The effect of ultra-low cost carrier market presence on the market fare of a network legacy carrier and the difference with low-cost carrier market presence

Master thesis

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Abstract

Low-cost carrier (LCC) market growth has been a great competitive driver in the U.S. airline industry over the past decades. However, indications of a stagnation in LCC growth are appearing. Several studies have pointed to the rise of a new type of carrier, the ultra-low cost carrier (ULCC). This raises the question whether ULCCs can become a new driver of competition in the U.S. domestic airline industry. This study examines the effect of ULCC market presence on the market fare of a network legacy carrier (NLC) and examines whether this effect is different from LCC market presence. In addition, the possible moderating effect of total ULCC market share is studied. This is researched using a panel data set containing 51,022 unique observations over the period of 2006 to 2015. The findings show that both ULCC market presence and LCC market presence are found to be a significantly negatively related to the market price of the NLC. Both relationships are of rather similar magnitude. Therefore, no evidence is found that ULCC market presence is related to larger reductions in the NLC market fare than LCC market presence. Additionally, no evidence was found for a moderating effect of market share. This means that there is no support to conclude that ULCC market presence with a large market share is related to larger reductions in the NLC market fare than ULCC market presence with a small market share. The findings provide an indication of a price pressing effect of ULCC market presence on NLC market fares, which could indicate that ULCCs could be a new competitive driver in the U.S. airline industry.

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1. Introduction

After the deregulation of the U.S. airline industry in 1978, a new type of carrier emerged, the low-cost carrier (LCC). This type of carrier offered lower airfares than a traditional network legacy carrier (NLC). LCCs have increased competition over the past decades by entering many new markets with lower airfares. Hüschelrath and Müller (2013) have even stated that "the existence and expansion of low-cost carriers must be considered as the main driver of competition in the domestic U.S. airline industry". However, recent studies have pointed to a stagnation in the growth of LCCs. Several studies (Wittman and Swelbar, 2013; Rosenstein, 2013 and Bachwich and Wittman, 2017) pointed to the emergence of a new type of carrier, the ultra-low cost carrier (ULCC). The ULCC distincts itself from the LCC through its extremely low base fares and its larger amount of ancillary revenues. This raises the question whether ULCCs are a new driver of competition in the U.S. airline industry.

As this is a relatively new development, not much has been written about the ULCC phenomenon in the literature. Wittman and Swelbar (2013) and Rosenstein (2013) both argued that the ULCC business model is different from that of a LCC, but did not test this econometrically. The study by Bachwich and Wittman (2017) is the only study so far that has econometrically studied the difference between LCCs and ULCCs. They have examined the effect of ULCC and LCC market presence as well as market entry on average market fares on a yearly level for the period of 2010 to 2015. Their study showed that ULCC market presence was associated with significantly larger decreases in the average market fare than LCC market presence. However, no significant difference was found between ULCC market entry and LCC market entry. They argue that this latter result could possibly be caused by the lack of market share of the ULCC when entering a new market, yet, no empirical evidence for this explanation was provided. Additional research regarding the ULCC phenomenon is very important, as the growth of ULCCs could potentially lead to reductions in not only the average market fare, but also to reductions in the airfare of other carriers. The emergence of the ULCC is likely to affect the competition in the market. It is therefore of great importance for policy makers as well as other stakeholders to get better insight into the effects of ULCC market growth. More knowledge on the effects of ULCC market presence could, for example, inform market authorities on whether they should stimulate ULCC market entries to increase competition in the market.

This study will build on the previous findings of Bachwich and Wittman (2017) by studying the effect of ULCC market presence on NLC airfares to examine whether NLCs will lower their market fare as a result of ULCC market presence. This would then indicate the competition increasing effect of ULCC market presence and could suggest the rise of a new competitive driver. Moreover, it is investigated whether the effect of ULCC market presence on NLC airfares is different from that of LCC market presence. The study by Bachwich and Wittman (2017) also argued that the relationship between ULCC market entry and the average airfare was possibly moderated by the market share of the ULCC. Yet, they have not econometrically studied the possible moderating effect of market share. This is another issue that this thesis will focus on. Both a fixed effects model and an

instrumental variables estimation will be used to study the phenomenon over a longer period (2006-2015) and at a quarterly level. The research question is: what is the effect of ULCC market presence on NLC market fares and is this effect different from the effect of LCC market presence on NLC market fares?

The first hypothesis states that ULCC market presence will lead to a reduction in NLC market fare. The reason for this expectation is that market presence of an ULCC that has much lower airfares than the NLC will force the NLC reduce its price to remain competitive in that market. The second hypothesis states that ULCC market presence leads to larger reductions in the NLC market fare than LCC market presence. As an ULCC is present in the market with a lower price than a LCC, the NLC should reduce its market fare with a larger portion to remain competitive in the market. Moreover, Bachwich and Wittman (2017) argued that increases in ULCC market share could potentially lead to larger decreases in the NLC airfare. The rationale behind this is that ULCCs with a larger market share have more market power and are therefore a larger threat to the NLC. The NLC therefore behaves more aggressively to maintain its market share by making larger reductions in its market fare. The third hypothesis therefore states that market presence of a ULCC with a large market share leads to larger decreases in the market fare of a NLC than market presence of a ULCC with a small market share.

The findings show that both ULCC market presence and LCC market presence are found to be significantly negatively related to the market price of the NLC. However, no evidence is found that ULCC market presence is related to larger reductions in the NLC market fare than LCC market presence. Additionally, there is found to be no evidence for a moderating effect of ULCC market share, meaning that ULCC market presence with a large market share is not related to larger reductions in the NLC market fare than ULCC market presence with a small market share. In short, the finding of the negative relationship between ULCC market presence and NLC market fares could indicate a potential competition increasing effect of ULCC market presence. This could then indicate that ULCCs could be a new driver of competition in the U.S. airline industry. However, more research is needed to show whether the reductions in the NLC fare are the result of ULCC market presence and whether one could therefore speak of a causal effect.

This paper is structured as follows. Section 2 provides an overview of the literature related to the effect of LCC and ULCC market entry/presence on airfares and the moderating effect of market share. Section 3 further substantiates the hypotheses of this study. Section 4 describes the data sources used in this study and provides the descriptive statistics. The methodology used is explained in section 5. Section 6 provides and discusses the results. Finally, section 7 provides the conclusion and section 8 will describe the limitations of the research and provides recommendations for further research. A broader description of the data sample construction and the instruments used, as well as a correlation matrix of the variables used in this study can be found in the appendix.

2. Literature Review

This section is divided into five subsections. The first subsection provides the context of the U.S. airline industry by giving a short description of the history and its developments. The second subsection gives an overview of the literature on the effect of LCC market entry on airfares. The third subsection elaborates on the potential stagnation in LCC growth and the fourth subsection describes the ULCC phenomenon. The last subsection gives an overview of the literature related to the moderating effect of market share.

2.1 Context

To better understand the ULCC phenomenon, it is important to know the history of the U.S. commercial airline industry and the developments since the deregulation of the market. Up to 1976, the U.S. airline industry was mainly regulated by the government. However, from 1976 onwards, the Civil Aeronautics Board (CAB) started to move slowly towards deregulation of the market. The Air Deregulation Act was passed by the CAB in 1978, which set out a plan for step-by-step deregulation of the market. The period preceding the deregulation was characterized by many new market entries and falling prices.

The deregulation of the market has led to three developments: the rise in hub-and-spoke operations, the introduction of price-based competition and the rise of low-cost carriers. Many large airlines started to operate from one or more hubs at which many of their long-haul passengers changed plane after which they continued their journey. This hub-and-spoke strategy has, on the one hand, increased the efficiency of the airline's operations by, for example, allowing carriers to fill a higher proportion of their seats on a flight and has enhanced the effectiveness of marketing devices. On the other hand, it increased the congestion at large hubs (Borenstein, 1992). In the period of market regulation all prices were fixed and carriers were therefore only able to compete on quality. After deregulation of the market, carriers were all able to offer different prices and this led to competition becoming based on a mixture between price and quality. This led to certain carriers pursuing a strategy with high-quality service in combination with high prices, whereas other carriers were pursuing a low-cost low-quality strategy. This resulted in multiple price segments in the same market and has also led the rise of the LCC. A LCC can offer lower airfares than a NLC on the same route through its lower unit costs. During the pre-regulated era, Pacific Southwest Airlines and Southwest Airlines were already operating the LCC business model at intra-state routes, as these were not fare-regulated. After 1978, Southwest Airlines expanded their business model and included inter-state routes. By the time of 1990, Southwest was by far the largest LCC in the national market. From 1990 onwards, the combined market share of LCCs steadily increased over time. While LCCs accounted for 7% of the U.S. domestic passenger traffic in 1990, by 2002 they accounted for 23.7% of the domestic passenger traffic (Ito & Lee, 2003a).

