or a complimentary meal? Furthermore, it is possible that there are omitted time-variant variables that influence how airlines transfer revenues into profits, such as managerial experience. Collecting additional data about airline management by utilizing surveys could help to eliminate such biases. Lastly, studies could also consider the fact that some BM changes lag instead of being directly transferred into revenues or profits. For instance, the introduction of a FFP incurs high costs immediately, but might only show a higher revenue and profit margin after a critical mass of customers makes use of it.

Despite these limitations, this study is relevant for scholars and policy makers. Through the construction of a measurement variable for business model convergence from all the variables in the dataset, I added a more recent study sample to the literature about BM convergence in the airline industry. My findings support the general belief among scholars about increasing BM convergence and show a decline in adherence to the traditional LCC model. I believe in the importance of such updates to create awareness on the convergence trend in general and to follow its development. Furthermore, even though the results do not allow for decisive recommendations to airlines yet, I hope to create awareness about how changes could affect airlines' revenues and the operating margin, and stimulate further research in this area. As Chesbrough (2010) already pointed out, an important part of BMI is to understand the potential value benefit resulting from changing specifications of the old BM or switching to a new model. This is especially important when considering the fact that the demand for passenger mobility will increase substantially over the decades to come. This trend will bring increasing competition to the airline industry, which will make it more difficult for incumbents to sustain their competitive advantage.

References

- Airberlin. (2018). Airberlin ceased flight operations. Retrieved March 30, 2018, from <https://www.airberlin.com/index-en.html>
- Airlines for America. (2018). Stage Length Definition. Retrieved April 2, 2018, from <http://airlines.org/glossary/stage-length/>
- Airlines for Europe. (2018). Alliance - Airlines for Europe. Retrieved April 2, 2018, from <https://a4e.eu>
- Al-Debei, M. M., El-Haddadeh, R., & Avison, D. (2008). Defining the Business Model in the New World of Digital Business. *AMCIS 2008 Proceedings*.
- Alamdari, F., & Fagan, S. (2005). Impact of the adherence to the original low-cost model on the profitability of low-cost airlines. *Transport Reviews*, 25(3), 377–392.
- Allison, P. D. (2005). *Fixed Effects Regression Models for Longitudinal Data Using SAS*. Cary: SAS Institute Inc.
- Amit, R., & Zott, C. (2001). Value Creation in E-Business. *Strategic Management Journal*, 520(22), 493–520.
- Amit, R., & Zott, C. (2012). Creating Value Through Business Model Innovation. *MIT Sloan Management Review*, 53(3), 41–49.
- Arellano, M. (1987). Computing Robust Standard Errors for Within-groups Estimators. *Oxford Bulletin of Economics and Statistics*, 49(4), 431–434.
- Belobaba, P., Odoni, A., & Barnhart, C. (2016). *The Global Airline Industry* (2nd ed.). Chichester: UK John Wiley & Sons.
- CAPA Centre for Aviation. (2015a). LCC Capacity Share Europe. Retrieved April 15, 2018, from <https://centreforaviation.com/insights/analysis/europes-airports-economic-impact--the-theory-and-the-practice-aci-europe-report-part-1-207594>
- CAPA Centre for Aviation. (2015b). LCC Capacity Share North America. Retrieved April 22, 2018, from <https://centreforaviation.com/insights/analysis/ulccs-glimpse-an-opening-as-the-us-consolidated-industry-focuses-on-yields-and-profits-219303>
- Casadesus-Masanell, R., & Ricart, J. E. (2010). From Strategy to Business Models and onto Tactics. *Long Range Planning*, 43(2–3), 195–215.
- Chesbrough, H. (2007). Business model innovation: it's not just about technology anymore. *Strategy & Leadership*, 35(6), 12–17.
- Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, 43(2–3), 354–363.

- Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation : evidence from Xerox Corporation ' s technology spin-off companies. *Industrial and Corporate Change*, 11(3), 529–555.
- Collins, D. L., Román, F. J., & Chan, H. C. (2011). An Empirical Investigation of the Relationship between Profitability Persistence and Firms' Choice of Business Model: Evidence from the U.S. Airline Industry. *Journal of Management Accounting Research*, 23(1), 37–70.
- Daft, J., & Albers, S. (2013). A conceptual framework for measuring airline business model convergence. *Journal of Air Transport Management*, 28, 47–54.
- Daft, J., & Albers, S. (2015). An empirical analysis of airline business model convergence. *Journal of Air Transport Management*, 46, 1–9.
- Dahan, N. M., Doh, J. P., Oetzel, J., & Yaziji, M. (2010). Corporate-NGO collaboration: Co-creating new business models for developing markets. *Long Range Planning*, 43(2–3), 326–342.
- Deloitte. (2017). *Fasten your seatbelts: in-flight connectivity takes off*. London, UK.
- Demil, B., & Lecocq, X. (2010). Business model evolution: In search of dynamic consistency. *Long Range Planning*, 43(2–3), 227–246.
- Diaconu, L. (2012). The Evolution of the European Low-cost Airlines' Business Models. Ryanair Case Study. *Procedia - Social and Behavioral Sciences*, 62, 342–346.
- Doganis, R. (2006). *The airline business* (2nd ed.). Routledge.
- Dormann, C. F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., ... Lautenbach, S. (2013). Collinearity: A review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, 36(1), 27–46.
- EasyJet. (2018). EasyJet Worldwide. Retrieved April 2, 2018, from <http://www.easyjet.com/en/help/extra-services/worldwide>
- Economou, V. P., & Chatzikonstantinou, P. G. (2009). Gaining company's sustained competitive advantage, is really a necessary precondition for improved organizational performance? The case of TQM. *European Research Studies Journal*, 12(3), 83–100.
- Eriksson, H.-E., & Penker, M. (2000). *Business Modeling With UML: Business Patterns at Work*. (Theresa Hudson, Ed.). New York: John Wiley & Sons.
- Eurocontrol. (2011). *Study into the impact of the global economic crisis on airframe utilisation*.
- Fitchard, K. (2015). The crazy economics of inflight Wi-Fi. Retrieved April 30, 2018, from <http://fortune.com/2015/07/01/flight-wi-fi-travel/>
- Franke, M. (2007). Innovation: The winning formula to regain profitability in aviation? *Journal of Air Transport Management*, 13(1), 23–30.

