Long-haul low cost airlines: A new business model across the transatlantic and its cost characteristics*

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Abstract

Existing academic literature is inconclusive about characteristics and viability of the long-haul low cost airline business model, whereas several airlines of this type are emerging. This article aims to uncover its defining characteristics by clustering a sample of 37 transatlantic airlines using principal component and hierarchical cluster analyses along a newly constructed long-haul airline business model framework. To contribute to the evaluation of business model viability, cost advantages between clusters are analyzed subsequently followed by a discussion of their sustainability. Key findings include the characterization of the emerging long-haul LCC business model and its significant differences from existing legacy hub and leisure carrier models. On a cluster average, 30-34% lower unit costs were identified.

Keywords— Airlines, Business models, Long-haul, Low cost, Point-to-point

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1 Introduction

Low cost carriers (LCCs) such as Ryanair and Southwest Airlines have revolutionized short- and medium-haul[1] airline markets across the world since the 1990s. The validity of the business model is proven practically through higher profitabilities (cf. Corbo, 2016). Additionally, many academic studies of short-/medium-haul LCCs were conducted, which agree on common underlying principles of the business model (cf. Fu et al., 2011; de Wit and Zuidberg, 2012; Cho et al., 2015; Fageda et al., 2015; Fu et al., 2015).

Long-haul LCCs are a more recent phenomenon. Since the 2000s, carriers of this type have emerged in the Asia-Pacific region, foremost AirAsia X in 2003 and Jetstar in 2007. Since 2015, this type of airline has emerged in the transatlantic market, for example Eurowings long-haul, Norwegian long-haul, Westjet long-haul and Wow air. Existing academic literature is inconclusive about the economic viability and potential of long-haul LCCs. More fundamentally, there is no consistent definition of the actual business model. For example, the model is often described as the short-haul low cost model moving into the long-haul arena, whereas some authors see these carriers as identical to already existing leisure carriers. Yet other authors state that these carriers are doomed to fail or are very limited to certain routes.

To fill this gap in the literature, this paper aims to uncover the defining characteristics of the long-haul LCC business model. To this end, we adapt and enhance an existing airline business model framework for long-haul operations. This framework builds the foundation for the subsequent clustering of airlines using principal component and hierarchical cluster analyses. Furthermore, to contribute to the discussion on long-haul LCC business model viability, cost differences are analyzed. To enable a comparison between business model clusters, system-wide unit costs are calculated and adjusted for differences in stage-length. Finally, the sources of cost advantages and their sustainability are discussed by analyzing unit cost differences in further detail through a comparison of two exemplary carriers.

Besides the academic novelty, there is also practical relevance for this study. Managers are monitoring the contemporary long-haul LCC development closely, as the ignorance the of short-/medium-haul LCC development in the 1990s and 2000s has caused many legacy hub carriers to become unprofitable or forced them to restructure. Policy makers, for example, need to be aware if long-haul growth shifts away from primary to secondary airports to allocate resources and re-evaluate infrastructure policies early on.

The remainder of this paper is structured as follows: Section 2 reasons the focus on the transatlantic market, Section 3 presents a review of previous studies on long-haul LCCs and airline business model frameworks. Section 4 introduces the adapted long-haul business model framework and the airline sample used in this study. In Section 5, methods and results of the airline clustering are discussed. Subsequently, Section 6 discusses the defining characteristics of the long-haul LCC business model. Section 7 provides insights from the cost benchmark between airline clusters and discusses sustainability of cost advantages. Section 8 concludes this paper and suggests further research.

[1]For the purpose of this paper, short- and medium-haul operations include flights with stage lengths up to 4000km as defined by Eurocontrol (2005)

2 The transatlantic airline market

We are focusing on airlines from one region to ensure geographical comparability. The three reasons for the selection of the transatlantic market are detailed in this section. There are four key groups of transatlantic carriers commonly referred to: Airlines that are part of a joint venture (JV), airlines that are part of an alliance but not part of a JV, leisure carriers and fourth, those newly emerging LCCs of interest in this study.

One of three joint ventures was formed between Star Alliance members Air Canada, United Airlines and the Lufthansa Group carriers Austrian Airlines, Brussels Airlines, Lufthansa, and Swiss. Another joint venture was created between the Sky Team members Air France, Alitalia, Delta Airlines, and KLM. The third joint venture was formed between One World members American Airlines, British Airways (including Paris-based carrier Open Skies), Finnair, and Iberia. Transatlantic long-haul routes are the remaining key profit pool for these JV carriers. This profit pool has been maintained mainly through the oligopoly-like structure of the three large joint ventures (Francis et al., 2007). This remaining profit pool is a first key reason for the selection of the transatlantic market in this study.

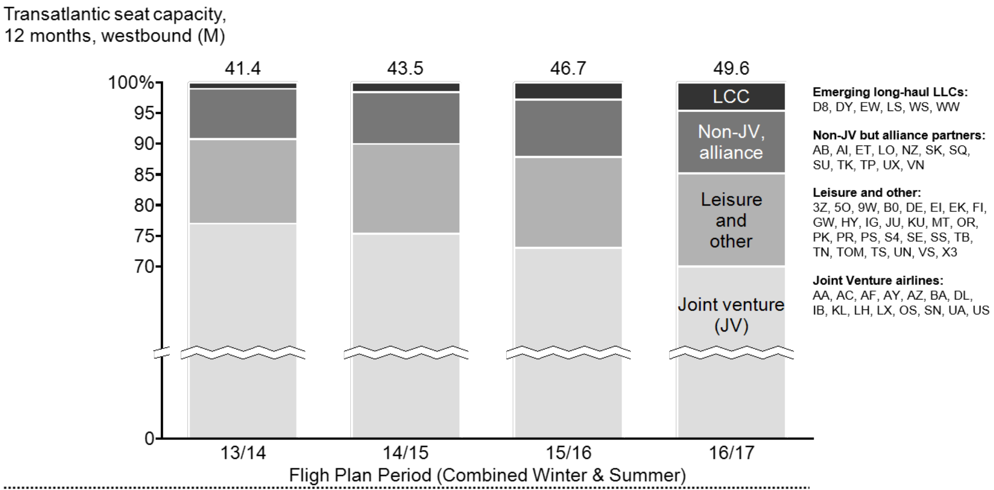
Air Berlin and TAP are examples of carriers that are part of one of the three alliances but not part of one of the JVs. These carriers benefit from alliance-wide code-sharing agreements but do not market their flights collectively as JV carriers. Leisure carriers such as TuiFly or Thomas Cook serve some transatlantic routes with low frequencies and are focused on leisure passengers, often as the subsidiaries of holiday package companies.

Since 2008 and 2009 respectively, the *Open Skies* agreements between the European Union (EU) and the United States (US) and Canada (CA) allow any EU, US or CA airline to operate commercial flights connecting any point between the relevant territories. These Open Skies agreements significantly lowered barriers to entry (De Poret et al., 2015). Likely motivated by this development, several new transatlantic long-haul carriers have emerged, for example Eurowings long-haul, Norwegian long-haul, Westjet long-haul, and WOW Air. International Airlines Group (IAG) and Air France/KLM Group have announced the start of their own long-haul low cost subsidiaries. Interestingly, this long-haul low cost market is approached from different directions: Eurowings is a subsidiary of Lufthansa, an existing legacy carrier, while Norwegian is a traditional short-haul LCC entering the long-haul market. The recent liberalization of this market is the second key reason for the selection of this market for our studies.

Figure 1 depicts the transatlantic seat capacity (directional EU-US/CA) by carrier type over the past four combined flight plan periods. It can be observed that the supply-side market share of the dominating joint venture carriers has declined from 77% in the combined summer and winter flight plan periods 2013/14 to 70% in 2016/17. Therefore, recently, non-JV carriers have grown at a significantly higher pace than the JV airlines. The strongest part of the growth has come from the long-haul LCCs. These carriers only contributed 0.4M seats in 2013/14 but already 2.3M in 2016/17, having gained market share significantly, from 1% to 5%. This recent shift in capacity share is the third reason for the selection of the transatlantic market in this study.

3 Literature review

This section begins with a review of previous studies that examined the phenomenon of long-haul LCCs. Subsequently, previous airline business model frameworks are summarized and compared to identify the most suitable framework for adaptation for this long-haul analysis.



Market shares:				
LCC	1%	2%	3%	5%
Non-JV, alliance	8%	8%	9%	10%
Leisure / other	14%	15%	15%	15%
JV	77%	75%	73%	70%

Data Source: Seat capacity database from Diio LLC (2016)

Figure 1: Transatlantic seating capacity (westbound) along flight plan periods split by carrier type

3.1 Previous studies on long-haul LCCs

Previous studies that addressed long-haul LCCs are listed in Table 1. To compare studies in detail, 11 characteristics that describe the long-haul LCC business model were extracted from the studies based on their appearance in at least two of the studies. Subsequently, each study was assessed along the 11 characteristics, which will be discussed in more detail below.

Previous studies agreed on one common characteristic of long-haul LCCs regarding the flight network design: all studies describe a long-haul LCC model that operates a point-to-point network instead of a hub-and-spoke network as operated by hub carriers such as British Airways or United Airlines. Point-to-point airlines operate a more decentral network and focus on simple operations, whereas hub carriers schedule their flights in and out of their hub to enable passengers to connect between flights. Often 50-60% of the passengers on long-haul flights of hub carriers are connecting passengers, not starting and terminating their travel at the ends of the long-haul flight (Morrell, 2008).

Although only Morrell (2008), Wensveen and Leick (2009), and Douglas (2010) actually mention pricing schemes for connecting flights of long-haul LCCs, all three expect the same sum-of-sector pricing concept. This type of pricing scheme for connecting flights simply adds the prices of two or more flight legs to determine the overall fare for the whole Origin-Destination (OD) journey. Another pricing scheme often applied by hub carriers determines prices individually for each OD, more independent of the legs traveled. In that case, tickets are often priced at marginal costs and well below the sum of the prices of the two individual flight legs (Wittmer et al., 2011, p.88). This pricing scheme becomes particularly challenging for the overall profitability when a carrier has a large share of connecting passengers priced at this marginal cost level (Tretheway, 2004).