NLCs reacted to the increasing number of LCCs entering their hubs by lowering their prices and starting their own low-cost subsidiaries. Each time a LCC started a new flight from a NLC hub, the NLC decreased its price to the level of the LCC and increased its flight frequencies or plane size (Oster Jr. & Strong, 2001). This finding is in accordance with the study performed by the

Transportation Research Board (1999). After studying twelve occasions in which a LCC entered at a NLC hub, they found that NLCs responded by reducing their airfares by 62% on average and increasing their capacity by 13% on these routes. This phenomenon has been called the "Southwest Effect" and is named after Southwest Airlines, which was the first large LCC (Windle & Dresner, 1995). Another strategy adopted by NLCs was to start their own low-cost carrier subsidiary. Like the LCCs, these subsidiaries had a standardized fleet type, flew to secondary airports and flew point-to-point. They flew especially on the routes where the NLC was most vulnerable for LCC market entry and avoided dominant hubs to minimize negative impact on the NLCs market power (Oster Jr. & Strong, 2001). Yet, these subsidiaries were not always successful. Pearson and Merkert (2014) studied the success of the subsidiaries, also known as airlines-within-airlines (AWAs). They found that AWAs had limited success, as only about 40% of the AWAs survived and after more than 20 years of AWAs, they are currently no longer present in the U.S. market.

2.2 The effect of LCC market entry on airfares

As mentioned earlier, LCC market entry has had great impact on airfares and this has widely been discussed in the literature. A distinction can be made within this field of research. Part of the studies focused on the effect of LCC market entry on the average market fare, whereas others focused on the effect of LCC market entry on the market fare of incumbents.

2.2.1 The effect on the average market fare

Joskow, Werden and Johnson (1994) studied the effect of LCC market entry on the average market fare and passenger traffic in 1986. They found that LCC market entry reduced the average airfare on a route by 9.2% and increased passenger traffic by 56-66%. In case the LCC would leave the market again, airfares would increase by 10.6% and passenger traffic would decrease again by 2.5-13%. A similar study was performed by Windle and Dresner (1995) who also studied the effect of LCC market entry on average airfares and passenger traffic on a route, but this time focussing specifically on Southwest Airlines in the period of 1991-1994. The results showed a similar relationship, but this time magnitude was much larger. They found that Southwest Airlines' market entry led to a 48% reduction in average market fare and 200% increase in passenger traffic. This difference in magnitude can partially be explained by the study of Vowles (2000), who studied the difference in effect between Southwest Airlines and other LCCs. The research showed that market entry by Southwest in the period 1996-1997 led to a $77.61 decrease in the average market fare, whereas market entry by other LCCs led to a decrease in the average market fare of $45.47. It can therefore be concluded that different LCCs can have different effects on price. Contrary to the studies that focused on the average fare on a route, Abda, Belobaba and Swelbar (2012) studied the impact of LCCs on the average fare at U.S. airports in the period of 1996-2009. Their research led to two findings. Firstly, airports with substantial LCC growth had significantly lower average fares than airports without substantial LCC growth. Secondly, airports with effective LCC entry were found to have significantly lower average airfares than airports without substantial LCC entry. Also, the market structure is of influence on the entry effect of an LCC. Hüschelrath and Müller (2013) studied LCC and NLC market entry in three types of markets, namely monopolies, oligopolies and oligopolies in which another LCC was already present. The results regarding LCC market entry

showed that LCC market entry has a larger effect on price in a monopoly market than it has in an oligopoly market. Furthermore, they found that entry into an oligopoly market in which another LCC was already present did not lead to significant decreases in airfare. Brueckner, Lee and Singer (2013) studied the effect of adjacent LCC competition in a market on the average market fare. The study showed that LCC market entry can lead to decreases in average market fare up to 33% and adjacent LCC market entry can lead to decreases in average market fare up to 20%. Additionally, they found that the market entry by Southwest airlines had more effect on price than other LCCs. Overall, what becomes clear is that the effect of LCC market entry on average market fare has been studied with many different approaches and all come to the same conclusion that LCC market entry leads to lower average prices on a route.

2.2.2 The effect on the airfare of incumbents

However, one could argue that it is a rather obvious finding that the average market fare will decrease when a carrier with a lower price enters the market. Another part of the literature therefore focused on the effect of LCC market entry on the price of incumbents, as it could also be the case that a large part of the decrease in average market fare is the result of incumbents reducing their price. This could then be a NLC incumbent reducing its price or a LCC incumbent reducing its price.

Most of the literature focused on the effect of LCC market entry on the market fare of NLC incumbents. One of the older studies that focused on this topic was a study by Whinston and Collins (1992). They studied the effect of market entry by People Express, a low-cost carrier, on the price of incumbents. The results showed that the airfare of incumbents dropped by about 35% after People Express entered the market, whereas no changes in price occurred in markets that were not entered by People Express. Furthermore, the incumbents reduced their airfare, but did not align their price to that of People Express. The average price of People Express remained about 19% below that of incumbents. This is in contrast with the more recent paper by Ito and Lee (2003b), who analysed the price responses of NLCs to LCC route entry between 1991 and 2002. They found that incumbents often align their airfare to that of the LCC but do not under-price the LCC. Daraban and Fournier (2008) have also examined LCC market entries between 1993 and 2006, but are one of the few that have also investigated the effect of LCC market exit on price. Their study showed that NLC prices decreased with about 20% after the LCC entered the market. However, as soon as the LCC left the market, airfares would rise again with 10%. Not only the actual entry and exit can influence prices, also the threat of entering a market is found to affect airfares. Goolsbee and Syverson (2008) studied this topic during roughly the same period as Daraban and Fournier (2008) and found that threatening to enter a market already leads to a reduction in the price of incumbents and that this already constitutes for more than half of the reduction in price in case of actual entry. When focussing on the airfares for business travellers and leisure travellers, Alderighi, Cento, Nijkamp, and Rietveld (2012) found that in case of LCC market entry, airfares for business travellers and leisure travellers are reduced quite uniformly by the NLC.

Next to the studies that focused on the price responses of NLC incumbents, there is some research that focussed on the price responses of LCC incumbents. Malighetti, Stefano and Redondi (2013)

have studied EasyJet's airfare response to new entrants in the market in the period of 2007 to 2009. They found that EasyJet's airfares decreased by about 3% after another LCC entered on their route. Furthermore, they argue that EasyJet reacts more forceful in markets that they serve more densely. Tan (2016) argues that LCCs might respond differently to market entry by another LCC, but that there are currently too little observations to provide an extensive answer.

2.3 Stagnation of the LCC

So far, there is extensive evidence of the competition increasing impact of LCC market entry over the past decades, but there are several studies that point to a stagnation of the LCC phenomenon. The rise of LCCs and their continuous expansion to new markets has stimulated the market by reducing airfares and expanding passenger volumes. Nonetheless, a study by Abda, Belobaba and Swelbar (2012) suggests that an end is coming to this continuous growth of LCCs. Their study focused on the U.S. domestic market in the period of 1990 to 2008. Even though they found evidence for the trend of lower airfares and higher passengers over the entire period, they also argued that there are several indicators that this trend will not sustain. Whereas, the number LCCs per airport increased from 0.5 in 1990 to 2.8 in 2005, after 2005 this number started to decrease again. They also argue that LCCs not only compete against NLCs, but also against other LCCs. De Wit and Zuidberg (2012) provide a similar argument for the stagnation of LCCs. They argue that the enormous growth in LCCs has led to route density problems as the market got more and more saturated. Carriers are trying to solve this problem by adjusting route frequencies, using specific airport categories, choosing routes with less price-sensitive demand and focussing on obtaining additional ancillary revenues. Another trend is the rise of hybrid carriers, these are carriers that show characteristics of both the NLC and LCC. Klophaus, Conrady and Fichert (2012) have examined the business models of 20 low-cost carriers in Europe. The characteristics of each carrier were compared to the criteria for the LCC and NLC business model. The results revealed that a large part of the carriers developed into hybrid carriers, because they showed characteristics of both LCCs and NLCs. Tsoukalas, Belobaba and Swelbar (2008) and Jiang (2014) investigated the unit costs (excluding fuel and transport-related expenses) of LCCs and NLCs and found that these costs are converging. An explanation for this finding is that NLCs have focused on regaining their profitability by cutting costs, whereas LCCs have experienced increased labour costs. However, still a gap between the two business models exists and this is mainly driven by the non-labour costs.

