# Airline alliances and the threat of low-cost carriers

## Master thesis

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## Abstract

The airline industry has been undergoing some interesting developments over the last few years. Liberalisation processes have led to an increase in low-cost carriers and national flag carriers have started to form alliances in order to increase global strength. This research is the first research to analyse the effect of the formation of airline alliances and low-cost carriers for the European interhub market. Through Ordinary Least Squares (OLS) regressions it is found that, in a situation in which alliances reach a certain level of size, the formation of an airline alliance has a positive effect on the fares of flights. Low-cost carriers have a price decreasing effect on the airline fares charged by alliance members.

# Table of content

## 1. Introduction

The airline industry is an industry characterized by dynamism, high growth and uncertainty. Thereby, it constantly deals with change and has seen some remarkable developments over the last couple of decades. Since the deregulation of US airlines major innovations have been adopted by the industry. In the 1980s hub-and-spoke-networks were adopted and routes of airlines were organized to fit into these networks. At the same time frequent flier programs and computerized reservations systems were introduced. In the 1990s however an innovation that started out small is now characterizing the worldwide aviation market and it has swept the entire industry, namely the formation of international airline alliances (Brueckner, 2001). The world airline industry is now dominated and characterized by three worldwide alliances: Star Alliance, Oneworld and SkyTeam (Star Alliance, 2013; Oneworld, 2013; SkyTeam, 2013).

At the start of this new empire questions and doubts were raised on the effects these alliances could have on the benefit of consumers through the pricing of airfares. Cost reductions caused by alliances are possible through various ways. It is efficient for airlines to cooperate on (intercontinental) flights. Using solely its own aircrafts on these routes is inefficient due to economies of scale and scope. Benefits associated with the forming of these global networks are related to the opportunities of airlines to reduce costs since they can cooperate and integrate on certain activities such as integrated frequent flyers programs and promotion activities (Park & Zhang, 2000). Moreover, they are able to link their existing networks without expanding on the number of flights and routes (Brueckner & Whalen, 1998). Airlines in an alliance " offer service primarily on routes between their hubs and the largest international cities and transfer passengers to foreign carriers if those passengers' ultimate destination is beyond these large hub cities (Whalen, 2007, p.40)". At last a positive effect can be gained through better coordination of connecting traffic (Park & Zhang, 2000). Increased levels of service can lead to increased demand and increased density on routes operated. Most used and common alliances are code-sharing alliances and antitrust-immunized alliances. The cost savings that could be realized through these alliances would put downward pressure on fares in all markets (Park & Zhang, 2000).

However prices could actually rise as well. Alliances substitute a situation of competitive price setting by a situation in which joint price setting occurs. This is especially true for parallel routes, these are routes from hub to hub of airlines belonging to the same alliance (Wan, Zou & Dresner, 2009). The European Commission is in charge of airline alliances within Europe, as it is the sole authority to grant any rights to the members. As stated by the European Commission (2012) it is of vital importance to remain vigilant against any form of anti-competitive behavior and keep markets operating efficiently. This is especially important when newly competitive markets are emerging as a result of liberalisation processes and antitrust rules. Therefore, it is interesting to do research on the effect of these alliances on the benefit of consumers within Europe. Since the effect on complementary routes is most likely positive this is especially interesting for parallel routes. The hub to hub system within Europe is widely used by consumers. European city-trips have become a popular segment in the market and business trips within Europe are constantly increasing within this hub to hub system as well. However contrary to the US airline industry, the European airline industry has not yet received much academic attention on consumers welfare as a consequence of airline alliances and hence a clear analysis on consumers welfare within Europe is still missing.

Another interesting and very important development in the airline industry over the last few years is the rise of low-cost carriers (LCCs). It has received a fair amount of attention over the years and capital markets closely observe the strategies of national carriers. According to Binggelli & Pompeo (2002) this is no surprise and easy to see why. Looking at 2001 most national carriers reported losses and even worse some went bankrupt. On the other side of the market though Europe's leading low-cost carriers were more than merely profitable: " Ryanair and EasyJet boasted operating margins of 26 and 9.5 percent, respectively—results that traditional airlines only dream about. In June 2002, Ryanair had a market capitalization of €4.9 billion ($4.82 billion), 45 percent more than that of British Airways (BA), which has revenues that are 20 times larger (Binggelli & Pompeo, 2002, p. 1)." The success of low-cost carriers has been increasing ever since. Nowadays they are found in many areas worldwide serving over 650 million passengers in 2010 which is about 23.5% of the market (Dobruszkes, 2013). Moreover, as stated by Franke (2004), national carriers are experiencing decreasing returns because low-cost carriers are operating on the same routes. This is especially the case for parallel routes. According to facts, figures and academic research low-cost carriers are gaining importance within Europe and an analysis of the airline industry in Europe would not be complete without the inclusion of these competitors.