Table 1: Previous studies that analyzed long-haul low cost airlines

		Long-haul low cost characteristics [1]												
Author/Year	**Study type**	Point-to-point network	Enabling transfers	Different from charters	Unbundling services	Sum-of-sector pricing	Leisure and VFR only	Premium cabins	Cargo loading	Large aircraft	Few weekly frequencies	Secondary airports	**Cost advantage**	**Viability of business model**
Francis et al. (2007)	Applicability of LCC model to long-haul; cost assessment	Y	N	*	N	*	*	Y	Y	Y	Y	Y	20%	"[. . .] May not ultimately prove viable [. . .]."
Pels (2008)	Analysis of competition between airline network types	Y	N	Y	*	*	*	*	*	Y	*	Y	*	"[. . .] We may see low-cost airlines on thick markets, such as London-New York[. . .]"
Morrell (2008)	Applicability of LCC cost advantages to long-haul	Y	Y	Y	Y	Y	*	N	N	Y	*	Y	<40%	"[. . .] Doubt on the widespread establishment of the business model for long-haul flights."
Wensveen and Leick (2009)	Definition of 3 business model types and subsumption of long-haul LCC	Y	N	Y	N	Y	N	Y	Y	*	Y	Y	20-25%	"If long-haul, low-cost carriers are to survive and adapt in the evolving air transport environment, they must continue to innovate."
Douglas (2010)	Evaluation of long-haul LCC models using strategic concepts	Y	Y	*	Y	Y	N	Y	*	Y	Y	Y	26%	*
Moreira et al. (2011)	Cost simulation of long-haul flying	Y	N	*	Y	*	*	N	Y	*	*	Y	10%	"[. . .] The viability of long-haul LCC operations must be highly questionable."
Daft and Albers (2012)	Route profitability simulation of long-haul low cost flying	Y	N	Y	Y	*	*	N	Y	N	*	Y	*	"[. . .] Regular low cost, long-haul operations are possible if [...] full-service carrier product is effectively unbundled and suitable trunk routes [...] identified."
De Poret et al. (2015)	Route profitability simulation of low-cost long-haul flying	Y	Y	*	Y	*	*	Y	Y	N	*	Y	*	"[. . .] Findings demonstrate how challenging the successful running of a European long-haul low-cost carrier can be."
Maertens (2015)	Assessment of 1 new long-haul LCC	Y	Y	N	Y	*	*	Y	*	N	Y	Y	*	"[...] It remains to be seen how Eurowings will be able to compete with full service legacy carriers that can [...] offer similar or even lower fares and daily frequencies [...]."
Whyte and Lohmann (2015)	LCC cost simulation of a specific long-haul route	Y	N	Y	N	*	N	Y	Y	N	N	N	13-17%	"All of these factors cast some doubt that the long-haul low-cost concept would not threaten FSAs in the same ways it has in short-haul markets."
Wilken et al. (2016)	Demand analysis for point-to-point flying	Y	Y	*	*	*	*	*	*	N	Y	Y	*	*

Y: Yes, i.e., study agrees with characteristic; *N*: No, i.e., study disagrees with characteristic; *: Characteristic not addressed in this study

[1] Extracted from listed studies when mentioned in 2 different publications

Previous studies also agree on target passenger groups, although only three studies discuss this characteristic in particular. The three studies highlight that long-haul LCC models would not only target leisure and *Visiting Friends and Family* (VFR) groups but also price-sensitive business travelers.

The remaining 8 characteristics are not consistently described in previous academic studies. Starting with the enablement or facilitation of transfers, earlier studies such as Francis et al. (2007) point out the importance of hub feed for long-haul flights but clearly describe that a long-haul LCC would not have any feed, except for self-connecting passengers. On the other hand, De Poret et al. (2015), for example, conclude that a long-haul low cost operating model can be successful on very thick routes or when sufficient feeder traffic can be found at either end of the route. They further state that transfer passengers from connecting hubs of short-haul LCCs might be a viable option for this business model.

Regarding a differentiation of long-haul LCCs from charter airlines, Pels (2008), for example, concludes that charter carriers would be different from long-haul LCCs as the former relies on tour operators to fill their aircraft whereas the latter carriers have to sell their own tickets. On the other hand, Maertens (2015) identifies major similarities between the business model of Eurowings long-haul and leisure operators. Whereas similarities to leisure carriers can certainly still be a valid characteristic, Maertens (2015) has limited his study to Eurowings long-haul, potentially not being representative for all emerging transatlantic long-haul carriers.

Another characteristic of long-haul low cost flying mentioned in previous studies is the unbundling of services. Unbundling refers to a trend introduced by short-/medium-haul LCCs where the ticket is sold separately from any add-ons such as luggage, a seat reservation, or food and drink options. Francis et al. (2007) and Wensveen and Leick (2009) stated that cutting these add-on services on long-haul flights would be difficult and likely less accepted by passengers. In contrast, more recent studies from De Poret et al. (2015) and Maertens (2015) see the absence of frills in the lowest ticket price as a key characteristic for the long-haul low cost model.

In terms of travel classes offered, Moreira et al. (2011) and Daft and Albers (2012) describe long-haul low cost as a single-class model with absence of any premium classes. More recent studies from De Poret et al. (2015) and Maertens (2015) describe the model with a premium class.

The usage of cargo space is again discussed with various outcomes. Morrell (2008) expects that due to high density single-class economy seating and the associated luggage volume and weight, no additional cargo space/weight would be available. Daft and Albers (2012) specifically state that additional cargo load could be the decisive factor for profitable operations when load factors are low.

Particularly earlier studies from Francis et al. (2007), Pels (2008), Morrell (2008), and Douglas (2010) find that very large aircraft such as the Airbus A380 would be required to achieve significant unit cost advantages over other carriers and are thus aircraft of choice for long-haul LCCs. More recent studies from Daft and Albers (2012), De Poret et al. (2015), Maertens (2015), and Wilken et al. (2016) identified smaller, efficient aircraft as a key characteristic for this business model, as it would be difficult to find sufficiently large markets to fill single-class Airbus A380. Wilken et al. (2016) even expects that smaller 200 seat single-aisle long-haul aircraft such as the Airbus A321LR would be better suitable for long-haul point-to-point flying.

Except for Whyte and Lohmann (2015), all studies agree that long-haul point-to-point flying would result in only few weekly frequencies being offered per destination, much less than the daily operations of hub carriers on most long-haul routes. The driver for this would be the lower point-to-point demand due to absence of feeder traffic and/or the usage of large aircraft.

Most studies describe usage of secondary airports as a characteristic of long-haul low cost flying, albeit to different extends. For example, Francis et al. (2007) believe the secondary airport strategy to be less effective due to the absence of facilities required for long-haul flying. Whyte and Lohmann (2015) state that long-haul LCCs will require major airports for passengers to be able to self-connect from other flights.

Summarizing this review, we formulate the following key insight:

Insight 1: There is no common definition of the long-haul LCC business model in academic literature and elements of this model are often described with opposite characteristics.

In this study, we aim to clearly define the long-haul LCC business model. We can also observe a simultaneous emergence of several transatlantic carriers as described in Section 2. All emerging carriers refer to themselves as long-haul LCCs. Based on these observations, we hypothesize the following:

Hypothesis 1: Transatlantic long-haul LCCs have a similar business model among each other and are significantly different from other long-haul carriers, thus, forming a new business model cluster in themselves.

It is clearly difficult to review business model viability if there is no common definition of the model itself. However, we attempted to summarize previous evaluations in Table 1 by quoting the critical sentences of the respective articles. Whereas, for example, Francis et al. (2007) and Moreira et al. (2011) state that the success of long-haul LCC operations is questionable, others, e.g. Pels (2008) and Daft and Albers (2012), believe that the model could work if sufficient demand can be gathered.

As for the short-/medium-haul LCCs, the potential success of long-haul LCCs is likely correlated with their ability to lower their operating costs significantly compared to their competitors. Previous studies estimate potential savings between 10% (Moreira et al., 2011) and 40% (Morrell, 2008). Summarizing the previous studies, we can derive the following insight:

Insight 2: There is no consistent view in academic literature on long-haul LCC business model viability, driven by different estimates around potential cost advantages.

We thus aim to further analyze the actual cost differences between the emerging long-haul low cost and other carriers, leveraging the findings and definitions of the first part of this study. Again, given the recent emergence and growth of these long-haul LCCs as outlined in Section 2, we believe that there must be a significant cost advantage for the carriers to operate profitable:

Hypothesis 2: Transatlantic long-haul LCCs have a significant cost advantage over other transatlantic carriers.

3.2 Previous studies on airline business model frameworks

Research on business models has become an important aspect for both academia and management with the purpose to accurately describe a company's value generation system with a manageable number of components. In this study, we aim to structurally analyze different airlines using this business model approach. We intend to adjust and extend existing airline business model frameworks. We will thus review existing industry-specific frameworks in this section. Furthermore, we will also relate these frameworks to the latest research on industry-unspecific business model research.

Wirtz et al. (2016) summarizes the current state of general, industry-unspecific, research on business models and provides a framework summarizing the findings of previous studies. Figure 2 depicts this framework with strategic components *Strategy*, *Resources*, and *Cooperation*, market components *Customer*, *Market offer*, *Revenue*, and operations components *Manufacturing*, *Procurement*, and *Financial*. Underlying elements of each component are summarized beneath the component name within each of the boxes.[2]

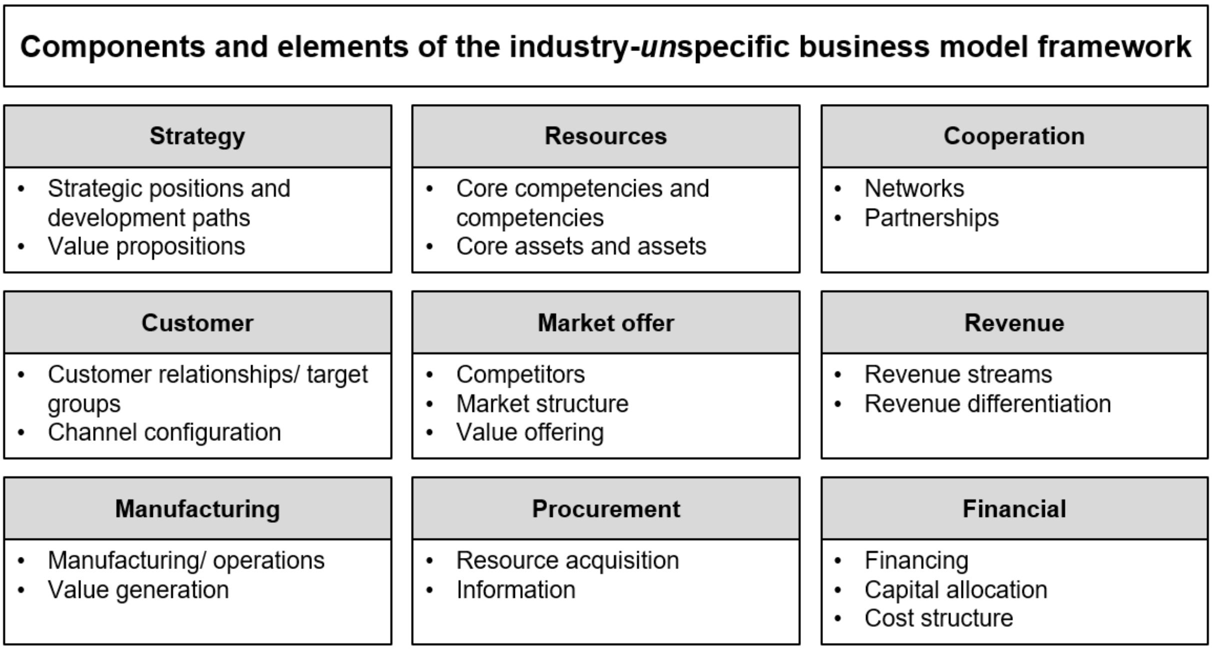


Figure 2: Components and underlying elements of the industry-unspecific business model framework, adapted from Wirtz et al. (2016)

From an industry-specific perspective, two airline business model frameworks have been developed and applied or enhanced several times, as indicated in Table 2. Mason and Morrison (2008) developed the *Product and organizational architecture* framework, which was enhanced later by Lohmann and Koo (2013) and Jean and Lohmann (2016). This framework differentiates between the *product* and *organizational architecture* of an airline. The product aspect contains service quality elements that relate the product to consumer preferences, namely connectivity, convenience, and comfort. The organizational architecture describes the vertical structure, production and distribution/sales elements.Mason and Morrison (2008) The second key airline-related framework stems from Daft and Albers (2013) and was applied and enhanced

[2]To harmonize nomenclature from different authors, this work describes over-arching dimensions of the framework as *components* and underlying, more descriptive dimensions as *elements*. Individual variables within these elements are referred to as *items*.

by Daft and Albers (2015). It differentiates between *corporate core logic*, *configuration of value chain activities*, and *assets*.