- German Aerospace Center. (2017). *Low Cost Monitor 1/2017*.
- Gillen, D., & Gados, A. (2009). Airlines within airlines: Assessing the vulnerabilities of mixing business models. *Research in Transportation Economics*, 24(1), 25–35.
- Graham, B., & Shaw, J. (2008). Low-cost airlines in Europe: Reconciling liberalization and sustainability. *Geoforum*, 39(3), 1439–1451.
- Hamel, G. (2001). Leading the revolution. *Strategy & Leadership*, 29(1), 4–10.
- Hunter, L. (2006). Low Cost Airlines: Business Model and Employment Relations. *European Management Journal*, 24(5), 315–321.
- Hvass, K. A. (2008). *A Boolean Analysis Predicting Industry Change: Innovation, Imitation & Business Models*. Copenhagen Business School.
- Hvass, K. A. (2012). A Boolean Approach to Airline Business Model Innovation. *CIBEM Working Paper Series*, (January), 1–13.
- International Air Transport Association. (2017a). 2036 Forecast Reveals Air Passengers Will Nearly Double to 7.8 Billion. Retrieved April 14, 2018, from <http://www.iata.org/pressroom/pr/Pages/2017-10-24-01.aspx>
- International Air Transport Association. (2017b). Operating Margins Squeezed by Rising Costs. Retrieved April 26, 2018, from <http://www.iata.org/pressroom/pr/Pages/2017-12-05-01.aspx>
- Jean, D. A., & Lohmann, G. (2016). Revisiting the airline business model spectrum: The influence of post global financial crisis and airline mergers in the US (2011 – 2013). *Research in Transportation Business and Management*, 21, 76–83.
- JetBlue. (2018). JetBlue Mint. Retrieved April 2, 2018, from <https://www.jetblue.com/flying-on-jetblue/mint/>
- Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing Your Business Model. *Harvard Business Review*, (December), 1–10.
- Kastalli, I. V., & Van Looy, B. (2013). Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management*, 31(4), 169–180.
- Klophaus, R., Conrady, R., & Fichert, F. (2012). Low cost carriers going hybrid: Evidence from Europe. *Journal of Air Transport Management*, 23(December 2011), 54–58.
- Lawton, T. C. (2002). *Cleared for Take-Off: Structure and strategy in the low fare airline business*. Farnham: Ashgate Publishing Limited.
- Lohmann, G., & Koo, T. T. R. (2013). The airline business model spectrum. *Journal of Air Transport Management*, 31, 7–9.
- Magretta, J. (2002). Why Business Models Matter. *Harvard Business Review*, 80(5), 86–92.

- Markides, C. (2006). Disruptive innovation: In need of better theory. *Journal of Product Innovation Management*, 23(1), 19–25.
- Markides, C., & Charitou, C. D. (2004). Competing with dual business models: A contingency approach. *Academy of Management Executive*, 18(3), 22–36.
- Mason, K., & Morrison, W. (2008). Towards a means of consistently comparing airline business models with an application to the “low cost” airline sector. *Research in Transportation Economics*, 24(1), 75–84.
- Mason, K., Morrison, W. G., & Stockman, I. (2011). Liberalization of Air Transport in Europe and the Evolution of “Low-cost” Airlines. *Liberalization in Aviation: Competition, Cooperation and Public Policy*, (May), 2–22.
- McKinsey&Company. (2013). *A short life in long haul for low-cost carriers. McKinsey&Company Travel, Transport & Logistics*.
- Norwegian Air Shuttle ASA. (2013). Norwegian Long-haul fleet. Retrieved April 28, 2018, from <https://www.norwegian.com/en/about/our-story/year-by-year/>
- Norwegian Air Shuttle ASA. (2018). Free WiFi. Retrieved April 26, 2018, from <https://www.norwegian.com/en/travel-info/on-board/in-flight-entertainment/>
- OAG Worldwide Aviation Services. (2015a). LCC Capacity Share Europe. Retrieved March 24, 2018, from <https://centreforaviation.com/insights/analysis/europes-airports-economic-impact--the-theory-and-the-practice-aci-europe-report-part-1-207594>
- OAG Worldwide Aviation Services. (2015b). LCC Capacity Share North America. Retrieved April 15, 2018, from <https://centreforaviation.com/insights/analysis/ulccs-glimpse-an-opening-as-the-us-consolidated-industry-focuses-on-yields-and-profits-219303>
- Osterwalder, A. (2004). *The Business Model Ontology a Proposition in a Design Science Approach*. Universite de Lausanne.
- Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Communications of the Association for Information Systems Clarifying Business Models: Origins, Present, and Future of the Concept. *Communications of the Association for Information Systems*, 16(16), 1–25.
- Pels, E. (2008). Airline network competition: Full-service airlines, low-cost airlines and long-haul markets. *Research in Transportation Economics*, 24(1), 68–74.
- Peterson, R. (2004). Rapid Rewards vs. Flightfund. Retrieved April 15, 2018, from <https://insideflyer.com/2004/01/rapid-rewards-vs-flightfund/>
- Porter, M. (2001). Strategy and the Internet. *Harvard Business Review*, 79(3), 62–78, 164.
- Porter, M. E. (1985). Competitive Advantage. In *Competitive Advantage: Creating and Sustaining Superior Performance* (pp. 1–30). New York.
- Porter, M. E. (1996). What is Strategy? *Harvard Business Review*, 6(1), 61–78.

- Porter, M. E., & Siggelkow, N. (2000). Contextuality Within Activity Systems. *Academy of Management Proceedings*, 1–7.
- Putten, B. Van, & Schief, M. (2012). The Relationship Between Dynamic Business Models and Business Cases. *Electronic Journal Information Systems Evaluation*, 15(1), 138–148.
- Ryanair. (2017). Ryanair ends GDS partnership. Retrieved April 11, 2018, from <https://corporate.ryanair.com/news/ryanair-to-end-gds-partnership-with-amadeus/>
- Ryanair. (2018). Priority & Two Cabin Bags. Retrieved April 29, 2018, from <https://www.ryanair.com/gb/en/plan-trip/travel-extras/priority-boarding>
- Sabre Airline Solutions Worldwide. (2010). *The Evolution Of The Airline Business Model*. Sabre Airline Solutions Website. Southlake.
- Sabre Airline Solutions Worldwide. (2016). GDS partnership with. Retrieved April 11, 2018, from <https://www.sabre.com/insights/releases/sabre-continues-to-support-easyjets-growth-with-business-travellers/>
- Santos, J., Spector, B., & van der Heyden, L. (2009). Toward a theory of business model innovation within incumbent firms. *INSEAD Working Paper Series*, 1–54.
- Schön, O. (2012). Business Model Modularity—A Way to Gain Strategic Flexibility? *Controlling & Management Review*, 2, 73–78.
- Scotti, D., & Dresner, M. (2015). The impact of baggage fees on passenger demand on US air routes. *Transport Policy*, 43, 4–10.
- Southwest Airlines. (2011). AirTran Acquisition. Retrieved April 22, 2018, from <http://investors.southwest.com/stock-information/airtran-acquisition>
- Soyk, C., Ringbeck, J., & Spinler, S. (2017). Long-haul low cost airlines: Characteristics of the business model and sustainability of its cost advantages. *Transportation Research Part A*, 106(April), 215–234.
- Stieglitz, N., & Heine, K. (2007). Innovations and the role of complementarities in a strategic theory of the firm. *Strategic Management Journal*, 28(1), 1–15.
- Štimac, I., Vince, D., & Vidović, A. (2012). Effect of Economic Crisis on the Changes of Low-Cost Carriers Business Models. *5th International Conference on Transport Science ICTS 2012*, 1–10.
- Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, 43(2–3), 172–194.
- Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), 40–49.
- Tomová, A., & Ramajová, L. (2014). Frequent Flyer Programs and Low-cost Airlines: Ongoing Hybridization? *Procedia - Social and Behavioral Sciences*, 110, 787–795.