In line with this the main research question of this paper will be as follows:

*"What is the effect of the formation of an airline alliance on the fares of flights, and do low-cost carriers affect the pricing of alliance members?"*

This effect will be determined empirically. Empirical research on the European airline industry is still rather scant. This is partly and probably due the fact that no data on airline pricing is readily available and has to be collected first. National flag carriers have been undergoing drastic changes and been going through some rough times. This research contributes to society by analyzing consumers welfare as a cause of airline alliances in parallel routes. In line with the European Commission consumers welfare should not be at stake due to cooperation and liberalisation rules. Moreover, this empirical research contributes to existing literature as well. This research is the first empirical research that combines the strategic choices of national flag carriers and the importance of the three worldwide airline alliances with the rising competition of low-cost carriers for the European airline industry.

The outline of this paper will be as follows: chapter two will provide an overview of important developments in the airline industry. In chapter three the theoretical background and related literature on airline alliances and low-cost carriers will be explained and accordingly hypotheses will be formed. The data and methodology will be explained in chapter four. Chapter five will discuss the results. More in depth discussion of these results and some limitations and implications for further research will be provided in chapter six. At last chapter seven will conclude.

# 2. Overview and development of the airline industry

In this chapter the development of the European as well as the US airline industry will be discussed, as the two are closely related to each other. The first part will discuss the history and important changes for the entire industry. Afterwards the focus will be on the development of airline alliances. And at last more detail will be given on the development and rise of low-cost carriers.

## *2.1 Development of the airline industry in the US and Europe*

The commercialization of the airline industry for the public took off in the US after World War I and government policy more than market forces shaped the development of the entire industry onwards (Borenstein & Rose, 2013).

In 1925 the first step towards the creation of a private US-airline industry was taken with the 'Contract Air Mail Act', better known as the 'Kelly Act'. With this act it was decided by the government to transfer airmail services to the private sector by establishing the practice of competitive bidding. This was the start of privatization and the US-airline industry took off (Airlines for America, 2013). After periods of privatization and first developments government support increased worldwide in the early days after World War I. This was partly due to the financial instability caused by the great depression for which the airline industry was no exception. The combination of low entry barriers and government subsidies caused many (small) air transportation providers to enter the market and concerns about fragmentation and destructive competition were raised. As a reaction to these concerns pressures to rationalize the industry became visible in the form of subsidies and regulation of privately-owned firms in the US and Europe. Moreover, countries wanted to promote and encourage the development of strong and stable national air carriers. Universal restrictions on foreign ownership of domestic carriers were established. International air fares were established by the airlines themselves, under the supervision of the International Air Transport Association (IATA) and subject to the approval of the relevant governments (Borenstein & Rose, 2013). In 1938 regulation efforts by the US government were set by the 'Civil Aeronautics Act', this was one of the most important bills ever for the airline industry. Together with this the Civil Aeronautics Agency (CAA) was created. This agency had the power to regulate airline fares, airmail rates and interline agreements. Moreover, it had the power over different mergers and routes. The goal was to keep rates at reasonable levels and at the same time encourage the development of commercial air transportation. In 1940 the agency was split into two separate powers, namely the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB). These two agencies and their corresponding powers together with technological improvements put the industry up for success (Airlines for America, 2013).

In the following period especially the decision of the US and subsequently European governments to deregulate the markets have had a major influence on the industry and attributed to the existence of trends and issues such as the rise of low-cost carriers. Deregulation involves the effective removal of many of the regulations affecting, in this case, the airline industry (Pender & Baum, 2000). State controls were removed in order to allow market forces to reinforce the market. In the US the airline deregulation act adopted by North America in 1978 is considered as the start of these deregulation efforts. The CAB was disbanded and an initial increase in new entrants offering lower fares was the immediate result. As stated in Borenstein & Rose (2013) in the following 23 years after the act real prices declined at 1.9% per year and traffic grew at an annual compounded rate of 2.4%. Figures such as these have often been used to point at the success and positive effects of deregulation. Increased competition, more choice and lower fares characterized the US airline industry in 1980s. Established carriers fought back after this initial period though and they did this in such a way that they managed to dominate the airline industry again after this period. As a result concentration levels were similar again to those in the period before deregulation (Pender & Baum, 2000).