2.4 The ultra-low cost carrier

Despite the potential stagnation of LCCs, several studies have drawn attention to the rise of a new type of carrier, the ultra-low cost carrier (ULCC). Wittman and Swelbar (2013) have examined whether the famous 'Southwest effect' still exists. They found that in 2007 the presence of Southwest Airlines at an airport resulted in a decrease in the airport's average one-way airfare of $36 (controlled for average route distance and other low-cost carrier competition), in 2012 this decreased to $17. One can therefore say that the Southwest effect still exists, but has diminished over time. Their study also showed that other LCCs have outperformed Southwest Airlines. Airport presence of JetBlue, Allegiant and Spirit led to decreases in the average one-way airfare of $32, $29 and $22, respectively. They argue that Spirit and Allegiant have chosen to pursue a different business

model, the so called “ultra-low cost carrier” model by offering extremely low base fares and making additional revenue through ancillary sources. The rationale behind this business model is that potential passengers only look at base fares when buying their ticket. This business model is different from that of JetBlue, which does not charge for baggage check-ins, on-board drinks and food and other amenities (Wittman & Swelbar, 2013). This is confirmed by Rosenstein (2013), who performed a case study on Spirit’s business model and also concluded that its business model has diverged from the standard LCC business model. The emergence of the ULCC business model in the U.S. market has been studied by Bachwich and Wittman (2017). They have examined whether the LCC and ULCC business model are significantly different from each other in the period of 2010 to 2015 with two different approaches. The first approach was to study the effect of LCC and ULCC market presence on the average market fare, where market presence was defined as the LCC or ULCC being present in the market with at least 5% of total passengers in the origin-destination market in a certain year. The results of their study showed that ULCC market presence was associated with an average market fare reduction of 21%, whereas LCC market presence was only associated with an 8% market fare reduction. Therefore, a significant difference between ULCC and LCC market presence has been found. The second approach was to study the effect of LCC and ULCC market entry on the average market fare. Market entry was then defined as the introduction of at least 10 annual nonstop frequencies in year. They found that both LCC and ULCC market entry were associated with a reduction of 14% in average airfare and thus that there is no significant difference between the two types of carriers regarding market entry. They argue that a potential reason for this result is that ULCCs lack enough capacity to affect the average market fare when entering a market. This would suggest that the market share of the ULCC could play a moderating role in the effect of market entry and possibly also the effect of market presence on airfare. Yet, this has not been studied econometrically.

According to Rosenstein (2013) and Wittman and Swelbar (2013), the ULCC business model differs from that of a LCC through its lower base fares and its larger amount of ancillary revenues. ULCCs still keep a large part of the LCC business strategy by: flying point-to-point, offering only one class, high-density seating, no free meals and drinks, no seat assignments, single type aircraft use, mainly flights to secondary or uncongested airports and minimal use of travel agents (Rosenstein, 2013). Yet, ULCC differ themselves from LCCs through completely unbundled fares and additional fees. This is confirmed by Fallert (2012) who argued that to be able to offer lower ticket fares, carriers started to unbundle their tickets. Fallert (2012) also provided several reasons why carriers started to unbundle their airfares. Firstly, the rise of internet search engines has increased the transparency of airline pricing. The face value of the ticket has become the main driver for ticket purchases. Secondly, oil and jet fuel prices remained high and impact the profitability of the airline on a daily basis. Thirdly, unbundled fares are promoted as an advantage for the customer, as they will only pay for the services used. This is sometimes also referred to as the à la carte method. Fourthly, unbundling is promoted as increasing the transparency of prices. Fifthly, ancillary fees are a major revenue driver through its high margins. Bachwich and Wittman (2017) have proposed a new definition for ULCCs that consists of three criteria. Firstly, ULCCs have significantly lower unit costs than the typical LCC. Secondly, a significantly larger part of the revenue is made through

ancillary sources. Thirdly, notwithstanding the additional revenues, ULCCs have lower total unit revenue. According to their criteria, three ULCCs are identified in the U.S. market, Spirit Airlines, Frontier Airlines and Allegiant Air.

2.5 The moderating effect of market share

When reviewing the literature on the relationship between market share and pricing it becomes clear that almost all studies focus on the price increasing effect of NLC market share, whereas very little to no attention has been paid to the effect of LCC or ULCC market share on the price of the NLC. One of the older studies that focussed on the relationship between the market share of a NLC and its airfare is the study by Borenstein (1989). His research found that a carrier's market share on a route and its market share at the endpoint airport are related to its ability to increase its airfare. He showed that a 1% increase in NLC market share led to a 0.03-0.22% increase in NLC airfare. Furthermore, a dominant carrier with a market share on a route of 70% or more could charge 2-12% higher airfares than its competitors which only had a 10% market share. A later study by Vowles (2000) confirmed the finding that carriers are able to raise their airfare as their dominance increases. The study found that as the market share of the largest shareholder in the market increases by 1%, the average price in the market will increase by 43 cents. Very few studies have paid attention to the moderating effect of LCC or ULCC market share on their pricing power when entering a new route. The United States Department of Transportation (1996) studied the low-cost competition of Delta Airlines and found that competition from certain low-cost carriers led to larger decreases in airfare than others. Competition from Morris Air on a route led to decreases in Delta's airfare of 33%, whereas competition from ValuJet only slightly changed Delta's fares. The authors attribute this to the fact that ValuJet had a lower market share on those routes than Morris Air had and was therefore viewed as much less of a competitive threat than Morris Air was.

Several studies have examined the effect of LCC market dominance on the NLC fare and have found indications of a price pressing effect of LCC dominance. Hofer, Windle and Dresner (2008) studied the effect of LCC dominance on LCC airfares from 1992 until 2002. Their research confirmed the price pressing effect of LCC dominance. During the whole period, LCCs offered lower airfares in markets in which they were dominantly present. One could therefore say that instead of charging a price premium in their dominant markets, LCCs were found to charge a negative price premium and that these increased over time. The LCC negative price premium increased from -14.7% to -23.7% of the average LCC airfare in 1997 and 2002, respectively. It becomes clear that there is evidence that dominant NLCs often charge a price premium and that LCC dominance could lead to lower airfares. However, the extent of literature that focuses on the effect of LCC market share on their pricing power is limited. Furthermore, no study has econometrically studied the effect of increases in the LCC or ULCC market share on the market price of the NLC.

To conclude, much has been written on the effect of LCC market entry on the average market fare and NLC airfare. However, signs of a stagnation of LCCs have appeared and a new type of carrier, the ULCC, is emerging. Yet, the extent of literature on this topic is very limited. The work of Bachwich and Wittman (2017) is the first that focused on the effect of ULCC market entry and

presence on airfares. They found that both ULCC market entry and ULCC market presence are associated with lower average airfares in the market. Furthermore, they found that the result was significantly different between ULCC market presence and LCC market presence. However, regarding market entry no significant difference was found between LCCs and ULCCs. They argue that this latter result could be caused by the fact that ULCCs lack enough capacity to affect the average market fare when entering a market. However, they have not econometrically studied the moderating effect of market share. When reviewing the literature on LCC market dominance and pricing, it became clear that dominant LCCs often have lower prices. This would imply that the market share of a LCC has a moderating effect and that LCCs with larger market shares have more impact on airfares in the market. This study builds on the work of Bachwich and Wittman (2017). Their study found that ULCC and LCC market presence were related to lower average market fares. However, one could argue that the average market fare automatically drops when a carrier with a lower airfare enters the market. Their finding does therefore not show that ULCC market presence leads to reductions in the airfare of incumbents as a result of increased competition in the market. This study will examine the effect of ULCC and LCC market presence on the market fare of the NLC. LCC and ULCC market presence could increase competition in the market which could lead to NLCs to reducing their market fare. Moreover, this study examines whether the effect of ULCC market presence and LCC market presence on the NLC market fare are different from each other. Additionally, this study econometrically examines the assertion made by Bachwich and Wittman (2017) of the moderating role of LCC or ULCC market share.