Table 2: Previous studies on airline business model frameworks

Author/Year	**Study type**	**Elements**	**Items**	**Application**
Mason and Morrison (2008)	Development of business model framework for comparison of low cost airlines	12: Profitability, Cost driver, Revenue, Connectivity, Convenience, Comfort, Distribution/sales, Aircraft, Labour, Airports attractiveness; Market structure	37	6 European carriers
Daft and Albers (2013)	Development of framework for measuring convergence of airline business models	7: Internal policy choices, external value network, inbound, production, marketing, tangible assets, intangible assets	40	5 German carriers
Lohmann and Koo (2013)	Examination of airline business model spectrum	6: Revenue, connectivity, convenience, comfort, aircraft, and labor	20	9 US carriers
Daft and Albers (2015)	Empirical analysis of airline business model convergence	8: Basic offering, Internal policy choices, external value network, inbound activities, production, marketing activities, tangible assets, intangible assets	36	26 European carriers
Pereira and Caetano (2015)	Meta-study categorizing existing airline business model frameworks	N/A	N/A	N/A
Corbo (2016)	Examination of hybrid business models established between LCCs and hub carriers	6: Network, revenue streams, distribution channels, alliances and partnerships, fleet structure, value proposition	10	6 US carriers, 6 European carriers (separately)
Jean and Lohmann (2016)	Analysis of external effects on airline business model changes over time	6: Revenue, connectivity, convenience, comfort, aircraft, and labor	22	8 US carriers

For this study, we have selected and adapted an existing airline-specific business model framework based on the self-imposed requirement to cover the business model aspects most comprehensively. To evaluate which of the existing frameworks are closest to the industry-unspecific framework, we allocated elements from Mason and Morrison (2008) and Daft and Albers (2015) to the components of the integrated business model framework of Wirtz et al. (2016). As a result, the framework of Daft and Albers (2015) was chosen as it covers all components from the industry-unspecific framework from Wirtz et al. (2016). The framework of Mason and Morrison (2008), although still very broad, did not fully cover cooperation, manufacturing, and procurement components.[3]

Table 2 further displays the application of the respective airline-specific frameworks. All previous studies were applied to airline samples on one continent. Thus, the selected framework had to be adapted for application to long-haul operations. This adaptation will be detailed in the next section.

[3]Table A.1 in the appendix provides the detailed allocation of the relevant airline-specific elements to those of the industry-unspecific components and elements.

Table 3: Long-haul airline business model framework

Component[1]	**Element[2]**	**Item[2]**	**Scale[2]**	**Explanation**	**Data Source[3]**	**#**
Strategy	Type of air product	Network connectivity (long-haul)	# of potential intra-airline connections per long-haul arrival	Count of same airline departures between 30-180 minutes after long-haul arrival. Averaged across all transatlantic arrivals.	Diio LLC (2016)	1
	Geographic focus	Network concentration (long-haul)	# of long-haul flights / # of origin airports	Origin airports are all long-haul airports on continent where airline is registered.	Diio LLC (2016)	2
Resources	Fleet structure	Fleet inhomogeneity (long-haul)	# of different aircraft types serving transatlantic market	Different sizes of one type counted individually, e.g. B787-8/B787-9 counted as two types.	Diio LLC (2016)	3
		Aircraft size (long-haul)	Aircraft cabin area (m^2) averaged by # of flights	Cabin area determined by aircraft type. Weighted by # of transatlantic flights per aircraft type.	Diio LLC (2016), http://airbus.com, http://boeing.com	4
Cooperation	Inter-organizational relationships	Cooperation intensity	(0: Interlining only, 1: Code-sharing, 2: Part of global alliance, 3: Part of joint venture)	Cooperation analysis based on the transatlantic market.	Airline websites	5
Customer	Target product-market combination	Premium passenger focus (long-haul)	# of premium seats / total # of seats	Seats counted as premium if different seat product other than economy seat installed.	Diio LLC (2016); Airline websites	6
		Focus on recurring passengers	[0: No Frequent Flyer Program (FFP) available, 1: FFP available]	FFPs target regular fliers, mainly business travelers. The availability of FFPs is seen as an indication that the airline targets this traveler group.	Airline websites	7
		Focus on leisure passengers	[0: Airline is subsidiary of holiday package company, 1: Airline is no subsidiary of holiday package company]	Holiday package companies often have their own airline subsidiary focused on bringing package holiday passengers to their destinations. Individually offered flights are less important.	Airline annual reports, latest available in 08'2016	8
	Distribution	Use of GDS	[0: No, 1: Yes]	Any use of a global GDS (Global distribution system).	Airline websites	9
Market offer	Service product	Service quality	Skytrax rating (# of stars)	Skytrax overall service rating using a scale from 1 to 5.	Airlineequality.com	10

Table 3: Long-haul airline business model framework

Component[1]	Element[2]	Item[2]	Scale[2]	Explanation	Data Source[3]	#
Revenue	Fare structure	One-way fare availability (long-haul)	(0: No discounted fares, 1: 100% of discounted return fare, 2: 50% of discounted return fare)	No discounted fares: One-way equals one-way flex fare. Determined by comparing one-way and return prices on 3 routes per carrier.	Airline websites	11
		Bundling concept on-board (long-haul)	[0: Nothing included, 1: Food and drinks included]	Services included in lowest base fare.	Airline websites	12
		Bundling concept other amenities (long-haul)	(0: Nothing included, 1: Seat reservation included, 2: Bag included, 3: Seat reservation and bag included)	Services included in lowest base fare. Scale developed by incurred cost for carrier: *Bag included* rated higher, as bag handling incurs higher costs for carrier than seat reservation.	Airline websites	13
Manufactur-ing	Route network	Flight frequencies (long-haul)	# of weekly flights / # of city-pairs		Diio LLC (2016)	14
		Transfer pricing complexity	(0: No bundled connecting flights offered, 1: Sum-of-sector pricing, 2: OD pricing)	Focus of the airline on transfer passengers within the network: Discounted OD fares increase transfer passenger volume. Determined by comparing transfer connection fares with the sum of the individual fares of the flight legs. Tested on 3 routes per carrier.	Airline websites	15
		Airport sizes (long-haul)	% of flights served from hub airports	A hub airport was defined with >100,000 long-haul seats / month (outgoing). Airport not seen as hub if larger airport in the IATA metro region.	Diio LLC (2016)	16
Procurement	Supply management	Fleet age (long-haul)	Average age (# of years) of long-haul fleet	Age of aircraft since first date of delivery from manufacturer.	http://airfleets.net	17
Financial	Finance management, infrastructure	*Excluded from analysis due to limited data availability across sample.*				

[1] According to industry-unspecific framework as depicted in Figure 2 [2] Adapted for long-haul from Daft and Albers (2015) or newly defined
[3] All data bases and websites accessed in 09'2016

4 Long-haul airline business model framework and airline sample

The selected business model framework from Daft and Albers (2015) had to be adjusted for the application to long-haul carriers. We removed, adjusted, and added items and scales but ensured that elements continue to be represented by their respective subordinated items. Table 3 summarizes the full business model framework used in this study, including the 17 items, respective scales, further explanation and data sources. Components are named according to the industry-unspecific framework from Wirtz et al. (2016), elements, items and scales are adapted from Daft and Albers (2015). The financial component was not covered in this study, as relevant data was not available across the full airline sample. However, characteristics of this financial component are also reflected through other components, e.g. the fleet structure or supply management. Items that are specifically measuring long-haul relevant aspects of an airline, are marked accordingly with the supplement *long-haul*.

There are three types of scales used in this framework. Continuous scales measure the concrete metric impact of an item. This type of scale is indicated in Table 3 with a *#* or *%* sign. For example, fleet inhomogeneity is measured using the number of different aircraft types. The second type are dichotomous ordinal scales, which are indicated with box brackets *[ ]*. For example, the availability of a frequent flyer program is measured with either 0 or 1, indicating whether or not a program is available. The third type are non-dichotomous ordinal scales, where there are more than two options to choose from. Values are ordered in an ascending way and only one value can be chosen. These scales are marked using round brackets *( )*. For example, cooperation intensity is measured in this way, where 0 represents the lowest value, interlining only, and 3 the highest value, the airline is part of a joint venture. In this case, being part of a joint venture is rated higher than being part of an alliance or code-sharing, which indeed is a more intensive way of cooperating between airlines. Another important example is the measurement of long-haul one-way fare availability. A rating of 0 highlights that no one-way fares are available, and 2, the highest rating, actually represents the highest value for this item, i.e., the one-way fare is priced at about 50% of the return fare.

Table 4: Filter applied to determine relevant airline sample

Criteria	**Reasoning**	**Comment**
(1) All passenger airlines flying transatlantic between US/CA[1] and Europe (EU28[2], CH[1], IS[1], NO[1])	All sizable transatlantic markets need to be included.	Airline subdivisions with *identical* marketing carrier but different brands were analyzed separately, e.g. British Airways Open Skies was analyzed separately, while Swiss Edelweiss Air was not.
(2) All airlines operating > 10 frequencies per month (total all destinations)	Excluding irrelevant airlines to increase comparability.	Operating ≤ 10 frequencies per month equivalent to max. 1 long-haul aircraft.
(3) All airlines headquartered in markets from (1)	Excluding airlines flying under 6th or 7th freedom.	Carriers are shaped by their home market. Evaluation in the transatlantic spectrum could distort the results.
(4) Excluding particular carriers	Excluding carriers that cannot be compared.	La Compagnie, FR[2] operates few business-class only flights and was excluded.