- Tuzovic, S., Simpson, M. C., Kuppelwieser, V. G., & Finsterwalder, J. (2014). From “free” to fee: Acceptability of airline ancillary fees and the effects on customer behavior. *Journal of Retailing and Consumer Services*, 21(2), 98–107.
- United States Bureau of Transportation Statistics. (2018). Airline Database. Retrieved April 11, 2018, from <https://www.transtats.bts.gov>
- Vidović, A., Štimac, I., & Vince, D. (2013). Development of Business Models of Low-Cost Airlines. *International Journal for Traffic and Transport Engineering*, 3(1), 69–81.
- Voelpel, S. C., Leibold, M., & Tekie, E. B. (2004). The wheel of business model reinvention: how to reshape your business model to leapfrog competitors. *Journal of Change Management*, 4(3), 259–276.
- Wirtz, B. W., Pistoia, A., Ullrich, S., & Göttel, V. (2016). Business Models: Origin, Development and Future Research Perspectives. *Long Range Planning*, 49(1), 36–54.
- Wooldridge, J. (2013). *Introductory Econometrics - A Modern Approach*. (J. Sabatino, Ed.) (5th ed.). Mason: South-Western, Cengage Learning.
- World Bank. (2018). World Development Indicators. Retrieved April 10, 2018, from <http://databank.worldbank.org/data/home.aspx>
- Zhenya, L., Reeves, M., Stalk, G., & Deimler, M. S. (2009). *Business model innovation*. Boston Consulting Group.
- Zott, C., & Amit, R. (2007). Business Model Design and the Performance of Entrepreneurial Firms. *Organization Science*, 18(2), 181–199.
- Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. *Journal of Management*, 37(4), 1019–1042.

Appendices

Appendix I: Literature Overview (Source: author's own contribution, adapted from various sources)

Authors	Study Name	Research Design	Application	Period
Focus on Business Model Convergence				
<i>Mason & Morrison (2009)</i>	Towards a means of consistently comparing airline business models with an application to the 'low cost' airline sector	Develop Product and Organizational Architecture framework to outline business model specifications. Compare six airlines.	6 European LCCs	2005, 2006
<i>Klophaus et al. (2012)</i>	Low cost carriers going hybrid: Evidence from Europe	Create index if carrier follows archetypical LCC business model or changed towards a hybrid model based on survey.	20 European LCCs, 5 FSCs as control group	2010
<i>Lohmann & Koo (2013)</i>	The business model spectrum	Map and summarize BM specifications based on Product and Organizational Architecture framework. Outline the emergence of hybrid models.	9 US carriers (LCC and FSC)	2008, 2009
<i>Jean & Lohmann (2016)</i>	Revisiting the airline business model spectrum	Similar to Lohmann & Koo (2013); Compares both studies.	8 US carriers (FSC and LCC)	2011 - 2013
<i>Vidović et al. (2013)</i>	Development of Business Models of Low-Cost Airlines	Analysis of Business Model aspects of LCCs. Outline the emergence of hybrid business models.	Selected carriers in Europe and US	2008 - 2010
<i>Daft & Albers (2013)</i>	A conceptual framework for measuring airline business model convergence	Developing a LCC business model framework illustrating certain business model specifications which is then applied to five airlines.	5 German airlines (LCC and FSC)	2003 - 2010
<i>Daft & Albers (2015)</i>	An empirical analysis of airline business model convergence	Uses BM framework from 2013 study, Gower coefficient to measure distance and calculate differentiation levels among BM of these airlines. Longitudinal research setting (2004, 2007, 2010, 2012).	25 European airlines (LCC and FSC)	2004-2012
Impact of Business Model Convergence on Profitability				
<i>Alamdari & Fagan (2005)</i>	Impact of the adherence to the original low-cost model on the profitability of low-cost airlines	Analysis of 10 LCCs and evaluation against traditional Southwest model, use spearman's rank to outline relationship between adherence to the original model and profitability.	10 US and European LCCs	2001
<i>Hvass (2012)</i>	A Boolean Approach to Airline Business Model Innovation	Boolean minimization algorithm to identify which combinations of business model activities lead to operational profitability.	10 US carriers	2001-2010

Appendix II: Variable Operationalization Approach (Source: author's own contribution, approach adapted from Soyk et al. (2017))

General framework			Airline-Industry Framework				
Main Components and Subcategories by Teece (2018)		Description from Schön (2012)	Components from Daft & Albers (2015)	Components from Mason & Morrison (2008)	Components considered in this study	Items based on Traditional LCC definition from (Belobaba et al., 2016; Hunter, 2006)	Items based on FSC definition from (Belobaba et al., 2016; Hunter, 2006)
Value Proposition	<i>Product & Service</i>	The product/service offering with which you want to address customer needs	Type of air product, Route network, Cabin product, Ground product	Profitability index, Airport index	Type of air product, Cabin product,	Point-to-point flying No in-flight entertainment, No on-board catering (no frills)	Hub-and-spoke system Frills system
	<i>Customer Needs</i>	The customers and their needs that the company wants to serve	Target product-market combination	Convenience index, Comfort index	Target product-market combination	Single-class cabin, No air cargo	Mixed cabin Air cargo transportation
	<i>Geography</i>	The countries and areas you want to do business in	Geographic focus	Connectivity index	Geographic focus	Short haul	Short- and long-haul
Revenue Model	<i>Pricing Logic</i>	The general pricing logic applicable and suitable given clients, products, value creation and interaction	Fare structure	Revenue index	Fare structure	Cheap-one way fares, Baggage-fee	Complex ticketing
	<i>Channels</i>	The channels through which the interaction is facilitated and the value delivered in the best way	Distribution, Advertising	Distribution/Sales index	Distribution, Advertising	Online and direct booking	Mainly through travel agents, Use of Global Distribution Systems
	<i>Customer Interaction</i>	The base and way of the interaction with the client	Distribution, Advertising	N/A	Distribution, Advertising	No loyalty programs	Use of frequent-flyer programs (collect & redeem miles)
Cost Model	<i>Core Assets & Capabilities</i>	The core assets and capabilities required for value creation	Fleet structure, Infrastructure, Human capital, Property capital, Input factor policy, Executive ownership	Labour index, Cost drivers, Aircraft index	Fleet structure, Input factor policy	Fleet uniformity, High aircraft utilization	Mixed fleet Low aircraft utilization
	<i>Core Activities</i>	The specific activities and processes that link assets and partners in value creation and which need to be mastered	Supply Management, Finance Management	N/A	<i>Excluded in this study</i>	N/A	N/A
	<i>Partner Network</i>	The depth and breadth of the partner network ideal for sustainable value creation	Inter-organizational relationships	N/A	Inter-organizational relationships	No codeshare/interlining, No alliance	Codeshare/interlining, Connecting flights, Baggage transfer, Member of airline alliance

Appendix III: Correlation Table (*Source: author's own contribution*)