3. Hypotheses

This section will further elaborate on the hypotheses mentioned earlier and will substantiate how certain expectations are formed by referring to findings in the literature.

When reviewing the literature, it became clear that no previous study had focused on the effect of ULCC market presence on NLC airfares. Only the study by Bachwich and Wittman (2017) showed that ULCC market presence was associated with a significant reduction in the average market fare. However, the average fare will automatically decrease as a carrier with a lower airfare enters the market. Their finding does therefore not show that ULCC market presence leads to reductions in the airfare of incumbents as a result of increased competition in the market. This study therefore focusses on the effect of ULCC market presence on the market fare of the NLC. To form expectations about the effect of ULCC market presence on NLC fares, it is useful to examine the effect of LCC market presence/entry on NLC fares, because the emergence of ULCCs shows similarities with the emergence of LCCs. Both phenomena entail the market entry of a new type of carrier with much lower airfares than current market prices and both phenomena lead to large reductions in the average market fare. There is literature available on the effect of LCC market presence on NLC airfares. The studies by Whinston and Collins (1992), Ito and Lee (2003b), Daraban and Fournier (2008), Goolsbee and Syverson (2008), Alderighi, Cento, Nijkamp, and Rietveld (2012) all showed the price reductions made by a NLC after LCC market entry. These findings helped to form expectations on the effect of ULCC market presence on NLC prices. The expectation is therefore that ULCC market presence will also lead to reductions in the NLC market fare.

Hypothesis 1a: ULCC market presence leads to a reduction in the NLC airfare on a route.

Regarding the difference in effect between LCC and ULCC market presence, the study by Bachwich and Wittman (2017) showed that ULCC market presence was associated with significantly larger decreases in the average market fare than LCC market presence. No study has yet examined the difference between ULCC and LCC market entry/presence on NLC airfares. When reviewing the literature, it became clear that the NLC and LCC business model are converging and the gap between their airfares is tightening (Klophaus, Conrady and Fichert, 2012; Tsoukalas, Belobaba and Swelbar, 2008 and Jiang, 2014). As ULCCs offer lower airfares than LCCs, the price gap between ULCCs and NLCs is larger than the price gap between LCCs and NLCs. It is therefore expected that a NLC must make larger airfare reductions to stay competitive when it concerns a ULCC market entry than when it concerns a LCC market entry.

Hypothesis 1b: ULCC market presence leads to a larger reduction in the NLC market fare than LCC market presence.

The study of Bachwich and Wittman (2017) showed that LCC market presence was associated with larger reductions in the NLC market fare than LCC market presence. However, no differences were found between the effect of LCC market entry and ULCC market entry on the NLC market fare. They argued that the similar effect of LCC and ULCC market entry could potentially be caused by

the fact that ULCCs lack sufficient market power when entering a new market. This would suggest the existence of a moderating role of the market share of the LCC or ULCC. The literature has focused mainly on the market dominance of the NLC, whereas very little to no attention has been paid to the effect of the LCC or ULCC market share on the pricing power of the NLC. The overall finding regarding NLC dominance is that NLCs increase their airfare as their dominance increases (Borenstein, 1989 and Vowles, 2000). Furthermore, there are two studies that found indications of a potential moderating effect of LCC dominance. The United States Department of Transportation (1996) found an indication that LCC dominance led to larger decreases in the NLC airfare. Hofer, Windle and Dresner (2008) confirmed this with their study on LCC dominance. They found that LCCs offered lower airfares in markets in which they were more dominantly present. Even though their study was not focussed on the effect of LCC market dominance on NLC airfares, the study shows the moderating effect of LCC market share. The studies by the United States Department of Transportation (1996) and Hofer, Windle and Dresner (2008) give an indication that increases in LCC market share can lead to larger decreases in NLC airfare. Regarding ULCC market share, no studies have been performed before. It is therefore assumed that, similar to the indication of increases in LCC market share, increases in ULCC market share lead to larger decreases in NLC market fare. NLCs will probably have to react more aggressively to LCCs or ULCCs with a large market share than to LCCs or ULCCs with only a few flights per quarter to remain their competitiveness on the route.

Hypothesis 2: The market entry of a ULCC with a large market share leads to larger decreases in the market price of a NLC than the entry of a ULCC with a small market share.

4. Data

This section is divided into three subsections. The first subsection will present the data sources used in the study and describe the sample construction. The second subsection will present the carrier classification used and the third subsection will discuss the descriptive statistics.

4.1 Data sources

Multiple data sources are used to construct the data set. The first data source is the Airline Origin and Destination survey (DB1B). This data consists of a 10% sample of all airline tickets of reporting carriers and is collected by the U.S. Bureau of Transportation Statistics. The survey provides many quarterly data such as: airfare, fare class, operating route (origin and destination) and operating carrier for the period of 1993 to 2016. The second data source is the T-100 Domestic Segment data bank, which is also maintained by the U.S. Bureau of Transportation Statistics. It provided domestic non-stop segment data that has been reported by carriers. Data includes additional flight characteristics such as: carrier, aircraft type, load factor, available capacity, flight distance and number of passengers. This concerns monthly data and is also available for the period of 1993 to 2016. The third data source is the U.S. Census Bureau from which the Metropolitan Statistical Areas (MSA) database is used. This database provides the data on population per metropolitan area for the period 2006-2015. This data is only available per year and not per quarter.

To create one complete data set, all three data sets had to be merged into one. This requested several steps. First of all, similar to Goolsbee and Syverson (2008), Gerardi and Shapiro (2009) and Dai et al. (2014), the DB1B data sample is reduced to only domestic, non-stop, coach class and one-way or round-trip tickets. The round-trip tickets are converted to one-way tickets by dividing the round-trip airfare by two and dropping the return journey. This ensures that journeys are not double counted. Secondly, the T-100 and DB1B data had to be converted to the same time unit. Therefore, the T-100 data had to be transformed from monthly to quarterly data. Thirdly, the T-100 data is merged with the data on population per metropolitan area. The population data are only available per year. The four quarters in a year will therefore have the same population value. Fourthly, the extended T-100 data is merged with the DB1B data. Merging DB1B and T-100 also helps excluding connecting tickets in the sample. T-100 does not distinguish between nonstop flights and connecting flights, whereas DB1B does. Merging both data allows to make this distinction and to create a data sample with only nonstop flights. A more extensive description of the sample construction can be found in the appendix of the paper (see appendix A). Fifthly, following the previous literature (Belobaba, Odoni and Barnhart, 2015; Morrison, 2001; Berry and Jia, 2010 and Dai, Liu and Serfes, 2014), this study will define origin and destination on a city-pair basis instead of airport-pair basis. A reason for this approach is that passengers mainly choose to travel to a certain metropolitan area and not to a specific airport. Furthermore, spatial correlation between the origin and destination market will be reduced.

4.2 Carrier classification

Finally, to study the effect of ULCC and LCC market presence on NLC airfares, the carrier had to be classified into three categories: NLCs, LCCs and ULCCs. The U.S. airline categorization from Bachwich and Wittman (2017) is supplemented with carriers used in the study of Brueckner, Lee and Singer (2013) and Hüschelrath and Müller (2013). Bachwich and Wittman (2017) made a selection of 10 major U.S. carriers. These carriers were then classified into the three categories based on unit costs, unit revenues and market fares. The reason for supplementing the classification of Bachwich and Wittman (2017) with additional carriers is to prevent sample selection bias from occurring. Sample selection bias can occur when a subset of data is systematically excluded from the sample and this could influence statistical significance or result in distorted results. In this study, including only the carriers used by Bachwich and Wittman (2017) could, for example, lead to a sample that only contains carriers that are present in a certain kind of markets and could therefore lead to biased results. It is important to note that Midwest ceased its operations in November 2009 and is therefore no longer present in the sample from that period on. Furthermore, Continental Airlines merged with United Airlines and they started reporting their data together from January 2012 on. From this period on Continental Airlines is no longer present in the sample. Similarly, Southwest Airlines and AirTran Airways merged and started reported their data together from January 2015 on. Southwest Airlines is therefore no longer present in the sample from January 2015 on. Dummies are used to indicate whether a carrier is a NLC, LCC or ULCC. The classification is presented in table 1.