[1] Referring to ISO 3166-1 alpha-2 letter country codes
[2] EU28: European Union comprising 28 member states (as of 2015)

Airlines analyzed in this paper were selected along four criteria, as summarized in Table 4. First, all passenger airlines that are marketing flights between US, Canada and the key European markets were selected. Key European markets were defined as countries, where an Open Skies agreement is in place, i.e. EU28 member states plus Iceland (IS), Norway (NO), Switzerland (CH)). Hereby, flights operated by a subdivision of an airline or by a third party using identical marketing carrier codes were analyzed as separate carriers only when flights are marketed and distributed as different brands, e.g. Air Canada Rouge and British Airways Open Skies were analyzed separately, while Lufthansa Cityline and Swiss Edelweiss Air were not. Second, of this sample, only airlines operating at least 10 transatlantic frequencies per month (total for all destinations) were selected, as airlines with less frequencies were thought to be irrelevant for this analysis. Third, airlines that do not originate in one of the above mentioned countries were removed from the sample to exclude 6th and 7th freedoms flights[4] not of interest in this study. And fourth, very particular airlines not comparable to any other carrier were excluded.

Table 5: Airline sample selected for analysis

Carrier	Carrier Name	Country of Origin	Alliance
AA	American Airlines	United States	OneWorld
AB	Air Berlin	Germany	OneWorld
AC	Air Canada	Canada	StarAlliance
AC/RV	Air Canada Rouge	Canada	StarAlliance
AF	Air France	France	SkyTeam
AY	Finnair	Finland	OneWorld
AZ	Alitalia	Italy	SkyTeam
BA	British Airways	United Kingdom	OneWorld
BA/EC	Open Skies	France	OneWorld
BY	Thomson Airways	United Kingdom	none
DE	Condor	Germany	none
DL	Delta Air Lines	United States	SkyTeam
DY	Norwegian Air Shuttle	Norway	none
EI	Aer Lingus	Ireland	none
EW	Eurowings	Germany	none
FI	Icelandair	Iceland	none
IB	Iberia	Spain	OneWorld
IG	Meridiana fly	Italy	none
KL	KLM Royal Dutch Airlines	Netherlands	SkyTeam
LH	Lufthansa	Germany	StarAlliance
LO	LOT Polish Airlines	Poland	StarAlliance
LX	SWISS	Switzerland	StarAlliance
MT	Thomas Cook Airlines U.K.	United Kingdom	none
OR	TUIfly Netherlands	Netherlands	none
OS	Austrian Airlines	Austria	StarAlliance
S4	SATA International	Portugal	none
SE	XL Airways France	France	none
SK	Scandinavian Airlines System	Sweden	StarAlliance
SN	Brussels Airlines	Belgium	StarAlliance
SS	CORSAIR	France	none
TP	TAP Portugal	Portugal	StarAlliance
TS	Air Transat	Canada	none
UA	United Airlines	United States	StarAlliance
UX	Air Europa	Spain	SkyTeam
VS	Virgin Atlantic Airways	United Kingdom	none
WS	Westjet	Canada	none
WW	WOW Air	Iceland	none

[4]6th and 7th freedom flights are flights that are operated between two countries by a carrier that is not headquartered in either the origin or the destination country of the particular flight.

Table 5 lists the resulting airline sample of 37 airlines. Both airline selection and subsequent analysis were based on the flight scheduling data base Diio LLC (2016) using data from August 2016. August data was selected since it is the month (together with July) with highest transatlantic traffic volume, driven in part by leisure carriers. Since the target of this study was to arrive at a most comprehensive overview, we decided for the month with the strongest volume across all carriers, including leisure airlines.

5 Determining business model clusters

To validate Hypothesis 1, i.e., newly emerging long-haul LCCs exhibit a similar business model among each other and are significantly different from other long-haul models, we performed principal component analysis (PCA) and hierarchical cluster analysis.

In transportation research, PCA has been used to interpret data sets with a large number of interrelated variables (see, for example Hansen et al. (2000) and Brons et al. (2009)). PCA reduces the dimensionality of the original data to a set of factors, which together account for as much variation of the original data set as possible. The factors are created by finding eigenvectors of the correlation matrix. Variables from the original data set with the highest correlation to the principal component factors are defined as *loading* variables. Data points with a strong correlation to one of the principal components generally have a strong correlation with the loading variables as well. (Jolliffe, 2002)

Hierarchical clustering analysis is a commonly applied cluster method in transportation research (see, for example, Sarkis and Talluri (2004) and Cabral and Ramos (2014)). This method initially places each data observation into its own cluster. Subsequently, two clusters with highest proximity are merged at each step. As a measure of proximity we used the average linkage algorithm.[5] Both PCA and cluster analysis were executed on a PC version of SPSS.

We combined PCA and hierarchical cluster analysis due to several reasons: PCA simplifies the ample number of variables within the business model framework by identifying the most relevant items that load the principal components. Through this, individual items driving the differentiation of clusters can be interpreted, which was seen as an essential part of this study. The visualization of clusters along the principal components provides guidance for the potential number of clusters. On the other hand, through the reduction of variables onto few principal components, part of the variation of the variables is removed. Thus, for the final cluster definition we applied hierarchical cluster analysis to the original data set. At the same time, the application of two different methodologies to the original data adds credibility to the results.

16 out of 17 variables from the framework defined in Section 4 are used in both methods. Variable # 9 was excluded as all airlines in the sample were using global distribution systems (GDS), thus this variable did not contain any variance. We used data from 37 airlines as defined in Section 4.

Two principal components were selected based on Cattell's scree plot criterion (Jolliffe, 2002). The scree plot can be observed in Figure B.1. The two first Eigenvalues explained 55.5% of the total variation. Oblimin factor rotation was applied subsequent to the initial identification of factors to achieve simpler and more interpretable factors. The factor score of the individual items can be obtained from Table 6.

Figure 3 depicts the loadings of principal components 1 (PC1) and 2 (PC2) with the

[5]The average linkage algorithm defines the proximity between two clusters as the average distance between all possible pairs of items within any two clusters.

Table 6: Rotated factor loadings of PCA

	Items	Factor 1	Factor 2
1	Network connectivity	**0.847**	-0.017
2	Network concentration	**0.687**	0.063
3	Fleet inhomogeneity	**0.622**	0.100
4	Aircraft size	**0.524**	-0.105
5	Cooperation intensity	**0.840**	0.225
6	Premium passenger focus	**0.547**	0.151
7	Focus on recurring passengers	**0.576**	-0.312
8	Focus on leisure passengers	**-0.737**	0.340
10	Service quality	**0.573**	0.149
11	One-way fare availability	**-0.823**	-0.175
12	Bundling concept on-board	0.112	**0.892**
13	Bundling concept other amenities	0.386	**0.714**
14	Flight frequencies	**0.816**	0.116
15	Transfer pricing complexity	**0.685**	-0.097
16	Airport sizes	**0.585**	0.182
17	Fleet age	-0.031	**0.716**

Significant items with factor loading of > ||0.5|| are marked in **bold**
Oblimin factor rotation was applied
Item #9 was excluded as reasoned in Section 5

analyzed 16 items. Since all items correlate with one of the PCs with a value higher than 0.5, we retained all 16 variables in the plot.

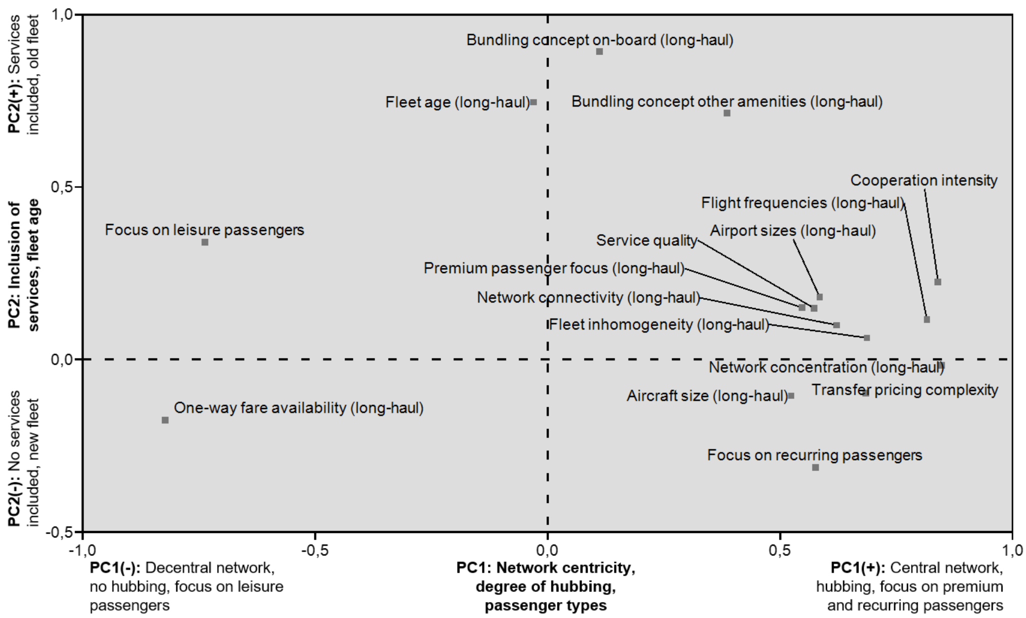


Figure 3: Factor loadings of principal components

PC1 is positively loaded with cooperation intensity, network connectivity, flight frequencies, network concentration, transfer pricing complexity, airport sizes, service quality, fleet inhomogeneity, premium passenger focus, and focus on recurring passengers. Negative correlation exists with focus on leisure passengers and one-way fare availability. We have thus named PC1 component characteristics in positive direction with *central network*, *hubbing*, and *focus on premium and recurring passengers*. Negative PC1 component characteristics were best described with *decentral network*, *no hubbing*, and *focus on leisure passengers*.

PC2 is positively loaded with increasing fleet age and higher service levels in lowest long-haul fare classes, both on-board and pre-/post flight. We thus called the positive characteristics of PC2 *services included* and *old fleet*. The negative characteristics of PC2 were described with *no services included* and *new fleet*.