	1	2	3	4	5	6	7	8	9
Independent Variables									
1. network	1								
2. no_entertain	0.50	1							
3. bag_fee	0.54	0.51	1						
4. no_cargo	0.69	0.51	0.55	1					
5. sing_class	0.07	0.28	-0.17	-0.05	1				
6. no_gds	0.43	0.26	0.23	0.32	0.19	1			
7. fleet_uni	0.42	0.40	0.16	0.52	0.07	-0.02	1		
Control Variables									
8. firm_age	-0.26	0.004	-0.29	-0.36	-0.11	-0.18	-0.02	1	
9. passengers	-0.14	-0.15	-0.50	-0.13	0.16	-0.07	0.18	0.53	1

Appendix IV: Variance Inflation Factors based on OLS model (*Source: author's own contribution*)

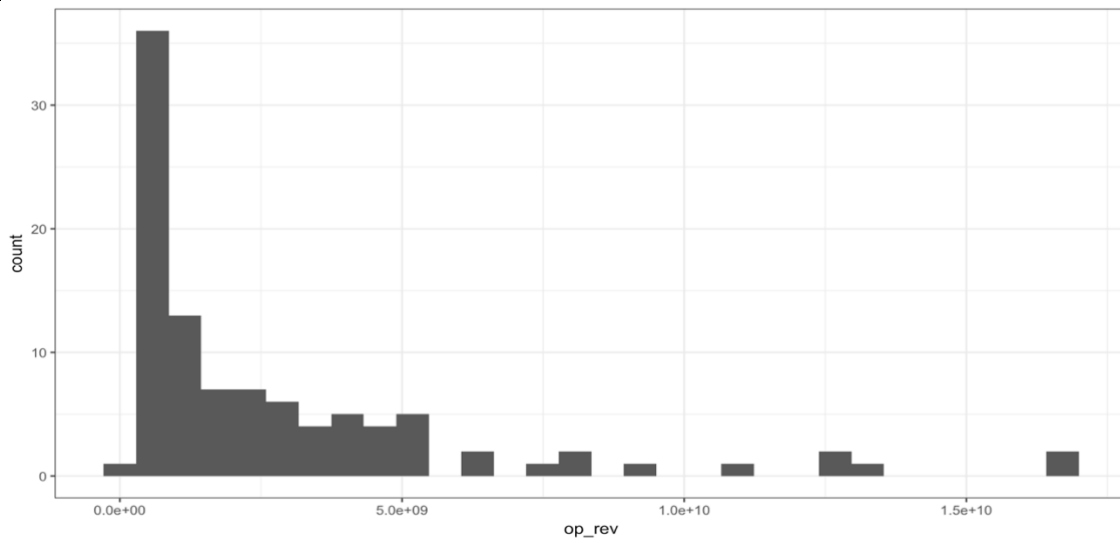
	GVIF	Df	$GVIF^{(1/(2*Df))}$
Independent Variables			
1. network	2.354	1	1.534
2. no_entertain	2.719	1	1.649
3. short_haul	1.658	1	1.288
4. no_cargo	4.626	1	2.151
5. sing_class	2.397	1	1.548
6. no_gds	1.640	1	1.281
7. fleet_uni	1.749	1	1.323
Control Variables			
8. log(firm_age)	2.586	1	1.608
9. log(passengers)	1.828	1	1.352
10. factor(year)	2.036	9	1.040

Appendix V: Data Sample used in Models (Source: author's own contribution, based on sources indicated in section 3.2.)