Table 1. The classification of the selected carriers

NLCs	LCCs	ULCCs
American Airlines	Alaska Airlines	Allegiant Air
Continental Airlines	AirTran Airways	Frontier Airlines
Delta Air Lines	JetBlue Airways	Spirit Airlines
Midwest Airlines	Southwest Airlines	
Northwest Airlines	Sun Country Airlines	
United Airlines	Virgin America	
US Airways		

4.3 Descriptive statistics

In this study, a three-dimensional panel data set is used. This data set contains 51,022 unique observations on seven NLCs on 1,874 different routes for the period Q1 2006 to Q4 2015. The main summary statistics of the variables employed are presented in table 2.

Table 2. Descriptive statistics of the dependent and independent variables

Variable	Mean	Std. Dev.	Min.	Max.
NLCfare	245.8498	89.09253	10	1507.938
LCCdummy	.4470425	.4971925	0	1
ULCCdummy	.1088942	.3115095	0	1
LCCmshare	.1888547	.2617592	0	.9997652
ULCCmshare	.0333977	.115035	0	.994575
Population	4,839,319	2,964,809	4,093,825	16,693,450

One can see that the mean airfare of a NLC on a route is $245.85. This mean fare is slightly higher than the one found in the study by Dai, Liu and Serfes (2014) who found a mean coach class airfare of $210.60. The higher mean airfare in this study can be explained by the fact that this study does not include the airfares of LCCs and ULCCs, but only includes the airfares of NLCs. As NLCs often have higher prices than LCCs and ULCCs, the average airfare found in this study will be higher than the one found in the study by Dai, Liu and Serfes (2014).

The mean for LCC and ULCC market presence are 0.447 and 0.109, respectively. This tells us that the at least one LCC is present in 44.7% of the observations and at least one ULCC is present in 10.9% of the observations. The rise of the ULCC is a much more recent phenomenon than that of the LCC, this could therefore be a possible explanation for the large difference in market presence. As a robustness check, the market presence of both type of carriers is also checked for the period of 2011-2015 to see if market presence has drastically changed. The results show that at least one LCC was present in 58.5% of the observations in that period, whereas at least one ULCC present in 15.2% of the observations. This is remarkable as one would think that ULCC market presence would have increased with larger percentage than LCC market presence, but LCC market presence has grown more than ULCC market presence over the period. When looking at the average total market share of the LCCs and ULCCs on a route, one can clearly see that the mean of the total LCC market share (18.9%) is much higher than that of the total ULCC market share (3.3%). Part of this result is caused by the fact that ULCCs have much less market presence that LCCs. The average market share is composed of the values of all observations, this value is zero when the carrier is not present on a route. The mean ULCC market share is therefore much lower than that of LCCs. When only looking at the market share of the LCC or ULCC when it is present in the market, still a clear difference can be seen between the two carriers (see table 3). The mean total LCC market share in case of market presence is 42.2%, whereas the mean total ULCC market share in case of market presence is 30.1%. Part of the difference in total market share between LCCs and ULCCs can also be caused by the fact that more LCCs (six) are included in this study than ULCCs (three) and therefore more LCCs can be present in a market at the same time.

Table 3. Descriptive statistics in the situation of LCC/ULCC market presence

Variable	Mean	Std. Dev.	Min.	Max.
LCCmshare	.4224536	.2336321	.05	.9997652
ULCCmshare	.3066982	.1941795	.050172	.994575

The mean value of average metropolitan area population at end-point city-pairs on a route is 4,839,319. The mean value is rather close to the minimum value (4,093,825), this shows that most of the average metropolitan area populations at many end-point city-pairs have a similar value, as they all range between 4,093,825 and 4,839,319. The maximum value shows that the largest average metropolitan area population at end-point city-pairs is 16,693,450.

Moreover, a correlation matrix (see appendix C) has been made to see to what extent the variables are correlated. The results show that there are no exceptional correlations, except for the interaction variables, which are highly correlated with the variables of the interaction. However, this is more than logical as the interaction is composed of the two variables.

5. Methodology

To study the effect of ULCC and LCC market presence and the moderating effect of market share, two econometric models are used. The first model is a fixed effects model and the second model is a fixed effects instrumental variables estimation to control for the possible endogeneity of four right-hand side variables. This section is divided into three subsections. The first subsection provides a description of the variables employed in the two models. The second subsection presents the methodology of the fixed effects model and the third subsection presents the methodology of the fixed effects instrumental variables estimation.

5.1 Variables description

To test the hypotheses and answer the earlier mentioned research question, multiple variables were used. Table 4 presents an overview of the dependent variable and the independent variables used in this study.

The variables *LCCdummy* and *ULCCdummy* are dummy variables that indicate whether a LCC or ULCC is present on the route. LCC and ULCC market presence is defined as the carrier being present in the market with at least 5% market share for at least two consecutive quarters. Based on the literature review and previously stated in the hypothesis 1a and 1b, it is expected that the both LCC and ULCC market presence negatively affect the NLC airfare on a route, due to the competition increasing effect of market entry. Regarding the difference in effect between LCC and ULCC market presence, it is expected that ULCC market presence leads to larger decreases in the NLC market fare than LCC market presence. The rationale behind this is that ULCCs enter the market with lower prices than LCCs, therefore the NLC must reduce its price with a larger amount to remain its competitiveness on that route.

Table 4. The dependent and independent variables

Dependent variable	Definition
NLCfare	The market fare of the NLC

Independent variables	Definition
LCCdummy	Dummy that indicates LCC market presence (1 if present)
ULCCdummy	Dummy that indicates ULCC market presence (1 if present)
LCCmshare	Sum of LCC market shares
ULCCmshare	Sum of ULCC market shares
Population	The arithmetic mean of the Metropolitan Statistical Area (MSA) population at two end-point city-pairs

Similarly, as stated in hypothesis 2, it is expected that *LCCmshare* and *ULCCmshare* are negatively related to the airfare of the NLC, meaning that increases in the total market share of LCCs or ULCCs on a route lead to larger decreases in the NLC airfare on that route. The rationale behind this is that the NLC must react more aggressively to maintain its competitiveness when a LCC or ULCC is

present in the market with a large market share than when the LCC or ULCC is present in the market with a small market share.

Population is used to control for market growth over time. Markets grow each year because of population growth. This also leads to an increased number of potential travellers on a route. This potential expansion of the market could lead to increases in economies of scale of a carrier, which in turn could reduce prices. The expectation is that increases in *Population* lead to decreases in the airfare of the NLC.

Besides the earlier mentioned variables, carrier-route fixed effects, year-quarter fixed effects and carrier-time fixed effects are used. Carrier-route fixed effects are implemented through the use of a fixed effects model. This entails that the model will treat each carrier-route combination as a unique entity and observes this entity over time. This corrects for the fact that a certain carrier can behave differently in different markets. A carrier might for example behave differently on a route between two large cities than it does on a route to/from a holiday destination. The carrier-route fixed effects then capture the unobserved effects for the specific carrier on a specific route over time. Year-quarter fixed effects (a_t) are implemented to capture the unobserved aggregate trends or macro-economic effects over time. Because the data in this study cover 10 years, it is important to control for unobserved time-specific trends. An example of an unobserved trend that is then captured is the economic crisis that started in 2008. Moreover, carrier-time fixed effects (a_{it}) are included to control for carrier-specific heterogeneity over time. These fixed effects capture changes in the carrier over time. This could, for example, be caused by changes in the behaviour of the carrier over time or changes in the offering of the carrier. It could be the case that a certain carrier has started to reduce its prices all over the country in order improve its overall competitive position in the domestic market. Price reductions are then not caused by the entry of a LCC or an ULCC, but by a change in the carrier's overall pricing strategy. Furthermore, a carrier could have started to slowly decompose its price over time to obtain lower base fares. Price reductions are then also not caused by LCC or ULCC market entries, but by changes in the carrier's business strategy. Other examples of carrier-related changes over time are bankruptcies, mergers and acquisitions. The carrier-route fixed effects, year-quarter fixed effects and time-carrier fixed effects capture changes in the behaviour of a carrier in a specific market, aggregate trends or macro-economic effects and changes in the carrier's behaviour or business strategy over time. However, route-time specific changes are not yet accounted for in this model. This is the reason for including *Population* in the model. Route-time specific changes are changes in the market over time, such as changes in the market size or market structure. Population captures the market growth over time and the *LCCdummy* and *ULCCdummy* will capture part of the changes in the market structure over time.