Figure 4 visualizes the scoring of the airlines within the sample along the principal components PC1 and PC2. Three groups of carriers can be identified based on the visual proximity of certain airlines in the data plot along the principal components. A first group of airlines is located in the top right quadrant. These airlines generally have a more central network, focus on connectivity and premium passengers. A second group of airlines can be located in the top left quadrant. According to the principal components, these airlines operate a less central network with low connectivity and simple pricing but have similar service and fleet age levels as cluster 1 airlines. The third cluster of airlines is located in the lower bottom half of the diagram. In terms of network centrality, connectivity and premium focus, this group of carriers is located in between groups one and two. These airlines offer significantly lower service levels in the lowest fare and operate newer aircraft fleet. This group contains airlines DY, EW, WW, and WS, which have recently started with transatlantic long-haul operations.

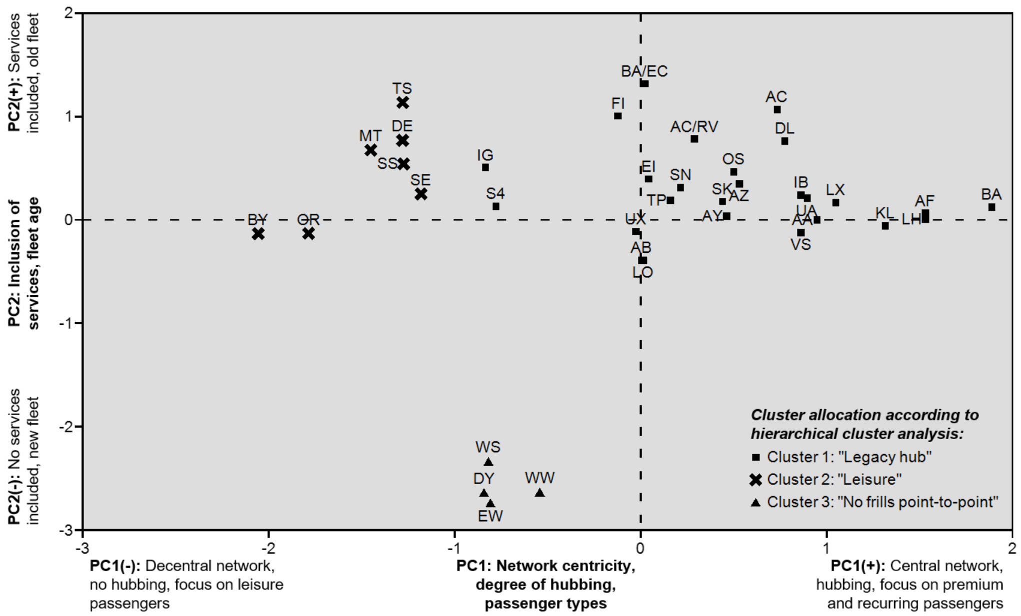


Figure 4: Principal component factor scores including cluster allocation determined by hierarchical clustering method. Airline letter codes according to Table 5.

To determine whether these visual groupings of carriers can be referred to as clusters, a hierarchical cluster analysis was conducted using the original data set of the 16 variables, normalized between 0 and 1. The dendogram displaying the hierarchical connections between groups and the formation of clusters is shown in Figure B.2. We chose three clusters based on the visual observations from the PCA factor score plot. The allocation of airlines to these three clusters through the hierarchical clustering method can also be observed in Figure 4: The type of marker represents the cluster into which the airline was allocated based on hierarchical cluster analysis.

One difference between the plot of the PC factor scores and the results of the hierarchical clustering can be observed. Whereas from a visual point-of-view, IG and S4 would be counted as part of the second cluster, hierarchical clustering analysis allocated the two carriers into cluster one. This can be explained as both IG and S4 have incorporated leisure-like characteristics but are also operating a rather central hub network. For this case, we have decided to select the results of the hierarchical clustering method as our final allocation, as the PCA factor scores do not reflect the total variance of the data set, whereas the hierarchical clustering method has been applied to the original data set, reflecting the full variance of the data.

Based on hierarchical cluster analysis and the results of PCA, we named cluster one airlines *Legacy hub*, as it contains carriers such as Lufthansa, Air France, and American Airlines. Cluster two was named *Leisure*, as it contains leisure or charter carriers such as Thomas Cook and Air Transat. Cluster three was named *No frills point-to-point*, as it contains the new long-haul carrier types that differentiate through their focus on a point-to-point network and the exclusion of frills or services in the lowest ticket fare. From now on, we will refer to no frills point-to-point carrier instead of long-haul LCCs, as we believe it better reflects the business model.

When revisiting Hypothesis 1 formulated in Section 3, we believe we have confirmed the thesis that newly emerging transatlantic long-haul carriers have a similar business model among themselves, significantly different from other leisure or hub models.

6 Characteristics of the long-haul no frills point-to-point carriers

Table 7 summarizes mean values by airline cluster for the 16 (out of 17) analyzed variables. Prior to this, all variables were normalized between 0 and 1 with lowest and highest values, respectively. The statistical significance of differences between clusters has been tested with the non-parametric Kruskal-Wallis H-test. Except for aircraft size and fleet inhomogeneity, the Null-Hypothesis that there is no significant difference between at least two out of three clusters has been rejected at the 5% level for all other items. For fleet inhomogeneity, the Null-Hypothesis is rejected at the 10% level.

In the following, we will discuss differences between airline clusters along the components and elements as defined in the business model framework in Table 3.

Strategy, resources, and cooperation

Items network connectivity and network concentration describe the network strategy of the airlines. Network connectivity measures how many potential connections before or after a scheduled long-haul flight departure or arrival, respectively, can be counted on average across the whole network. As expected, this value is highest for legacy hub carriers. The value is lowest for leisure carriers. No frills point-to-point carriers lie in between the two other business model clusters. No frills point-to-point carriers offer more connections to long-haul flights leveraging their short-haul network, enabling passengers to connect. This is a clear and important differentiation to the existing leisure business model.

Network concentration is a measurement of how centralized the network of an airline is. Our analysis shows that it is highest for cluster one (i.e., legacy hub) carriers. This was expected since a concentrated network is the foundation of any hub carrier's business model. For cluster three (i.e., emerging no frills point-to-point) airlines, the average network concentration is as

Table 7: Mean values of normalized items for each airline cluster

	Items	Cluster 1 Legacy Hub	Cluster 2 Leisure	Cluster 3 No frills p2p	Kruskal-Wallis H-test	Kruskal-Wallis p-value
1	Network connectivity[1]	0.47	0.00	0.17	16.3	0.000
2	Network concentration[1]	0.28	0.07	0.07	11.3	0.004
3	Fleet inhomogeneity[2]	0.32	0.11	0.09	6.0	0.051
4	Aircraft size[3]	0.53	0.47	0.36	1.4	0.498
5	Cooperation intensity[1]	0.83	0.14	0.17	22.1	0.000
6	Premium passenger focus[1]	0.40	0.18	0.15	10.8	0.005
7	Focus on recurring passengers[1]	0.96	0.29	1.00	18.9	0.000
8	Focus on leisure passengers[1]	0.00	0.86	0.00	29.9	0.000
10	Service quality[1]	0.46	0.00	0.00	7.3	0.026
11	One-way fare availability[1]	0.19	1.00	1.00	20.8	0.000
12	Bundling concept on-board[1]	1.00	1.00	0.00	36.0	0.000
13	Bundling concept other amenities[1]	0.76	0.48	0.00	17.5	0.000
14	Flight frequencies[1]	0.59	0.17	0.22	16.7	0.000
15	Transfer pricing complexity[1]	0.90	0.36	0.75	13.4	0.001
16	Airport sizes[1]	0.84	0.59	0.48	7.7	0.021
17	Fleet age[1]	0.47	0.40	0.07	9.0	0.011
	Number of airlines in cluster	26	7	4		

[1] Statistically significant at 5%-level
[2] Statistically significant at 10%-level
[3] Not statistically significant at 10%-level
All values normalized between 0 and 1 across all clusters: 0 represents lowest value within sample, 1 represents highest value
Item #9 was excluded as reasoned in Section 5

low as for leisure airlines, pointing towards a similarly decentralized network with a focus on point-to-point routes.

Both clusters two and three airlines have a more homogeneous long-haul fleet than legacy hub carriers. Cluster two and three carriers seem to be able to operate their long-haul flights with few different aircraft types, whereas legacy hub carriers require different size aircraft to serve different markets from their hub.

Although we expected no frills point-to-point carriers to have smaller aircraft sizes compared to other airlines, these results could not be confirmed as differences were statistically insignificant.

Most legacy hub carriers are part of a joint venture and/or one of the three large alliances. Both leisure and no frills point-to-point carrier cooperate significantly less. Likely driven by the lower need for connecting passengers as indicated by the low network connectivity.

Summarizing the above findings, we conclude that the network strategy of emerging carriers exhibits significant differences from both legacy hub and leisure carriers. Emerging carriers focus on a decentralized point-to-point model while leveraging low-complexity coincidental feeder traffic at existing short-haul bases. A more homogeneous long-haul fleet reduces complexity. So far, these carriers have entered fewer inter-organizational relationships, potentially to further limit complexity.

Customer, market, and revenue

When observing target customer-market combination scores across the business models, it seems that legacy hub carriers focus on premium passengers and service quality, while both leisure and no frills point-to-point carriers score significantly lower on both metrics without significant differences between the two groups. However, no frills point-to-point carrier focus on recurring passengers just as legacy hub carrier using their frequent flyer programs. Leisure carriers have a significantly smaller focus on recurring passengers. This is in line with the high focus on touristic passengers of leisure carriers. Leisure airlines can rely on package holiday companies to fill the seats of their aircraft and are less dependent on recurring passengers.

Most legacy hub carriers employ complex pricing/revenue management systems to differentiate between business travelers willing to pay higher prices and e.g. tourists. This is likely to increase unit revenue as well as back office complexity cost. For example, return tickets that include a weekend stay are generally priced lower than tickets without a weekend stay. The latter one is targeted at business travelers that prefer to return prior to the weekend. As a result, long-haul low cost one way fares are often not available at legacy hub carriers, which would undermine this mentioned differentiation. On the other hand, no frills point-to-point and leisure airlines do offer low price one-way fares.

Both legacy hub and leisure carriers include on-board services such as food and drinks as well as other services such as checked luggage into their lowest base ticket price on transatlantic flights. The emerging airlines in cluster three generally include fewer or no on-board or airport amenities into the lowest base ticket price. The absence of frills in the lowest base fare (i.e., debundling) enables the airline to offer lower prices, which causes cluster three carriers to have a tendency to appear in (online) price comparisons with the lowest priced tickets, thus, having a high chance to be selected by the customer. Additionally, these airlines benefit from opportunities to earn more ancillary revenues for add-on services.

Regarding the customer, market, and revenue components of the business, we have observed that the emerging carriers are again neither following the legacy hub nor the leisure model but rather pick essential parts suitable for a long-haul point-to-point model. No frills point-to-point carriers target all passenger groups including recurring business travelers and have incorporated a simple one-way pricing to allow customers to mix flights from different airlines. Furthermore, similar to short-haul LCCs, all services are excluded in the lowest ticket price.