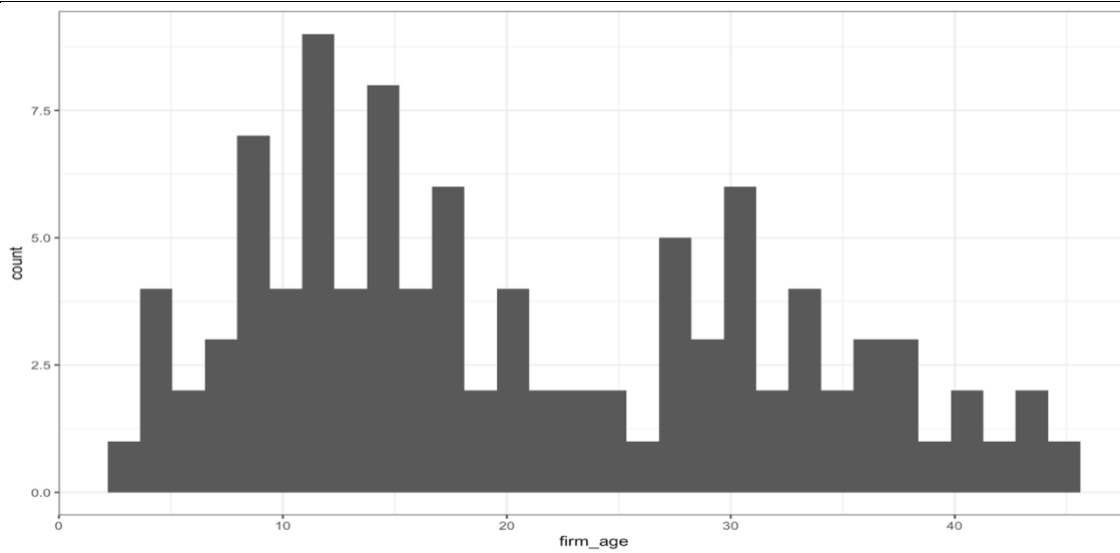
id	code	name	country	year	ebit	op_rev	passengers	fleet_end	fleet_uni	network	no_codeshare	no_catering	no_entertain	short_haul	checkin	no_gds	bag_fee	no_ffp	no_allianc	low_fare	website	sing_class	no_cargo	purity	
1	U2	EasyJet	UK	2007	247 032 392,28	2 580 914 005,35	3720000	137	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93	
2	U2	EasyJet	UK	2008	109 996 869,56	2 856 292 338,07	4370000	165	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,86
3	U2	EasyJet	UK	2009	71 452 341,37	3 170 771 954,16	4520000	181	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,86
4	U2	EasyJet	UK	2010	415 796 190,00	3 424 271 670,00	4880000	196	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0,79
5	U2	EasyJet	UK	2011	544 171 257,00	4 013 844 399,94	5450000	204	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,86
6	U2	EasyJet	UK	2012	366 727 389,27	4 269 992 018,88	5840000	203	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
7	U2	EasyJet	UK	2013	550 734 646,09	4 718 366 444,79	6080000	209	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
8	U2	EasyJet	UK	2014	700 389 537,25	5 457 252 039,84	6480000	226	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
9	U2	EasyJet	UK	2015	789 521 578,07	5 377 468 190,18	6860000	241	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
10	U2	EasyJet	UK	2016	507 872 049,47	4 761 555 419,58	7310000	257	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0,79
11	BE	Flybe	UK	2007	51 558 100,47	831 652 350,60	700000	80	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
12	BE	Flybe	UK	2008	10 048 773,29	727 411 200,79	730000	68	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
13	BE	Flybe	UK	2009	8 631 477,66	665 440 270,96	720000	68	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
14	BE	Flybe	UK	2010	26 239 295,00	700 106 750,00	720000	69	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
15	BE	Flybe	UK	2011	-5 436 373,49	682 653 185,05	760000	83	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
16	BE	Flybe	UK	2012	-39 653 273,73	701 988 646,98	720000	98	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
17	BE	Flybe	UK	2013	860 957,29	667 779 994,47	770000	98	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
18	BE	Flybe	UK	2014	-14 478 149,44	654 480 755,21	770000	66	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
19	BE	Flybe	UK	2015	10 626 892,88	761 960 434,64	820000	74	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
20	BE	Flybe	UK	2016	-2 538 749,50	748 296 415,72	880000	83	0	0	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0,57
21	FR	Ryanair	Ireland	2007	528 763 641,92	2 671 800 112,19	5093200	168	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
22	FR	Ryanair	Ireland	2008	87 644 009,66	2 783 611 063,52	5856600	181	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
23	FR	Ryanair	Ireland	2009	398 295 464,99	2 959 827 602,43	6650400	232	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
24	FR	Ryanair	Ireland	2010	488 200 000,00	3 629 500 000,00	7206300	272	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
25	FR	Ryanair	Ireland	2011	666 024 100,94	4 279 828 758,69	7581500	294	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
26	FR	Ryanair	Ireland	2012	688 489 542,61	4 681 958 961,42	7925600	305	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
27	FR	Ryanair	Ireland	2013	628 197 261,52	4 804 192 449,26	8166800	297	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
28	FR	Ryanair	Ireland	2014	992 803 248,36	5 382 404 416,75	9060000	308	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
29	FR	Ryanair	Ireland	2015	1 394 069 542,05	6 240 229 924,60	10640000	341	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0,93
30	FR	Ryanair	Ireland	2016	1 464 627 544,35	6 347 164 921,32	11997800	383	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	0,86
31	DY	Norwegia	Norway	2007	18 153 674,01	572 545 473,20	693400	32	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0,86
32	DY	Norwegia	Norway	2008	-43 077 500,27	793 888 211,22	913700	40	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0,86
33	DY	Norwegia	Norway	2009	67 058 442,51	857 093 847,77	1080000	46	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,79
34	DY	Norwegia	Norway	2010	26 238 548,81	1 073 375 736,62	1300000	57	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,79
35	DY	Norwegia	Norway	2011	52 666 820,00	1 332 343 563,20	1570000	62	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,71
36	DY	Norwegia	Norway	2012	52 955 507,22	1 683 197 481,96	1770000	68	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,71
37	DY	Norwegia	Norway	2013	119 432 108,60	1 909 832 446,05	2070000	85	0	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,50
38	DY	Norwegia	Norway	2014	-158 920 361,30	2 200 782 324,45	2400000	95	0	0	1	1	1	1	1	0	1	0	1	1	1	1	0	0	0,36
39	DY	Norwegia	Norway	2015	35 866 961,87	2 318 057 009,95	2570000	99	0	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0,36
40	DY	Norwegia	Norway	2016	174 150 577,47	2 493 128 184,54	2930000	116	0	0	1	1	1	1	1	0	1	0	0	1	1	1	1	0	0,29
41	VY	Vueling	Spain	2007	-78 414 828,32	396 532 871,77	622000	20	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0,93
42	VY	Vueling	Spain	2008	-40 353 097,02	461 431 507,17	588600	21	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0,86
43	VY	Vueling	Spain	2009	41 550 810,00	621 366 857,15	820000	26	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0,86
44	VY	Vueling	Spain	2010	60 086 000,00	796 514 000,00	1520000	36	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,71
45	VY	Vueling	Spain	2011	10 907 865,19	826 398 319,31	1231600	44	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,71
46	VY	Vueling	Spain	2012	30 938 501,56	1 026 305 995,71	1480000	53	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,71
47	VY	Vueling	Spain	2013	152 482 061,47	1 028 346 283,62	1348000	64	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,71
48	VY	Vueling	Spain	2014	131 906 867,72	1 517 887 509,40	2145000	80	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,71
49	VY	Vueling	Spain	2015	123 526 482,60	1 728 228 068,95	2478000	96	1	0	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0,64
50	VY	Vueling	Spain	2016	43 274 593,80	1 812 615 270,39	2805000	106	1	0	0	1	1	1	1	0	1	0	0	1	1	1	1	0	0,57
51	W6	Wizz Air	Hungary	2007	-2 872 647,94	335 685 953,32	460000	17	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0,93