5.2 Fixed effects model

The first model is a fixed effects model. This model is chosen over the regular OLS model for several reasons. A fixed effects estimation corrects for the time-invariant unobserved heterogeneity. This unobserved heterogeneity could lead to biased coefficients. The model also controls for time-invariant market characteristics such as distance and whether the origin/destination is a hub or

holiday destination. Another advantage of the model is that it treats each route as a separate market, this prevents from comparing markets that are very different from each other. A log-log model is used for two reasons. First, logarithms transform skewed distributions to more normal distributions and therefore smoothens the distribution of the variables. Secondly, by using logarithms elasticities are created, which ease the interpretation of the results. Year-quarter fixed effects (a_t) are used to control for time-specific heterogeneity and carrier-time fixed effects (a_{it}) are used to control for carrier-specific heterogeneity. Moreover, robust standard errors are used to correct for autocorrelation and heteroskedasticity. This has led to the following model:

$$logNLCfare_{ijt} = \beta_1 + \beta_2 logLCCdummy_{jt} + \beta_3 logULCCdummy_{jt} + \beta_4 logLCCmshare_{jt} + \beta_5 logULCCmshare_{jt} + \beta_6 logPopulation_{jt} + a_{it} + a_t + \varepsilon_{ijt}$$

5.3 Fixed effects instrumental variables estimation

Even though the fixed effects model corrects for time-invariant unobserved heterogeneity, still possible endogeneity remains a problem. Endogeneity occurs when one or more explanatory variables are correlated with the error term. This could be caused by several factors, but simultaneous causality is a frequent cause. Simultaneous causality occurs when the independent variable not only affects the dependent variable, but the dependent variable simultaneously also affects the independent variable. There are four variables that are likely to be endogenous, namely *LCCdummy*, *ULCCdummy*, *LCCmshare* and *ULCCmshare*. The endogeneity issue regarding *LCCdummy* and *ULCCdummy* would be caused by the fact that if airfares are high, market entry by a LCC or an ULCC is more likely to occur, because it is easier for a LCC or ULCC to obtain a larger market share by undercutting the price of a NLC, as the price gap between the LCC or ULCC and the NLC is larger in this situation. LCCs and ULCCs are therefore more likely to enter a market if the NLC market fare is high. Endogeneity would then also be an issue for *LCCmshare* and *ULCCmshare* as these interactions are composed of the *LCCdummy* and *ULCCdummy*. Furthermore, LCCs and ULCCs are able to obtain a larger market share when the NLC airfare is high, because the LCC or ULCC is able to attract much more customers through its low prices. Whereas the previous fixed effects models measured the relationship between ULCC market presence and the market fare of the NLC, this fixed effects instrumental variables estimation measures the causal effect of ULCC market presence on the market fare of the NLC. When performing the instrumental variables estimation, several instruments will be used. Based on instruments used by Gerardi and Shapiro (2009) and Dai, Liu, and Serfes (2014), the logarithmic and geometric means of Metropolitan Statistics Area (MSA) populations and the general enplanement at end-point city-pairs are used as instruments in this study. A more detailed overview of the instruments used can be found in appendix B. Due to the difficulty of finding appropriate instruments, it is important to mention that the quality of the instruments can become an issue and that extra care should be taken when interpreting the results of this regression. The fixed effects instrumental variables estimation model is shown below (hats are indicating the instrumented variables):

$$log\text{NLCfare}_{ijt} = \beta_1 + \beta_2 \widehat{\text{LCCdummy}}_{\text{jt}} + \beta_3 \widehat{\text{ULCCdummy}}_{\text{jt}} + \beta_4 log\widehat{\text{LCCmshare}}_{\text{jt}} + \beta_5 log\widehat{\text{ULCCmshare}}_{\text{jt}} + \beta_6 log\text{Population}_{jt} + a_{it} + a_t + \varepsilon_{ijt}$$

6. Results and discussion

After preparing the data and specifying the two models, the regressions were performed. This section is divided into two subsections. The first subsection presents and discusses the results of the fixed effects model and second subsection presents and discusses the results of the fixed effects instrumental variables estimation.

6.1 Fixed effects model

A logarithmic fixed effects model with robust standard errors is used to determine the relationship between LCC or ULCC market presence and NLC market airfares. Furthermore, the model will show whether there is a moderating effect of ULCC market share. The results of the first fixed effects regression are displayed in table 5.

Table 5. Results of the first fixed effects regression

	NLCfare	NLCfare	NLCfare
LCCdummy	-0.039**	-0.040**	-0.058**
	(0.007)	(0.007)	(0.015)
ULCCdummy	-0.055**	-0.057**	-0.079**
	(0.007)	(0.007)	(0.024)
Population		-0.703**	-0.704**
		(0.158)	(0.157)
LCCmshare			0.005
			(0.005)
ULCCmshare			0.007
			(0.007)
Carrier-time fixed effects	Yes	Yes	Yes
Year-quarter fixed effects	Yes	Yes	Yes
constant	5.558**	16.281**	16.308**
	(0.007)	(2.408)	(2.401)
R^2	0.26	0.27	0.27
N	51,022	51,022	51,022

Robust standard errors in parentheses

* $p<0.05$; ** $p<0.01$

When observing the outcomes of the fixed effects model, it becomes clear that most of the results are in accordance with the expected outcomes. The results in table 5 show that ULCC market presence is significantly (at the 1% level) negatively related to the market fare of the NLC. This is in accordance with the hypothesis 1a which stated that ULCC market presence leads to a reduction in the NLC market fare. Market presence of at least one ULCC is related to a 7.9% lower NLC market fare. The results further show that LCC market presence is also significantly (at the 1% level) negatively related to the NLC market fare. This confirms the findings of older studies on the effect of LCC market presence on NLC airfares. Market presence of at least one LCC is related to a 5.8% lower NLC market fare. The effects found in this study are of a smaller magnitude than the ones

found by Bachwich and Wittman (2017). Their study showed that the average market fare would be 21% lower in case of ULCC market presence and 8% lower in case of LCC market presence However, this difference in magnitude can be explained by the fact that they have studied the effect of LCC and ULCC market presence on average market fares. The decrease in the average airfare is composed of two parts. Firstly, the average will automatically decrease when a carrier enters the market with a lower airfare. Secondly, the average airfare could also decrease because incumbents reduce their airfare to remain competitive in the market. The results of this regression provide indications for the latter.

Based on the difference between the coefficients of *LCCdummy* and *ULCCdummy* one might argue that there is found to be a significant difference between ULCC market presence and LCC market presence. However, the difference between the two coefficients is rather small. Also, when looking at the 95% confidence intervals of *LCCdummy* and *ULCCdummy* one can clearly see that these are almost similar. The findings in this study do therefore not show a large difference between the LCC market presence and ULCC market presence. This does not mean that there is proven to be no large difference between the effect LCC and ULCC market presence on the NLC market fare. The lack of difference between the two variables could be caused be a lack of statistical power of the *ULCCdummy*. As already mentioned earlier, LCCs are present in 44.7% of the observations, whereas ULCCs are only present in 10.9% of the observations. It could be the case that the difference between LCC market presence and ULCC market presence is larger in reality, but that more observations are needed to confirm this.

Furthermore, the results show that *Population* is negatively related to the market price of the NLC and significant at the 1% level. This finding is in accordance with what was expected. Population growth is an indicator for market growth and this market growth could lead to increases in economies of scale of a carrier, which in turn could lead to decreases in airfare. The result shows that a 1% increase in the average MSA population at end-point city-pairs is related to a 0.7% decrease in the market fare of the NLC.