Europe, inspired by the US, began liberalization processes in 1993. The changes in Europe however were less drastic as compared to the deregulation process in the US. Liberalisation occurred in three different packages of measures between 1993 and 1997. A measure regarded as most important for Europe is the Third Aviation Package. After the introduction of this package it became more difficult for governments to protect their national flag carriers by intervening in the market for new carriers. An important change among these packages is that government approval is now no longer needed with respect to fare setting and the launching of new services. This means that in theory now any European Airline can start services in another member country at the fares it chooses to charge. Airlines, especially the smaller ones, were now better able to meet certain demand. Overall a larger degree of regulations stay put in Europe as compared to the US, however also these liberalisation processes created an European airline environment conducive to more competition. The completion of these European Commission’s rules and liberalisation processes have stimulated market growth for the European airline industry (Pender & Baum, 2000). In 2007 the European Commission and the US Department of Transportation (DOT) signed the so called ‘open skies agreement’ which includes provisions that should strengthen cooperation between the two airline industries (European Commission, 2012).

### *2.2 The forming of airline alliances*

Chan (2000) describes in his research how globalization has led airlines to form alliances. Airlines sought ways to cope with competition and gain access to global markets that were too huge to be dominated by one airline. Now that deregulation contributed to the fact that national flag carriers were no longer protected. As a response to deregulation major airlines started to reorganize the structure of their routes into the well-known hub-and-spoke systems. From the 1990s airlines started to form alliances and these have characterized the entire industry onwards. (Brueckner, 2001). The oldest alliance is operated by KLM and Northwest, as they agreed on code-sharing in 1989. Currently three groups of alliances dominate the international airline industry. Star Alliance is the largest among the three. United Airlines and Lufthansa started this alliance with a code-sharing agreement. The second largest one, SkyTeam, is initially developed between Air-France and Delta. And the third one, Oneworld, is formed originally from an agreement between American Airlines and British Airways. All three alliances have been growing rapidly since they were formed in order to increase global strength. Especially expanding operations and partnerships into Asian countries has been a trend over the last years in order to target the fast-growing Asian market (Wan et al., 2009). Table 1 shows the members of each alliance and the year it has been founded.

**Table 1**: Members and summary statistics of the three airline alliances.

| | **Star Alliance** | **SkyTeam** | **Oneworld** |
|---|---|---|---|
| **Established:** | 1997 | 2000 | 1999 |
| **Passengers (per year):** | 670 million | 522 million | 341 million |
| **Countries served:** | 194 | 187 | 157 |
| **Participants:** | 27 | 19 | 12 |
| **Current Participants:** | Adria Airways | Aeroflot | Airberlin |
| | Aegean Airlines | Aerolineas Argentinas | American Airways |
| | Air Canada | Aeromexico | British Airways |
| | Air China | Air Europa | Cathay Pacific |
| | Air New Zealand | Air France | Finnair |
| | ANA | Alitalia | Iberia |
| | Asiana Airlines | China Eastern | Japan Airlines |
| | Austrian | China Souhern | LAN |
| | Avianca, Taca Airlines | Czech Airlines | Malaysia Airlines |
| | Brussels Airlines | Delta Airlines | Qantas |
| | Copa Airlines | Kenya Airlines | Royal Jordanian |
| | Croatie Airlines | KLM | S7 Airlines |
| | Egypt Air | Korean Air | |
| | Ethiopian Airlines | Middle East Airlines | |
| | Lot Polish Airlines | Saudia | |
| | Lufthansa | TAROM | |
| | Scandinavian Airlines | Vietnam Airlines | |
| | Shenzen Airlines | Xiamen Air | |
| | Singapore Airlines | | |
| | South African Airways | | |
| | Swiss | | |
| | TAM Airlines | | |
| | TAP Portugal | | |
| | THAI | | |
| | Turkish Airlines | | |
| | United | | |
| | US Airways | | |