id	code	name	country	year	ebit	op_rev	passengers	fleet_end	fleet_uni	network	no_codeshare	no_catering	no_entertain	short_haul	checkin	no_gds	bag_fee	no_ffp	no_allianc	low_fare	website	sing_class	no_cargo	purity
52	W6	Wizz Air	Hungary	2008	-10 435 582,08	428 760 557,29	620000	22	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0,93
53	W6	Wizz Air	Hungary	2009	14 683 388,31	481 405 373,89	820000	30	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0,93
54	W6	Wizz Air	Hungary	2010	7 000 000,00	589 000 000,00	980000	35	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0,93
55	W6	Wizz Air	Hungary	2011	45 226 777,76	737 100 250,29	1130000	36	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
56	W6	Wizz Air	Hungary	2012	34 605 041,88	774 970 806,30	1230000	40	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
57	W6	Wizz Air	Hungary	2013	98 298 539,30	905 993 823,08	1390000	46	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
58	W6	Wizz Air	Hungary	2014	150 109 176,34	1 100 920 259,24	1650000	55	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
59	W6	Wizz Air	Hungary	2015	219 979 760,91	1 283 155 413,54	2000000	67	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
60	W6	Wizz Air	Hungary	2016	221 248 030,36	1 396 885 300,81	2380000	79	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
61	NK	Spirit A.	USA	2007	25 287 008,73	602 973 398,35	697400	36	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
62	NK	Spirit A.	USA	2008	13 144 198,69	565 735 193,85	697600	28	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
63	NK	Spirit A.	USA	2009	81 133 527,63	509 801 463,78	632500	28	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
64	NK	Spirit A.	USA	2010	52 835 122,46	599 338 375,74	695200	32	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
65	NK	Spirit A.	USA	2011	103 791 166,43	770 038 123,89	851800	37	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
66	NK	Spirit A.	USA	2012	131 247 900,14	994 514 952,40	1042300	45	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0,71
67	NK	Spirit A.	USA	2013	201 947 561,76	1 183 522 795,42	1241400	54	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
68	NK	Spirit A.	USA	2014	250 607 185,66	1 362 561 898,30	1429400	65	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
69	NK	Spirit A.	USA	2015	422 547 561,06	1 777 314 607,81	1792100	79	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
70	NK	Spirit A.	USA	2016	368 926 599,94	1 930 824 057,79	2161800	95	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0,86
71	WN	Southwes	USA	2007	625 200 009,56	7 794 054 733,61	8871300	520	1	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,57
72	WN	Southwes	USA	2008	322 658 422,90	7 921 300 213,07	8852900	537	1	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,57
73	WN	Southwes	USA	2009	190 801 319,80	7 537 380 381,52	8631000	537	1	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,57
74	WN	Southwes	USA	2010	757 932 731,19	9 285 443 095,49	8819100	548	1	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,57
75	WN	Southwes	USA	2011	498 173 445,00	11 191 290 320,00	10397400	698	0	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,50
76	WN	Southwes	USA	2012	469 954 835,26	12 890 189 767,11	10934700	694	0	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0,50
77	WN	Southwes	USA	2013	914 262 479,74	12 661 605 343,48	10807600	681	0	0	1	0	0	1	1	0	0	0	1	1	1	1	0	0,43
78	WN	Southwes	USA	2014	1 569 544 219,61	13 124 211 328,49	11049700	665	1	0	1	0	0	1	1	0	0	0	1	1	1	1	0	0,50
79	WN	Southwes	USA	2015	3 416 088 405,80	16 449 677 405,96	11817100	704	1	0	1	0	0	1	1	0	0	0	1	1	1	1	0	0,50
80	WN	Southwes	USA	2016	3 126 630 503,45	16 984 422 349,21	12472000	723	1	0	1	0	0	1	1	0	0	0	1	1	1	1	0	0,50
81	G4	Allegiant	USA	2007	24 213 720,89	277 089 529,39	326500	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
82	G4	Allegiant	USA	2008	24 503 317,09	348 800 120,10	429900	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
83	G4	Allegiant	USA	2009	55 786 344,52	407 769 229,56	532800	46	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
84	G4	Allegiant	USA	2010	49 589 241,52	500 889 681,16	590300	52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
85	G4	Allegiant	USA	2011	34 423 788,79	542 940 180,72	617600	57	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93
86	G4	Allegiant	USA	2012	97 779 036,98	671 587 168,22	698700	63	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93
87	G4	Allegiant	USA	2013	109 098 473,08	702 342 968,76	724100	70	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93
88	G4	Allegiant	USA	2014	109 221 414,48	789 283 246,70	815400	70	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93
89	G4	Allegiant	USA	2015	308 129 832,02	1 046 316 071,52	950100	80	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0,93
90	G4	Allegiant	USA	2016	304 298 769,66	1 119 144 092,29	1112800	84	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0,86
91	B6	JetBlue	USA	2007	130 639 898,15	2 184 760 179,08	2138700	134	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
92	B6	JetBlue	USA	2008	78 201 339,59	2 347 424 282,32	2192000	142	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
93	B6	JetBlue	USA	2009	208 291 627,10	2 405 951 004,95	2245000	161	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
94	B6	JetBlue	USA	2010	251 335 080,00	2 852 238 040,00	2425400	160	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
95	B6	JetBlue	USA	2011	224 390 865,80	3 138 684 657,05	2637000	169	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
96	B6	JetBlue	USA	2012	277 882 134,36	3 681 938 280,22	2895600	180	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
97	B6	JetBlue	USA	2013	301 764 584,28	3 836 217 530,49	3046300	194	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0,36
98	B6	JetBlue	USA	2014	357 488 502,71	4 037 884 699,52	3207800	203	0	0	0	0	0	1	1	0	1	0	1	1	1	0	0	0,29
99	B6	JetBlue	USA	2015	1 008 027 602,04	5 318 671 952,89	3510100	215	0	0	0	0	0	1	1	0	1	0	1	1	1	0	1	0,36
100	B6	JetBlue	USA	2016	1 077 402 149,70	5 446 136 476,23	3826300	227	0	0	0	0	0	1	1	0	1	0	1	1	1	0	1	0,36

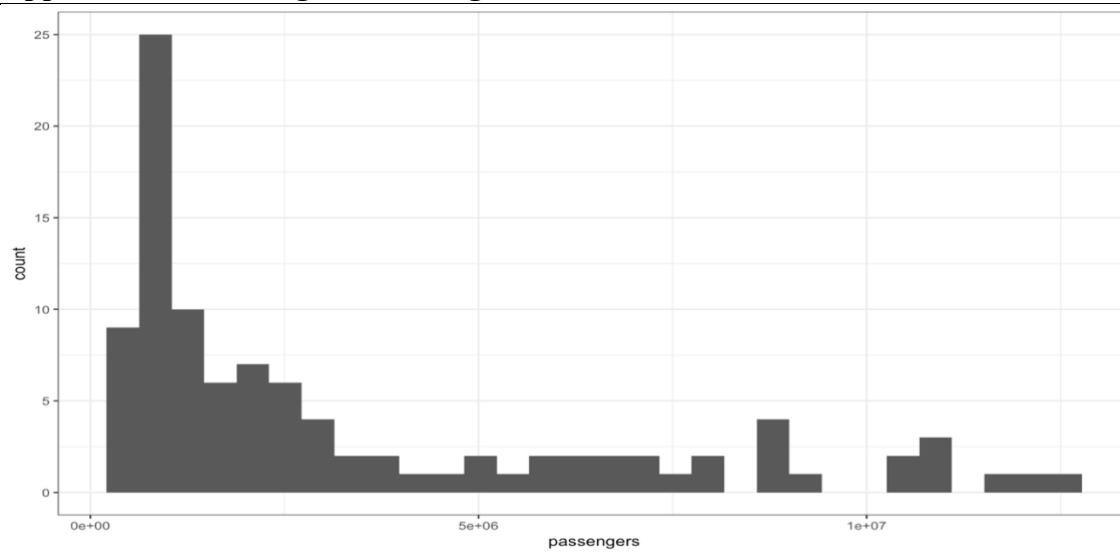
Appendix VI: Histogram Operating Revenue