When looking at the results of *LCCmshare* and *ULCCmshare* one can clearly see that they are contrary to what was expected. Both *LCCmshare* and *ULCCmshare* are found to be insignificant (at the 5% level). The expectation was that LCC or ULCC market presence with a large total market share was related to larger decrease in the NLC market fare than LCC or ULCC market presence with a small total market share. The rationale behind this expectation was that market presence of a LCC or ULCC with a large total market share put much more competitive pressure on a NLC than market presence of LCC or ULCC with only several flights per quarter. As a result of the higher competitive pressure, the NLC would behave more aggressively to remain competitive on the route by making larger reductions in its airfare. The insignificant result of *LCCmshare* and *ULCCmshare* shows that no evidence is found for a moderating role of LCC or ULCC market share. This shows that it is just the fact that a LCC or ULCC is present in the market is related to the reduction in the NLC market fare and that the extent of market share does not play a significant role in this relationship.

6.3 Fixed effects instrumental variables estimation

A logarithmic fixed effects instrumental variables estimation was used to correct for the possible endogeneity of the right-hand side variables *LCCdummy*, *ULCCdummy*, *LCCmshare* and *ULCCmshare* and to measure the causal effect of ULCC market presence on the market fare of the NLC. The results of this regression are presented in table 6.

Table 6. Results of the fixed effect instrumental variables estimation

	NLCfare
$\widehat{\text{LCCdummy}}$	-1.014
	(1.324)
$\widehat{\text{ULCCdummy}}$	0.434
	(3.423)
Population	-0.752**
	(0.308)
$\widehat{\text{LCCmshare}}$	0.234
	(0.336)
$\widehat{\text{ULCCmshare}}$	-0.181
	(1.178)
Carrier-time fixed effects	Yes
Year-quarter fixed effects	Yes
N	50,816

Robust standard errors in parentheses
* $p<0.05$; ** $p<0.01$

As can be seen from table 7, the results are very different from those of the fixed effects regression. With regard to *LCCdummy* and *ULCCdummy*, both are found to not significantly (at the 5% level) effect the market price of the NLC. This result is different from the fixed effects regressions where both variables were found to be significantly related to the market price of the NLC. It can be concluded from these results that no effect was found of LCC or ULCC market presence on the NLC market fare.

Furthermore, the results show that *Population* is found to significantly (at the 1% level) negatively affect the market fare of the NLC. This is in accordance with the expectation and the result of the fixed effects model. The result shows that a 1% increase in the average MSA population at end-point city-pairs leads to a 0.8% decrease in the market price of the NLC.

When looking at the result of *LCCmshare* and *ULCCmshare* one can clearly see that both variables are not significant (at the 5% level). This is similar to the finding of the fixed effects model. It can therefore be concluded that no evidence was found for a moderating effect of LCC or ULCC market share. Furthermore, *LCCdummy*, *ULCCdummy*, *LCCmshare* and *ULCCmshare* have been tested for endogeneity. The results showed the variables are indeed endogenous and this would verify the use

of the instrumental variables estimation. However, in addition to the endogeneity test, the strength of the instruments has been tested using the Sargan-Hansen test. The joint null hypothesis that all instruments are valid instruments is rejected and one can conclude that the instruments used are actually not proven to be valid instruments. This confirms the earlier mentioned concern and shows that extra care should be taken when interpreting the results of this model. The IV estimator is inconsistent and can therefore even be more inconsistent than an OLS regression (Cameron & Trivedi, 2005). The fixed effects regression is therefore chosen as the main model in this study and those results will be used to answer the research question stated earlier in this paper. This has implications on the interpretation of the results, as there can now only be spoken of relationships between variables and not of causal effects.

7. Conclusion

LCC market entries have played an important role as a competitive driver in the U.S. airline industry. Yet, several studies pointed to a possible ending to this era of constant LCC market growth. Route density, but also the convergence of the NLC and LCC business model are mentioned as two of the causes. Despite the stagnation of LCC market growth, recent studies mention the rise of a new type of carrier, the ultra-low cost carrier (ULCC). This type of carrier could potentially become a new competitive driver in the U.S. airline industry. Due to the recentness of this development, few studies have researched this phenomenon.

This study adds to the literature by studying the effect of ULCC market presence on the market fare of the NLC and examining whether this effect is different from the effect of LCC market presence. Furthermore, the moderating role of total ULCC market share is examined in the situation of ULCC market presence. The research question was: what is the effect of ULCC market presence on NLC market fares and is this effect different from the effect of LCC market presence on NLC market fares?

In order to address this research question, a three dimensional panel data set from 2006 to 2015 was used. Both a fixed effects regression and a fixed effects instrumental variables estimation are performed. The results of this study show that there is found to be a significant negative relationship between ULCC market presence and the market price of the NLC. Market presence of at least one ULCC is related to a 7.9% lower NLC market fare. Furthermore, it is found that LCC market presence is also found to be significantly negatively related to the market fare of the NLC, because market presence of at least one LCC is related to a 5.8% lower NLC market price. The relationship between ULCC or LCC market presence and the NLC market fare is thus of rather similar strength. However, part of this small difference could be influenced by the limited number of ULCC observations. Additionally, no significant moderating effect of LCC or ULCC market share was found. The results therefore show that ULCC or LCC market presence with a large market share is not related to a larger reduction in the NLC market fare than ULCC or LCC market presence with a small market share. This is contrary to the expectation that a NLC would behave more aggressively to LCC or ULCC market presence with a large market share by making larger reductions in its airfare to remain competitive on the route.

This study has found evidence that ULCC market presence is related to lower NLC market fares. This shows the indication of a potential competition increasing effect of ULCC market presence, which could indicate that ULCCs could be a new competitive driver in the U.S. airline industry. Further research is needed to show whether the reductions in the NLC are caused by the market presence of the ULCC and whether one could therefore really speak of a causal effect.

8. Limitations and recommendations

Having presented and discussed the results, this section will discuss several limitations to the research approach used and will provide recommendations for further research. Firstly, a limitation of the instrumental variables estimation used is the validity of the instruments. The endogeneity test showed that *LCCdummy*, *ULCCdummy*, *LCCmshare* and *ULCCmshare* were indeed endogenous, which increases the importance of using instrumental variables to control for the endogeneity. However, the Sargan-Hansen test showed that the instruments used were weak and could not be considered valid instruments. The MSA population data used concerned annual data, whereas quarterly data would be preferred. The use of quarterly data would therefor already somewhat improve the quality of the instruments. Yet, it would probably be better to search for different instruments. This would help to test for a causal effect instead of relationship. Secondly, MSA population was used to control for market growth in this study. However, population growth is not the only source of market growth. There are multiple sources that can lead to market growth, such as increases in real GDP per capita that allows people to travel more or changes in the carbon emission regulation at an airport that can lead to an increased number of take-offs. Future studies might therefor look for a more precise measure of market growth. Thirdly, this study controls for changes in the market structure through the dummies of LCC and ULCC market presence and the total LCC and ULCC market share. However, additional NLC market entries could also affect the market structure, but this is uncontrolled for in this study. Also the market exit of a carrier can affect the market structure, but this is something that is also not controlled for in this study. These are two issues that future studies could take into consideration. Fourthly, this study has made use of a carrier classification that divided the carriers into NLCs, LCCs and ULCCs. The results showed that LCCs and ULCCs are both negatively related to the market fare of the NLC. However, it could be the case the strength of the relationship is different for each specific carrier. The study by Vowles (2000) also showed that different LCCs can have different effects on price. It could be that market presence of a certain ULCC is related to larger reductions in the market fare of the NLC than another ULCC. A future study could therefore examine the effect of each specific LCC or ULCC on the market fare of the NLC Disaggregating the LCCs and ULCCs could give a better insight into the effect of each carrier.

References

Abda, M. B., Belobaba, P. P., & Swelbar, W. S. (2012). Impacts of LCC growth on domestic traffic and fares at largest US airports. *Journal of Air Transport Management*, 18(1), 21-25.

Alderighi, M., Cento, A., Nijkamp, P., & Rietveld, P. (2012). Competition in the European aviation market: the entry of low-cost airlines. *Journal of Transport Geography*, 24, 223-233.

Bachwich, A. R., & Wittman, M. D. (2017). The emergence and effects of the ultra-low cost carrier (ULCC) business model in the US airline industry. *Journal of Air Transport Management*, 62, 155-164.