Operations and procurement

From an operations point-of-view, no frills point-to-point carrier operate fewer flight frequencies per route compared to legacy hub carriers. This is a very essential difference, as the absence of large numbers of transfer passengers reduces the demand for a long-haul flight leg. In turn, depending on the aircraft size, the airline cannot fill a daily flight per route. Thus, to serve destinations with a high (daily) frequency, either the city-pair would have to bear sufficient direct demand or the carrier would have to increase the share of connecting passengers, likely lowering the cost-benefits achieved through the low-complexity approach incorporated by no frills point-to-point carriers today.

Legacy hub carriers generally price tickets by city pair instead of by flight leg. Fares for transfer passengers on competing routes are often lower than direct flights. Given a lower need for connecting passengers, leisure and no frills point-to-point carriers have a higher tendency to employ this leg-based pricing scheme for connecting flights, eliminating cross-subsidization of flights and removing complexity from their pricing and revenue management departments.

Compared to legacy hub carriers, both no-frills point-to-point and leisure carriers use smaller (non-hub) secondary airports. These secondary airports generally impose lower landing and handling charges which result in a lower cost structure of these airlines.

Furthermore, no-frill point-to-point airlines have a significantly lower average fleet age than both legacy hub and leisure carriers, which points towards a higher fuel efficiency and in turn lower operating cost. It will be interesting to monitor over time whether this trend will continue once these airlines have reached maturity, i.e., whether a young fuel efficient fleet is part of the carrier's procurement strategy.

From an operations point-of-view, emerging carriers include aspects known from short-haul low cost and leisure carriers, rather than legacy hub carriers: No frills point-to-point carriers operate fewer frequencies due to the wanted absence of large numbers of transfer passengers and again here, operate with a low cost focus by strongly utilizing secondary airports and focusing on younger fuel efficient aircraft.

Concluding this section, we observe that emerging carriers include business model aspects of legacy hub, leisure, as well as short-haul LCCs, forming it into a coherent business model. To summarize, we can describe the emerging business model of cluster three carriers in the following way:

> *Insight 3: No frills point-to-point carriers operate a decentral point-to-point model while leveraging low-complexity coincidental feeder traffic at existing short-haul bases. These carriers target all passengers groups and have a strong focus on low complexity and low cost.*

7 Cost analysis

In this section, cost differences between airline clusters are quantified and discussed. At first, the unit costs of the carriers within each cluster are normalized and compared. In a second step, the unit costs of an exemplary long-haul no frills point-to-point carrier are compared with an exemplary carrier from the legacy hub cluster in detail to discuss sustainability of cost advantages.

7.1 Cluster cost benchmark

To validate Hypothesis 2, i.e., emerging transatlantic long-haul LCCs have a significant (20-30%) cost advantage over transatlantic carriers, we compared unit costs by airline cluster.

Cost per available seat kilometer (CASK) was used as the unit cost of choice, calculated using total operating costs and total system-wide available seat kilometers (ASK) during 2015. Annual reports for the year 2015 were chosen, as this was the latest full-year published data available at the point of analysis.

Although total costs increase with stage-length, CASK decrease, as aircraft and crew are more productive since being more time in the air and less on the ground, and stage-length independent airport and handling, or overhead costs can be distributed across more kilometers. Different airlines can have fundamentally different system-wide mean stage lengths depending on the network. Carriers with a higher share of short-haul routes will have a lower system-wide mean stage-length and vice versa. Thus, CASK need to be adjusted when comparing them between carriers. Swan and Adler (2006) have provided a very useful function explaining the influence of stage length and seat capacity on a single flight. In their airline data project, Swelbar and Belobaba (2016) apply a method that is commonly applied in the airline industry. The latter formula adjusts costs based on the stage-length difference of a carrier to the sample mean. It cannot fully account for all differences of the cost data between carriers. For example, cost differences arising from different shares of narrow-body and wide-body aircraft within the network might not be fully reflected through this equation. However, we expect it to have sufficient accuracy for the purpose of comparing total costs across airline clusters. We have chosen the formula as applied by Swelbar and Belobaba (2016), where l_i is the system-wide mean stage-length of carrier i:

$$CASK_{adj,i} = CASK_{unadj,i} * \sqrt{\frac{l_i}{\frac{1}{n}\sum_{i=1}^{n} l_i}}$$

Figure 5 displays the stage-length adjusted system-wide CASKs (left axis) and the stage-length (right axis) of the airlines within the sample. For 32/37 airlines cost data was derived from the sources as indicated. For non-listed carriers, no public cost data was available. The mean system-wide stage length across the sample was calculated with 2,531km in 2015.

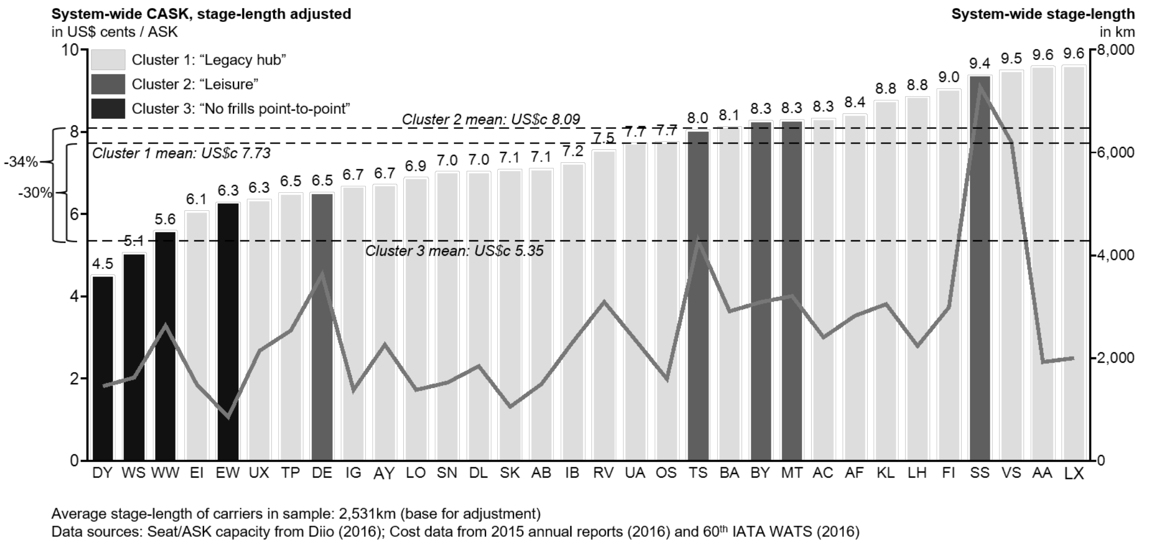


Figure 5: Stage-length adjusted system-wide CASK and mean stage-lengths for airlines within the 3 determined clusters

Cluster one, i.e., legacy hub carriers have a stage-length adjusted mean CASK of US$c 7.73 (Sample standard variation: $\sigma_{s,1} = 1.09$), cluster two (leisure) carriers of US$c 8.09 ($\sigma_{s,2} = 1.03$), and cluster three (no-frills point-to-point) carriers of US$c 5.35 ($\sigma_{s,3} = 0.76$). This equals a 30% lower average cost base of no frills point-to-point carriers compared to legacy hub carriers, and a 34% lower average cost base versus leisure carriers, on an stage-length adjusted basis.[6]

When revisiting the second hypothesis formulated in Section 3, we believe we have confirmed the thesis that transatlantic long-haul LCCs have a significant unit cost advantage over other transatlantic carriers.

7.2 Sustainability of cost advantages

We have observed that no frills point-to-point carriers on average have a 30%-34% unit cost advantage over other carriers. To further understand these cost differences and evaluate their

[6]A remark on the applied formula for stage-length adjustment, as we discussed the accuracy of the formula earlier: Although we cannot conclude on the accuracy of the method, the results are according to our expectations that no frills point-to-point carriers have lowest costs in the sample. We thus believe that the applied stage-length adjustment formula provides sufficient accuracy to compare unit costs between airline clusters.

sustainability, a comparison of individual cost items is necessary. Data from publicly available annual reports was not comparable on a cost item base across the full sample. Thus, a case study approach was chosen. We compared the no frills point-to-point carrier with the lowest unit cost (Norwegian Air Shuttle, DY) to the largest legacy hub carrier in Europe (Lufthansa, LH).[7] We decided that both carriers in this case study had to stem from the same continent to rule out major cost differences due to geography or accounting.

Figure 6 compares the stage-length adjusted unit operating costs between Norwegian and Lufthansa. Norwegian has a significant unit cost advantage over Lufthansa: With total operating cost (incl. aircraft depreciation) of 4.5 US$c/ASK, Norwegian operates at significantly (49%) lower cost than Lufthansa. The degree of sustainability of this cost advantage over time will be discussed in the following paragraphs.

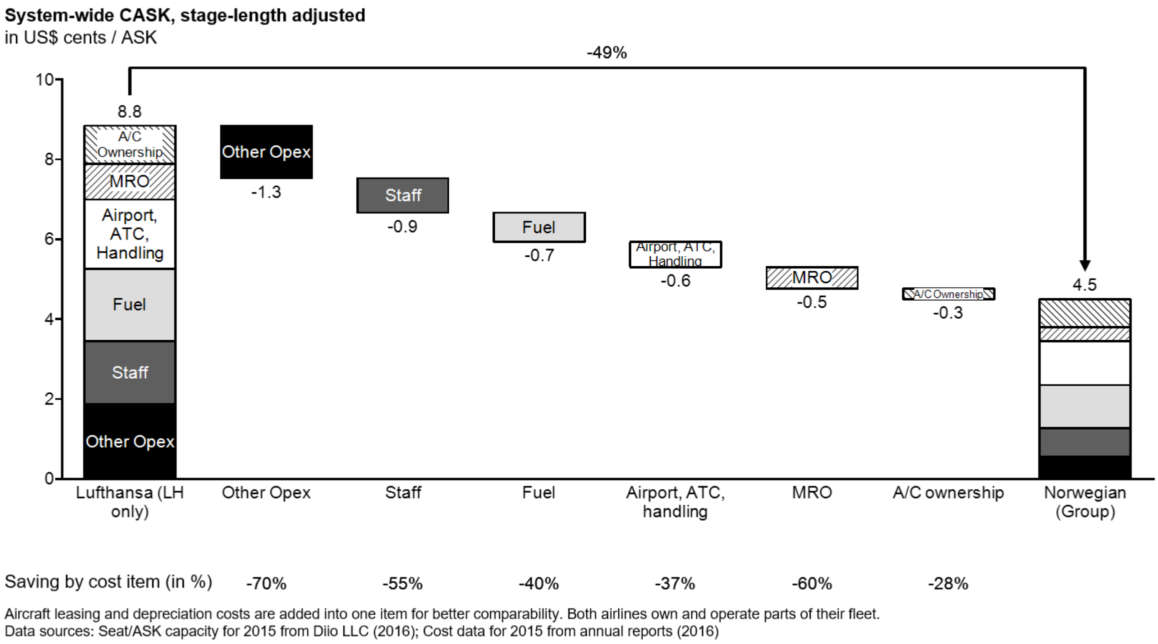


Figure 6: Differences in operating costs between Lufthansa and Norwegian by cost item

The largest cost difference lies in the *Other operating expenses* (or *Other OPEX*). Norwegian's operating expenses are 1.3 US$c/ASK (or 70%) lower compared to Lufthansa. This cost item includes administrative costs for further (external) services, marketing, sales, systems, IT, and customer relations. In an extensive hub-and-spoke network, large volumes of connecting passengers require processes and customer relation structures e.g. to manage irregularities such as missed connections. Complex OD pricing systems need to be in place to optimize revenue streams also from connecting passengers, not just on a single flight basis. An inhomogenous long-haul aircraft fleet results in more complex aircraft and crew rotations as well as crew training. All of these aspects need to be organized and managed in the back-office, often requiring complex systems and infrastructure. The same is true for different service classes: Managing different service classes, e.g. four classes at Lufthansa, increases complexity, and thus cost, further. Since Norwegian focuses on more efficient and less complex point-to-point (long-haul) networks, a significant portion of this cost advantage can be claimed to be a sustainable advantage of this business model.