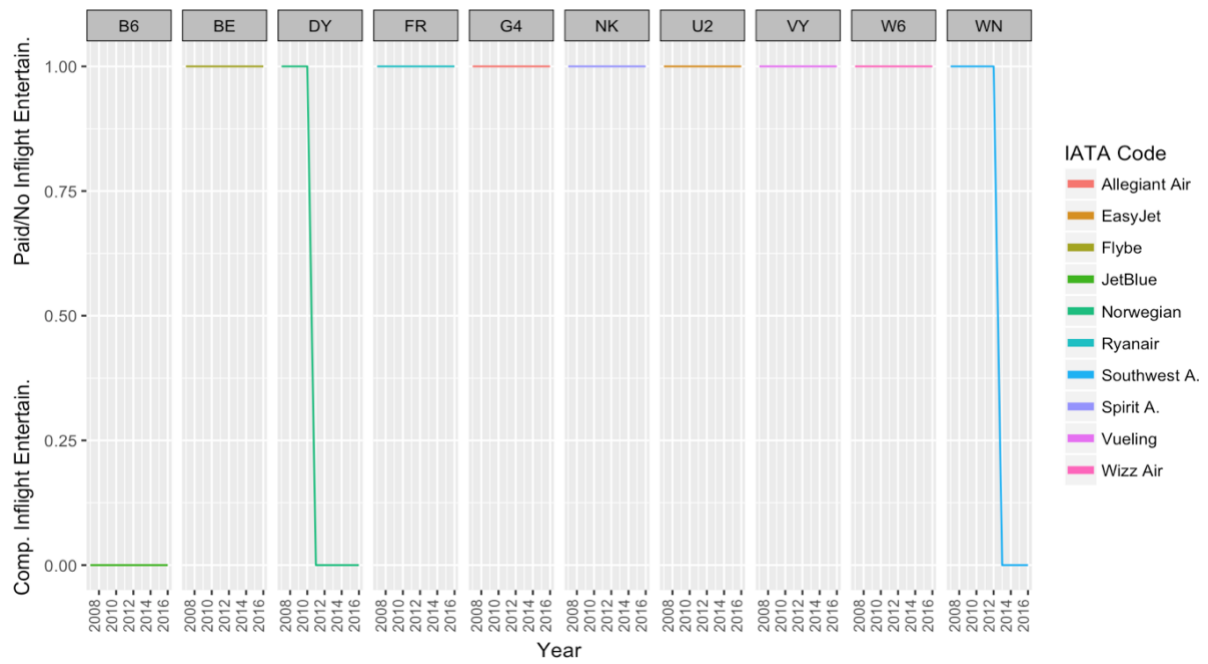
Appendix VII: Histogram Firm Age



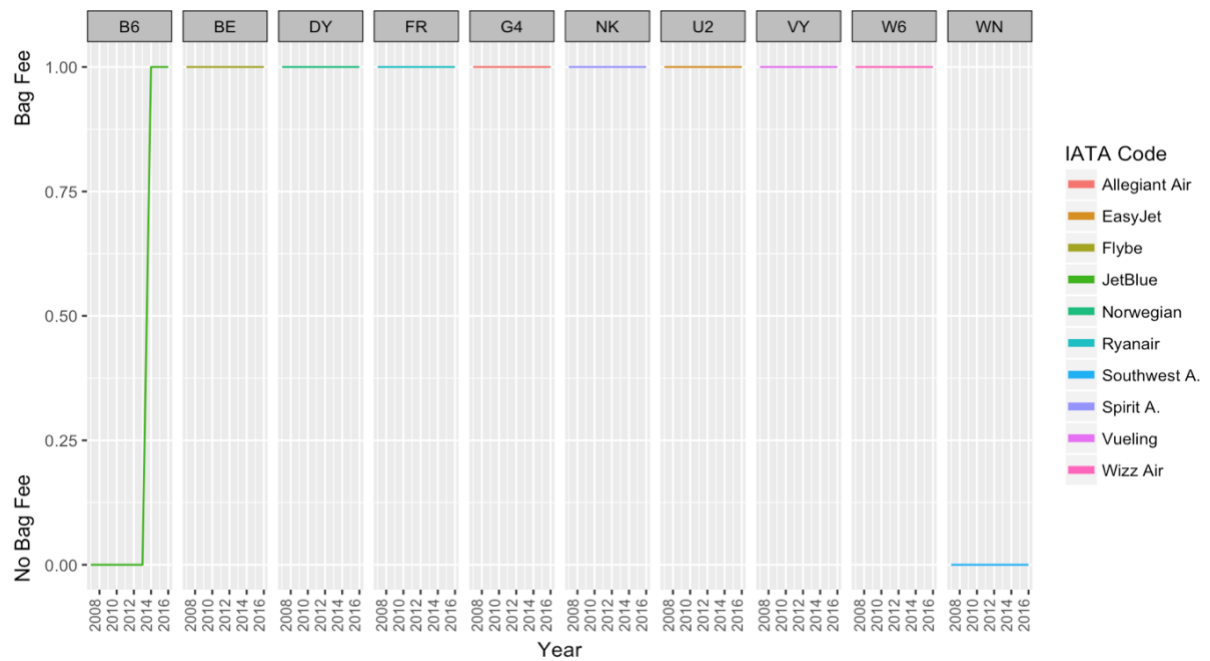
Appendix VIII: Histogram Passengers



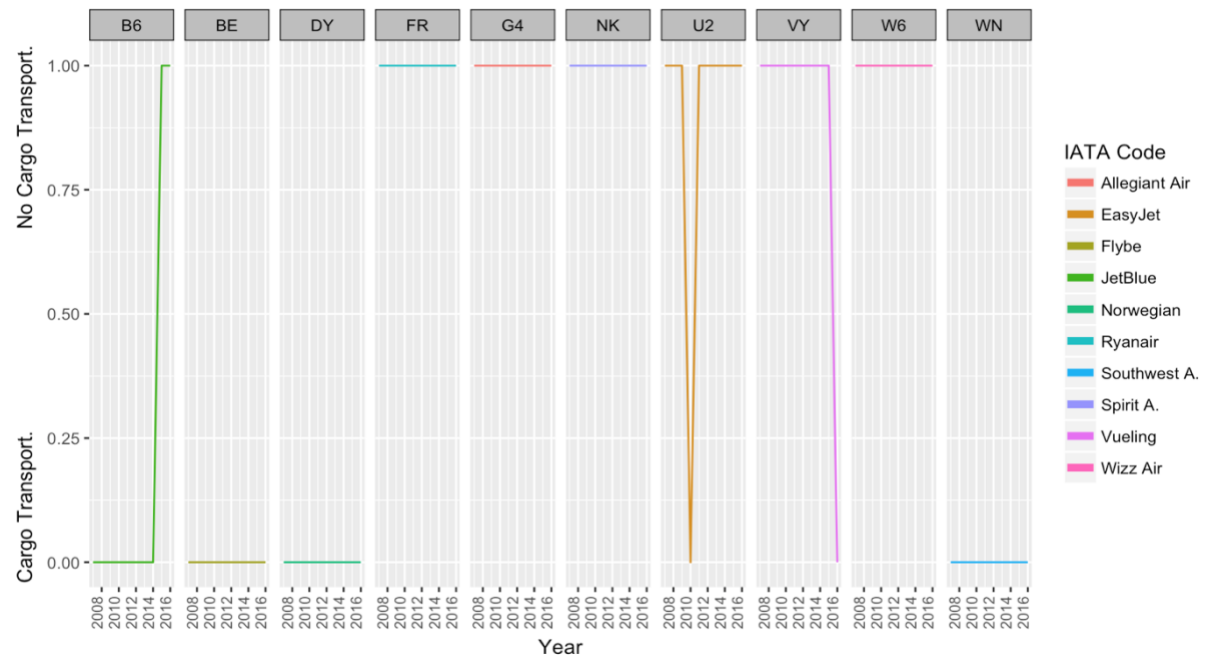
Appendix IX: In-flight Entertainment Changes