Belobaba, P., Odoni, A., & Barnhart, C. (2015). *The global airline industry*. West Sussex: John Wiley & Sons.

Berry, S., & Jia, P. (2010). Tracing the woes: An empirical analysis of the airline industry. *American Economic Journal: Microeconomics*, 2(3), 1-43.

Borenstein, S. (1989). Hubs and high fares: dominance and market power in the US airline industry. *The RAND Journal of Economics*, 344-365.

Borenstein, S. (1992). The evolution of US airline competition. *The Journal of Economic Perspectives*, 6(2), 45-73.

Brueckner, J. K., Lee, D., & Singer, E. S. (2013). Airline competition and domestic US airfares: A comprehensive reappraisal. *Economics of Transportation*, 2(1), 1-17.

Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications*. Cambridge: Cambridge university press.

Chi, J., & Koo, W. W. (2009). Carriers' pricing behaviors in the United States airline industry. *Transportation Research Part E: Logistics and Transportation Review*, 45(5), 710-724.

Dai, M., Liu, Q., & Serfes, K. (2014). Is the effect of competition on price dispersion nonmonotonic? evidence from the us airline industry. *Review of Economics and Statistics*, 96(1), 161-170.

Daraban, B., & Fournier, G. (2008). Incumbent responses to low-cost airline entry and exit: A spatial autoregressive panel data analysis. *Research in Transportation Economics*, 24(1), 15-24.

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

Evans, W. N., & Kessides, I. N. (1993). Localized market power in the US airline industry. *The Review of Economics and Statistics*, 66-75.

Fallert, S. (2012). Ancillary revenues in air transport–gain and pain. In R. Conrady, & M. Buck, *Trends and Issues in Global Tourism 2012* (pp. 145-150). Heidelberg: Springer-Verlag Berlin Heidelberg.

Gerardi, K. S., & Shapiro, A. H. (2009). Does competition reduce price dispersion? New evidence from the airline industry. *Journal of Political Economy*, 117(1), 1-37.

Goolsbee, A., & Syverson, C. (2008). How do incumbents respond to the threat of entry? Evidence from the major airlines. *The Quarterly journal of economics*, 123(4), 1611-1633.

Hofer, C., Windle, R. J., & Dresner, M. E. (2008). Price premiums and low cost carrier competition. *Transportation Research Part E: Logistics and Transportation Review*, 44(5), 864-882.

Hüschelrath, K., & Müller, K. (2013). Patterns and effects of entry in US airline markets. *Journal of Industry, Competition and Trade*, 13(2), 221-253.

Ito, H., & Lee, D. (2003a). Low cost carrier growth in the US airline industry: past, present, and future. *Brown University Department of Economics*, No. 2003-12.

Ito, H., & Lee, D. (2003b). Incumbent responses to lower cost entry: evidence from the US airline industry. *Brown University Department of Economics*, No. 2003-22.

Jiang, Q. (2014). The evolution of US airlines' productivity and cost performance from 2004-2012. *Doctoral dissertation, Massachusetts Institute of Technology*.

Joskow, A., Werden, G., & Johnson, R. (1994). Entry, exit, and performance in airline markets. *International Journal of Industrial Organization*, 12(4), 457-471.

Klophaus, R., Conrady, R., & Fichert, F. (2012). Low cost carriers going hybrid: Evidence from Europe. *Journal of Air Transport Management*, 23, 54-58.

Lijesen, M. G., Rietveld, P., & Nijkamp, P. (2004). Do European carriers charge hub premiums? *Networks and Spatial Economics*, 4(4), 347-360.

Malighetti, P., Stefano, P., & Redondi, R. (2013). The Low-cost fare response to new entry. *European Transport Research Review*, 5(4), 185-194.

Morrison, S. A. (2001). Actual, adjacent, and potential competition estimating the full effect of Southwest Airlines. *Journal of Transport Economics and Policy*, 35(2), 239-256.

Oster Jr., C., & Strong, J. (2001). Predatory Practices in the US Airline Industry. *US Department of Transportation*.

Pearson, J., & Merkert, R. (2014). Airlines-within-airlines: a business model moving East. *Journal of Air Transport Management*, 38, 21-26.

Rosenstein, D. E. (2013). The Changing Low-Cost Airline Model: An Analysis of Spirit Airlines. *Aviation Technology Graduate Student Publications*, Paper 19.

Tan, K. M. (2016). Incumbent Response to Entry by Low-Cost Carriers in the US Airline Industry. *Southern Economic Journal*, 82(3), 874-892.

Transportation Research Board. (1999). *Entry and Competition in the U.S. Airline Industry: Issues and Opportunities.* Washington, D.C.: National Academy of Sciences.

Tsoukalas, G., Belobaba, P., & Swelbar, W. (2008). Cost convergence in the US airline industry: An analysis of unit costs 1995–2006. *Journal of Air Transport Management*, 14(4), 179-187.

United States Department of Transportation. (1996). *Report of the Office of the Secretary*. Washington DC: United States Department of Transportation.

Vowles, T. M. (2000). The effect of low fare air carriers on airfares in the US. *Journal of Transport Geography*, 8(2), 121-128.

Whinston, M. D., & Collins, S. C. (1992). Entry and competitive structure in deregulated airline markets: an event study analysis of People Express. *The RAND Journal of Economics*, 445-462.

Windle, R., & Dresner, M. (1995). The short and long run effects of entry on US domestic air routes. *Transportation Journal*, 14-25.

Wittman, M., & Swelbar, W. (2013). Evolving Trends of U.S. Domestic Airfares: Impacts of Competition, Consolidation and Low-Cost Carriers. *MIT Small Community Air Service White Paper No. 3*, Report No. ICAT-2013-07.

Appendix

Appendix A. Final sample construction

In order to construct the data set, several steps had to be undertaken. First, the DB1B data set had to be constructed by merging the coupon, market and ticket data. Before merging these three sub-datasets, only the observations with less than three ticket coupons or less than two market coupons were kept and observations with a distance equal to zero were dropped. The coupon data were then merged with market data, after which this combined dataset was merged with the ticket data. This ensured that only one leg of the flight remained in the data set. After merging, the data were further cleaned by dropping observations in which there was: a change in ticketing carrier, the ticketing carrier was different from the operating carrier, the dollar credibility was equal to zero or the fare was a bulk fare. Next, all roundtrip fares were divided by two and all the observations for which the airfare was lower than $10 or higher than the 99th percentile were dropped. Furthermore, as all fares of JetBlue are labelled as unrestricted first class in the original DB1B database, all JetBlue fares were changed to be coach class in this study. Only the observations that were coach class are kept for this study. Next, the T-100 data set had to be prepared. The observations for which the number of seats, distance or departures performed was zero were dropped. Furthermore, only observations for which more than 10 departures were performed or more than 100 tickets were issued in a given quarter were kept. Next, the MSA population data were then manually merged with the T-100 data by pairing the Metropolitan ID of the population data with the corresponding City Market ID of the T-100 data. Only the observations for which no data was missing are kept. The final data sample is then constructed by merging the modified DB1B data with the extended T-100 data.

Appendix B. Instrumental variables

Instrumental variable	Definition
AmeanPOP2	The arithmetic mean of the Metropolitan Statistical Area (MSA) population at two end-point city-pairs squared
GmeanPOP	The geometric mean of the Metropolitan Statistical Area (MSA) population at two end-point city-pairs
GmeanPOP2	GmeanPOP squared
Genp	The general enplanement tool that is calculated as follows: $Genp = \frac{\sqrt{(enp_{j1} * enp_{j2})}}{\sum k \sqrt{enp_{k1} * enp_{k1}}}$, where j indexes the airline, k indexes all airlines and enp_1 and enp_2 are the quarterly enplanement at the two end-point city-pairs from the T-100 data base.

Appendix C. Correlation matrix

	NLCfare	LCCdummy	ULCCdummy	LCCmshare	ULCCmshare	Population
NLCfare	1.0000					
LCCdummy	-0.1779	1.0000				
ULCCdummy	-0.1244	0.1171	1.0000			
LCCmshare	-0.1949	0.9715	0.0948	1.0000		
ULCCmshare	-0.1233	0.0917	0.9785	0.0708	1.0000	
Population	-0.0220	0.3036	0.0234	0.2599	-0.0110	1.0000