[7]Table A.2 summarizes the most relevant collected data used in this case study.

Norwegian operates at 55% lower staff cost per ASK than Lufthansa. Generally, lower cost crew contracts, less overseas rest time, as well as less senior crews have been previously discussed as potential drivers for lower staff cost in low cost long-haul airlines. (De Poret et al., 2015; Whyte and Lohmann, 2015) Whereas the latter advantage will seize over time, a lower crew cost base and more efficient deployment are sustainable competitive advantages - as long as the advantage over other carriers remains.

Fuel cost are a significant cost bucket for airlines. Norwegian has 40% lower unit fuel cost than Lufthansa. Key driver for this lower consumption and cost per unit are younger, more fuel efficient aircraft, and a higher seat density. Unless Norwegian will phase-out its aircraft significantly earlier than Lufthansa, sustaining a younger, more fuel efficient fleet, the first source of cost advantage will diminish over time and cannot be seen as a sustainable competitive advantage. The seating density can be viewed as a sustainable advantage, as long as the additional seats can be filled with paying customers.

Figure 6 combines passenger- and flight-related airport and handling fees, as well as air traffic control (ATC) expenses, as they are not separately reported by both airlines. Our analysis shows that Norwegian operates at 37% lower cost than Lufthansa. A key reason is likely the usage of secondary airports such as London Gatwick or Oakland close to San Francisco, which generally charge lower landing and passenger-related fees than large hub airports. (De Poret et al., 2015) Only 7% of Lufthansa's long-haul destinations/origins are non-primary airports, which is typical for a legacy hub carrier and likely the key reason for higher Airport / ATC / Handling costs. It can thus be concluded that this cost advantages is more sustainable for Norwegian.

Although we have focused this discussion on costs, we need to point out differences in unit revenues between the two carriers. Lufthansa earns significantly higher (9.3 US$c/ASK) revenues per ASK than Norwegian (4.7 US$c/ASK), stage-length adjusted. Key reason is the clear focus of Lufthansa on premium passengers, offering a sophisticated First, Business, and Premium Economy class product. The share of premium seats per aircraft is also significantly higher at Lufthansa. The higher unit revenues translate into a slightly higher operating margin for Lufthansa of 4.4% vs. 3.7% for Norwegian.

Maintenance, Repair, and Overhaul (MRO) costs are 60% lower for Norwegian. Key reason is a younger fleet that does not e.g. require significant overhaul procedures at this point. Once the fleet age increases, these costs will also increase for Norwegian. MRO costs also include overhaul of cabin interior such as the exchange of premium class seats. In 2015, Lufthansa invested heavily into their seat product. Given Norwegian's lower focus on premium passengers and less advanced two class product, there will be fewer expenses of this kind.

The last cost advantage from the point-to-point network becomes obvious when looking at combined charter, leasing and aircraft depreciation costs. These asset costs are around 28% lower at Norwegian, although the opposite trend would be expected due to the average long-haul fleet age, 3.9 years at Norwegian versus 11.1 years of Lufthansa. A younger fleet can be expected to result in higher leasing or depreciation costs. This unexpected result can be explained once more with the point-to-point network design. Norwegian has the opportunity to utilize its long-haul aircraft significantly more per day: 16.6 hours versus 13.0 hours at Lufthansa. Due to a lower need for connecting passengers, there is a lower need to schedule aircraft to stay on the ground to wait for connecting passengers from other flights. Furthermore, Norwegian only uses one single long-haul aircraft type in two configurations (Boeing 787-8 and 787-9), whereas Lufthansa uses seven different long-haul aircraft types for different markets, thus incurring a higher need to form sub-fleets with higher average stand-by requirements per aircraft, for example for maintenance). In addition, asset costs at Norwegian can also be distributed among significantly more seats per aircraft.

Emerging carriers have sustainable cost advantages due to the nature of their business model. Lower other operating costs, charter/leasing/depreciation costs, airport expenses, and (a share of the) lower staff costs are sustainable cost advantages over legacy and often also leisure carriers that will likely continue to prevail. Fuel and MRO cost advantages will (at least partly) diminish over time, apart from the advantage obtained through a higher seat density. Particularly Norwegian's increasing share of long-haul ASKs will likely further widen the unit cost gap to both legacy hub and leisure carriers.

> *Insight 4: In this case study, unit cost advantages of no-frills point-to-point airlines could be observed across all cost items, of which a significant share seems to be sustainable. Highest savings are obtained in overhead and complexity management as well as staff costs.*

8 Conclusion

Previous studies on long-haul LCCs do not agree on either business model characteristics or level and sustainability of cost advantages. Thus, the aim of this paper was to provide clarity regarding the defining business model characteristics and cost advantages of emerging long-haul LCCs, with a focus on the liberalized transatlantic market.

We were able to validate our first hypothesis that the business model of the emerging long-haul LCCs is significantly different from existing legacy hub and leisure carriers and that these airlines form their own cluster. The key differences lie in the focus on a decentral point-to-point model while leveraging low-complexity and non-discounted feeder traffic at existing short-haul bases. Compared to leisure carriers, target customers are not only leisure and VFR, but also business passengers. A strong focus on cost can further be observed, particularly through low complexity operations, homogeneous and efficient long-haul fleets, de-bundled services, and utilization of secondary airports. Based on our findings, we named this model the long-haul no frills point-to-point carrier. On a cluster mean, no frills point-to-point carriers operate at 30-34% lower costs than legacy hub or leisure carriers, respectively, thus validating our second hypothesis.

There are two key aspects that this study did not answer but will need additional focus. First, revenue differences on a long-haul flight leg operated by a legacy hub carrier vs. a no frills point-to-point carrier were not studied. Legacy hub carriers often transport >50% of connecting passengers on a long-haul flight. As a result, ticket revenues are split between different flight legs. A study that compares actually accrued revenues on long-haul flights of carriers with different business models could provide further insights into the reach and limitations of a long-haul point-to-point business model. Second, due to the absence of large volumes of transfer passengers, the point-to-point business model might be restricted to thick markets. A thorough demand analysis building on the findings of Wilken et al. (2016) to identify the potential and limitations for these carriers could be enlightening, particularly with the market entrance of small and efficient long-haul aircraft such as the Airbus A321neoLR, i.e., long-range, from 2019.

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A Tables

Table A.1: Allocation of elements from airline-specific business model frameworks to industry-unspecific elements and components

Industry-unspecific		*Airline-specific*		
Components from Wirtz et al. (2016)	**Elements from Wirtz et al. (2016)**	**Elements from Daft and Albers (2015)**	**Elements from Mason and Morrison (2008)**	**Elements in this study**
Strategy	Strategic positions and development paths, value propositions	Type of air product, Geographical focus, input factor policy, business policy	Profitability index, Connectivity	Type of air product, geographic focus
Resources	(Core) competencies, (core) assets	Fleet structure, human capital, property capital	Aircraft productivity, Labor productivity	Fleet structure
Cooperation	Networks, partnerships	Inter-organizational relationships	**N/A**	Inter-organizational relationships
Customer	Customer relationships/ target groups, channel configuration	Target product-market combination, Distribution, Advertising	Distribution/sales, Airport attractiveness	Target product-market combination, Distribution
Market offer	Competitors, market structure, value offering	Cabin product, ground product	Market structure, convenience, comfort	Service product
Revenue	Revenue streams, revenue differentiation	Fare structure	Revenue achievement	Fare structure
Manufacturing	Manufacturing/ operations, value generation	Route network	**N/A**	Route network
Procurement	Resource acquisition, information	Supply management	**N/A**	Supply management
Financial	Financing, capital allocation, cost structure	Finance management, infrastructure	Cost drivers	*Excluded*

Table A.2: Operational data from LH, DY as used in the case study

	Cluster 1 Lufthansa (LH)[1]	Cluster 3 Norwegian (DY)
General operating characteristics		
Total ASK (M)	186,836	45,292
Mean stage-length (km)	2,234	1,451
Load factor (%)	80.3	86.2
Passengers transported (M)	61.5	25.8
Fuel consumption (l/100 ASK)	3.19	2.63
Block hours (wide-body) / a/c / d	12.98	16.56
Long-haul fleet age (years)	11.1	3.9
Total employees	35,517	4,576
Unit operating revenue[2] per ASK		
Total operating revenue (US$c/ASK)	9.25	4.67
Unit operating costs[2] per ASK		
Fuel (US$c)	1.81	1.08
Airport / ATC / Handling (US$c)	1.73	1.10
Staff[3](US$c)	1.58	0.71
A/C ownership (US$c)	0.96	0.69
MRO (US$c)	0.89	0.36
Other OPEX (US$c)	1.88	0.56
Unit operating cost - total (US$c)	8.84	4.50
Operating margin[4](%)	4.4	3.7

[1] LH main-line only, excl. other group airlines and Eurowings
[2] Stage-length adjusted
[3] Including external employee cost and all benefits
[4] Including all costs as listed. Income/gains from foreign currency translation and other and non-operating losses/gains are excluded
Sources: 2015 annual reports; Diio LLC (2016)