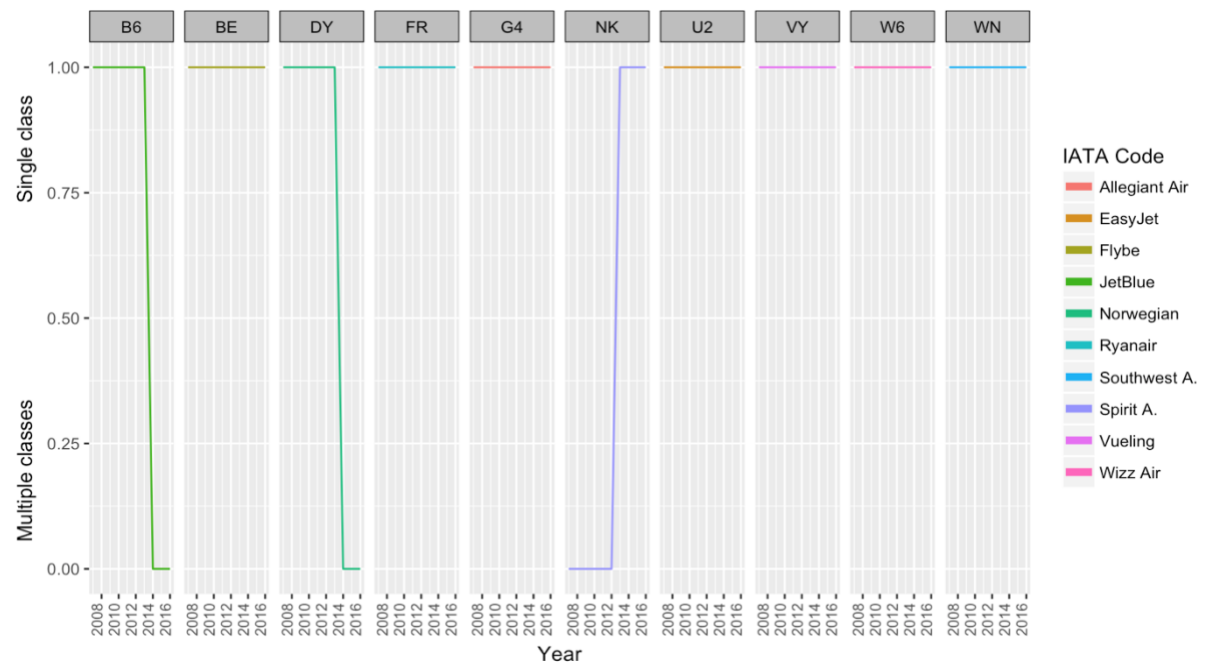
Appendix X: Checked Baggage Fees Changes



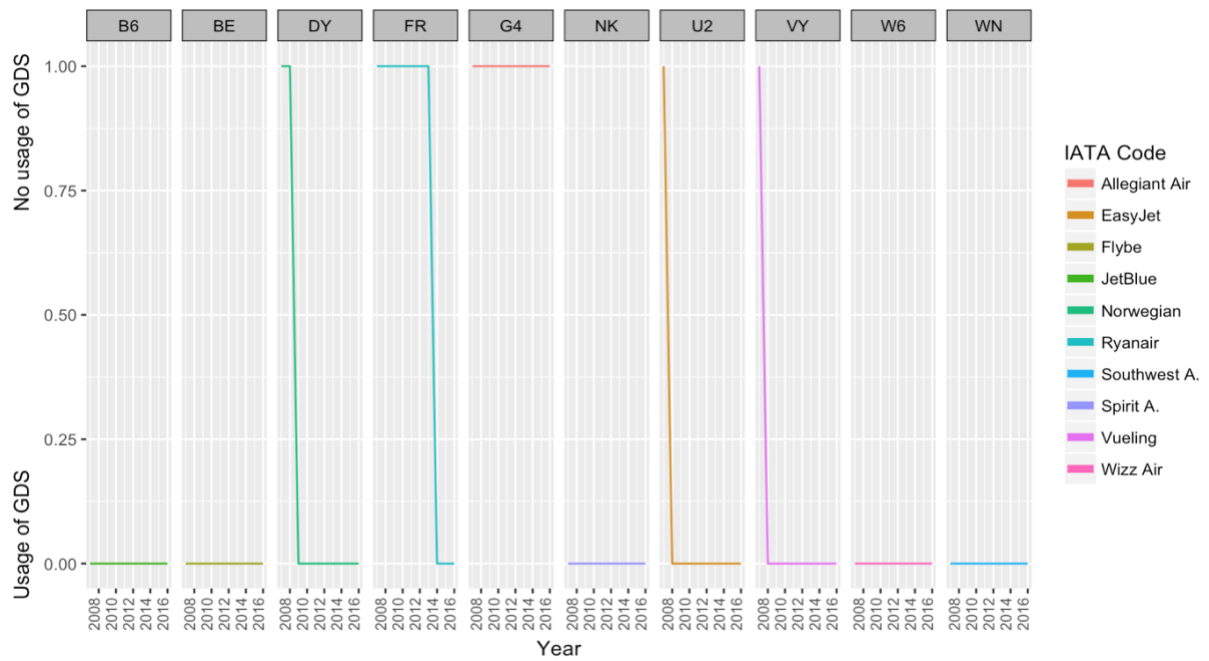
Appendix XI: Cargo Transportation Changes



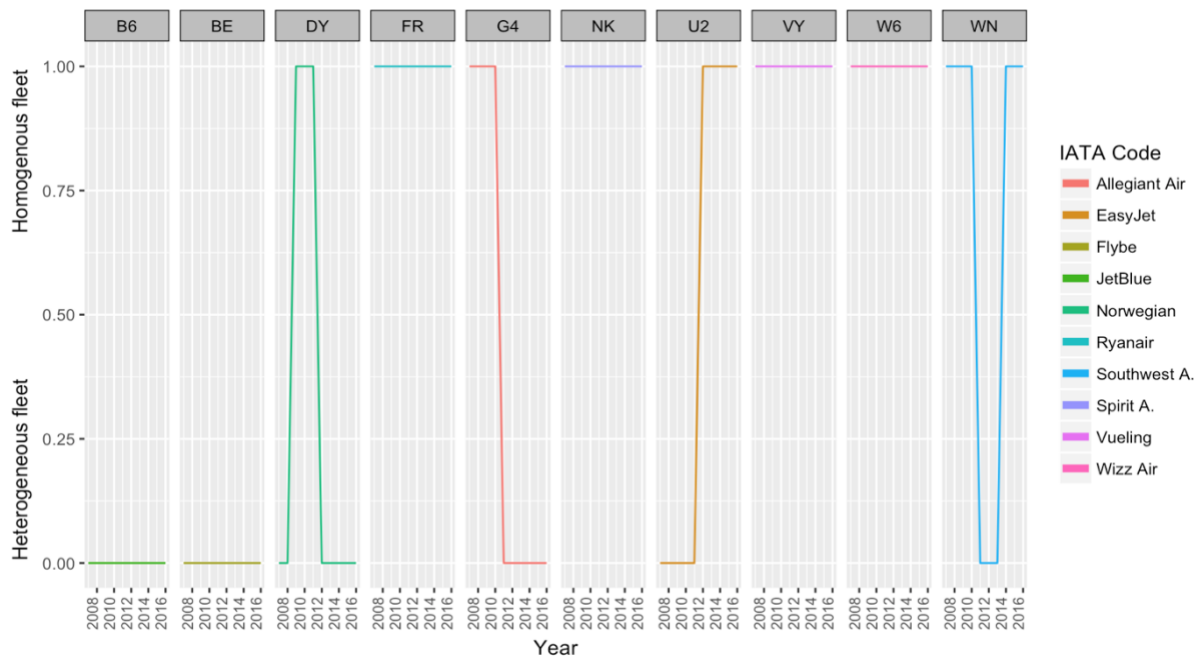
Appendix XII: Cabin-Class Changes



Appendix XIII: Global Distribution System Changes



Appendix XIV: Fleet Uniformity Changes



Appendix XV: Network Changes