B Figures

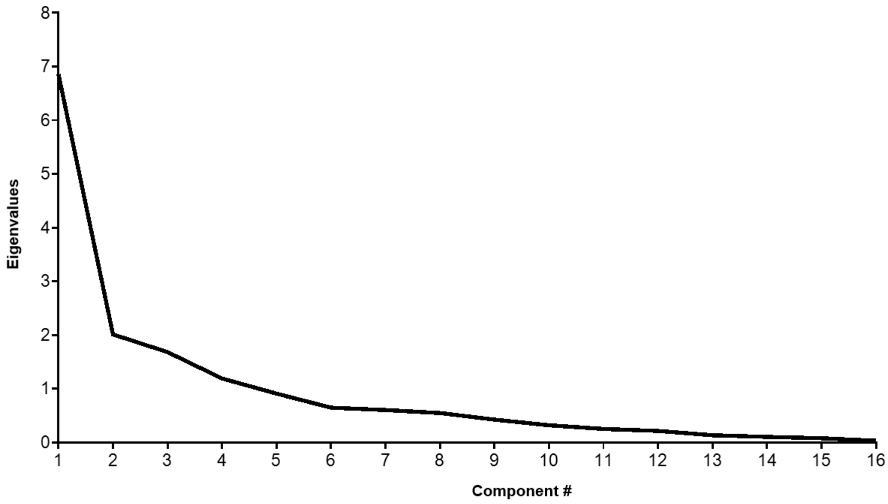

Figure B.1: Principal component analysis: Scree plot of Eigenvalues

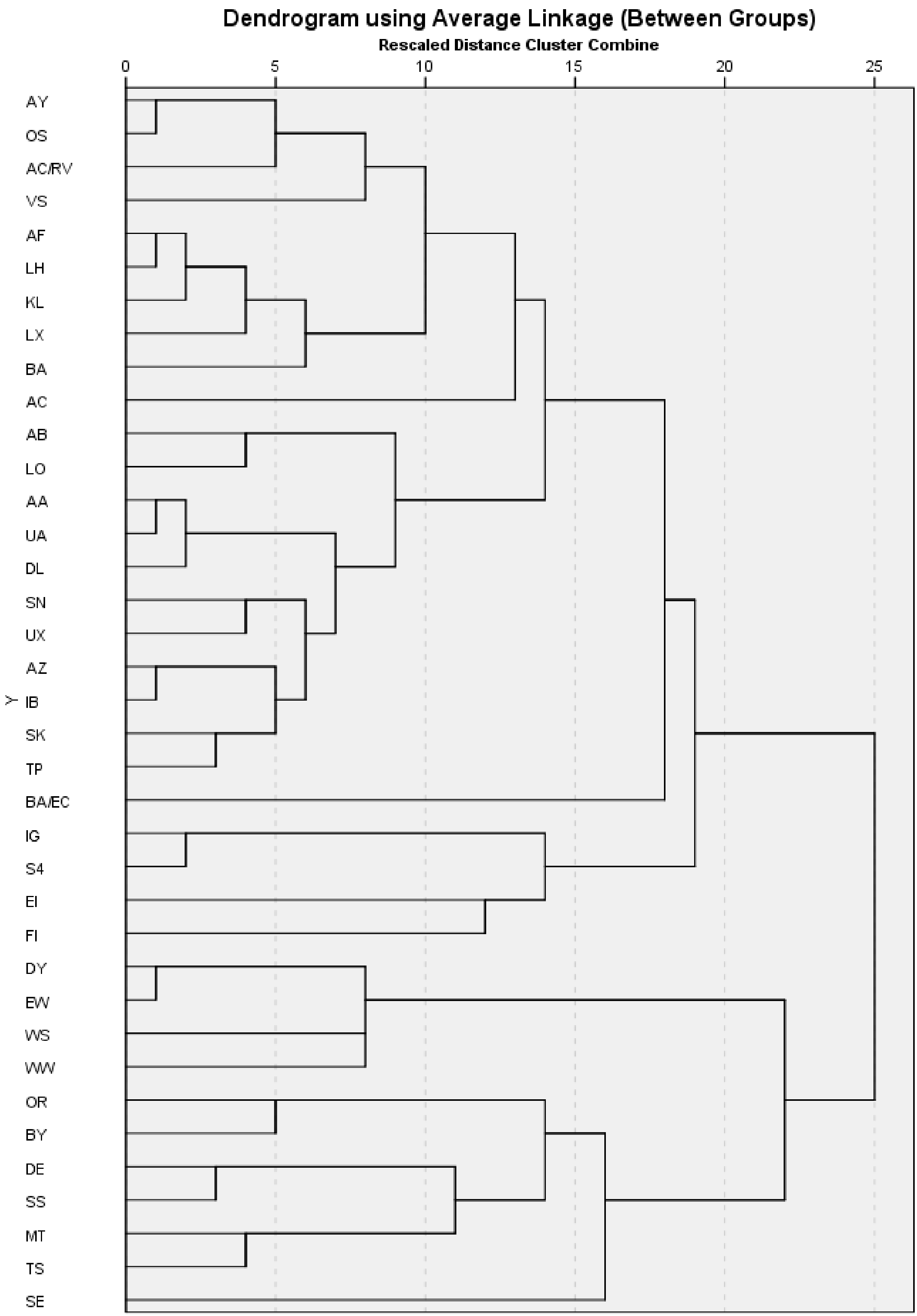

Figure B.2: Hierarchical cluster analysis: Results of cluster analysis shown in dendogram

References

Brons, M., Givoni, M., and Rietveld, P. (2009). Access to railway stations and its potential in increasing rail use. *Transportation Research Part A: Policy and Practice*, 43(2):136–149.

Cabral, A. M. R. and Ramos, F. d. S. (2014). Cluster analysis of the competitiveness of container ports in Brazil. *Transportation Research Part A: Policy and Practice*, 69:423–431.

Cho, W., Windle, R. J., and Dresner, M. E. (2015). The impact of low-cost carriers on airport choice in the US: A case study of the Washington–Baltimore region. *Transportation Research Part E: Logistics and Transportation Review*, 81:141–157.

Corbo, L. (2016). In search of business model configurations that work: Lessons from the hybridization of Air Berlin and JetBlue. *Journal of Air Transport Management*, In press.

Daft, J. and Albers, S. (2012). A profitability analysis of low-cost long-haul flight operations. *Journal of Air Transport Management*, 19(1):49–54.

Daft, J. and Albers, S. (2013). A conceptual framework for measuring airline business model convergence. *Journal of Air Transport Management*, 28:47–54.

Daft, J. and Albers, S. (2015). An empirical analysis of airline business model convergence. *Journal of Air Transport Management*, 46:3–11.

De Poret, M., O'Connell, J. F., and Warnock-Smith, D. (2015). The economic viability of long-haul low cost operations: Evidence from the transatlantic market. *Journal of Air Transport Management*, 42:272–281.

de Wit, J. G. and Zuidberg, J. (2012). The growth limits of the low cost carrier model. *Journal of Air Transport Management*, 21:17–23.

Diio LLC (2016). Diio Mi - Market Intelligence for the Aviation Industry.

Douglas, I. (2010). Long-haul market entry by value-based airlines: Dual business models support product innovation. *World Review of Intermodal Transportation Research*, 3(3):202–214.

Eurocontrol (2005). Glossary for Flight Statistics & Forecasts. Technical report, European Organization for the Safety of Air Navigation (EUROCONTROL).

Fageda, X., Suau-Sanchez, P., and Mason, K. J. (2015). The evolving low-cost business model: Network implications of fare bundling and connecting flights in Europe. *Journal of Air Transport Management*, 42:289–296.

Francis, G., Dennis, N., Ison, S., and Humphreys, I. (2007). The transferability of the low-cost model to long-haul airline operations. *Tourism Management*, 28(2):391–398.

Fu, X., Dresner, M., and Oum, T. H. (2011). Effects of transport service differentiation in the US domestic airline market. *Transportation Research Part E: Logistics and Transportation Review*, 47(3):297–305.

Fu, X., Lei, Z., Wang, K., and Yan, J. (2015). Low cost carrier competition and route entry in an emerging but regulated aviation market – The case of China. *Transportation Research Part A: Policy and Practice*, 79:3–16.

Hansen, M. M., Gillen, D., and Djafarian-Tehrani, R. (2000). Aviation infrastructure performance and airline cost: A statistical cost estimation approach. *Transportation Research Part E: Logistics and Transportation Review*, 37(1):1–23.

Jean, D. A. and 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.

Jolliffe, I. T. (2002). *Principal Component Analysis*. Springer, 2nd edition.

Lohmann, G. and Koo, T. T. R. (2013). The airline business model spectrum. *Journal of Air Transport Management*, 31:7–9.

Maertens, S. (2015). The new Eurowings flights from Germany. *German Aerospace Center - Institute for Air Transport and Airport Research*, page Working Paper.

Mason, K. J. and Morrison, W. G. (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.

Moreira, M. E., O'Connell, J. F., and Williams, G. (2011). The Viability of Long-Haul, Low Cost Business Models. *Journal of Air Transport Studies*, 2(1):69–91.

Morrell, P. (2008). Can long-haul low-cost airlines be successful? *Research in Transportation Economics*, 24(1):61–67.

Pels, E. (2008). Airline network competition: Full-service airlines, low-cost airlines and long-haul markets. *Research in Transportation Economics*, 24(1):68–74.

Pereira, B. A. and Caetano, M. (2015). A conceptual business model framework applied to air transport. *Journal of Air Transport Management*, 44-45:70–76.

Sarkis, J. and Talluri, S. (2004). Performance based clustering for benchmarking of US airports. *Transportation Research Part A: Policy and Practice*, 38(5):329–346.

Swan, W. M. and Adler, N. (2006). Aircraft trip cost parameters: A function of stage length and seat capacity. *Transportation Research Part E: Logistics and Transportation Review*, 42(2):105–115.

Swelbar, W. S. and Belobaba, P. P. (2016). Airline Data Project.

Tretheway, M. W. (2004). Distortions of airline revenues: why the network airline business model is broken. *Journal of Air Transport Management*, 10(1):3–14.

Wensveen, J. G. and Leick, R. (2009). The long-haul low-cost carrier: A unique business model. *Journal of Air Transport Management*, 15(3):127–133.

Whyte, R. and Lohmann, G. (2015). Low-cost long-haul carriers: A hypothetical analysis of a 'Kangaroo route'. *Case Studies on Transport Policy*, 3(2):159–165.

Wilken, D., Berster, P., and Gelhausen, M. C. (2016). Analysis of demand structures on intercontinental routes to and from Europe with a view to identifying potential for new low-cost services. *Journal of Air Transport Management*.

Wirtz, B. W., Pistoia, A., Ullrich, S., and Göttel, V. (2016). Business Models: Origin, Development and Future Research Perspectives. *Long Range Planning*, 49(1):36–54.

Wittmer, A., Bieger, T., and Müller, R. (2011). *Aviation Systems: Management of the Integrated Aviation Value Chain*. Springer, 1st edition.