*Source:* www.oneworld.com ; www.staralliance.com ; www.skyteam.com

Breuckner (2001) states that alliances are an attractive option for airlines looking to extend their overseas networks. Alliance partners typically collaborate to provide 'seamless' service, so that an interline trip on the two carriers feels like travel on a single airline. They do this by coordinating flights, by ensuring gate proximity at connecting airports and by merging the frequent flier programs with which they ensure convenience for their passengers. Besides they typically practice code-sharing agreements in which the component flights of an interline trip are now ticketed as if they occurred entirely on one airline. A second 'group' of advantages for the airlines can be related to cooperation benefits for the alliances. These benefits include sharing of sales offices, maintenance costs and operational facilities. Thirdly alliances can lead to increased traffic for the partners, since alliances can link cities within their international network and streamline transfers between different carriers. (Brueckner & Whalen, 1998; Brueckner, 2001; Wan et al., 2009). At last they can enjoy antitrust immunity which allows them to set prices in a cooperative way. Being a member of one of the large alliances does not automatically grants antitrust immunity amongst all airlines. It has to be granted by the authority of the corresponding regions. In Europe the European commission has the right to grant antitrust immunity and in the US the Department of Transportation has the sole authority. Many established carriers within the three large alliances have been granted antitrust immunity for transatlantic and other routes since the 1990s (Gillespie & Richard, 2011). All these advantages can result in an increase in load factors and lower operating costs per passenger or economies of density on alliance routes. These agreements, advantages and outcomes have become an important and widely used segment of airline alliances as they are today.

Besides advantages for the airlines themselves to engage in alliances Wan et al. (2009) point to some possible advantages for consumers as well. Flexible schedules, reduced travel time, shared frequent flyer programs, improved luggage handling services and better reach of more destinations are associated benefits for the consumers.

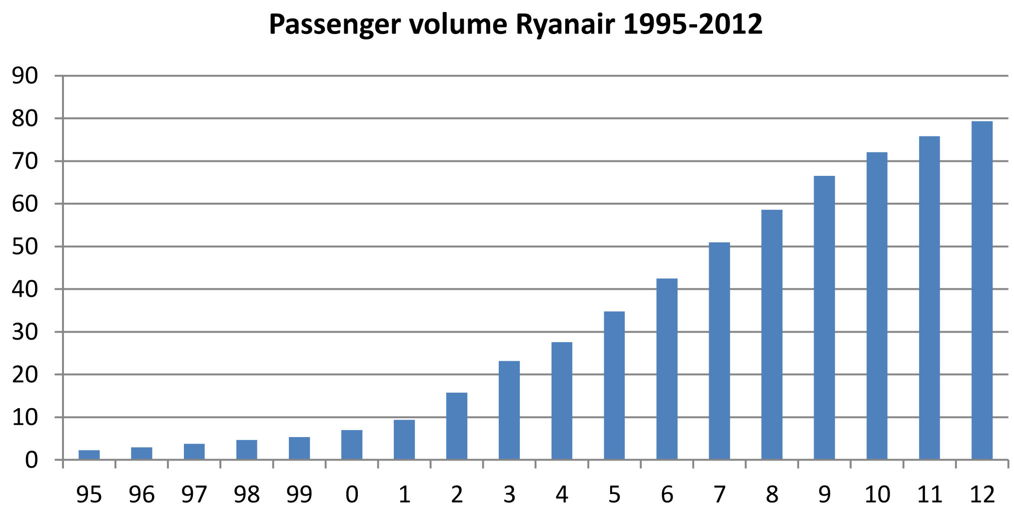
### *2.3 The rise of the low-cost carriers*

Pender & Baum (2000) discuss in their paper how deregulation contributed to the rise of low-cost airlines, though not all carriers survived and some had difficulty coping with the fierce competition. Besides the advantages of lower labor costs that these carriers could benefit from their failures were the result of some disadvantages, such as: a lack of market identity; thin capitalization and limited resources. An early established low-cost operator in the US that has achieved great success is Southwest. This low-cost carrier has been very successful and it has served as an inspiration for following low-cost airlines in the US and also in Europe. Southwest was formed in 1971 in Texas and started their operations with three Boeings with which they served three routes across Texas. By

2012 these figures have increased to 3000 flights a day with a fleet of 694 Boeing jets (Southwest airlines co., 2013). It is now America's largest low-cost operator, recognized worldwide and ranked among the top 50 airlines in the world (Pender & Baum, 2000). Moreover, as is stated in Pender & Baum, the low-cost airlines that survived in the US market might be only a small component of the entire market their actual impact is much bigger though. High-cost carriers tried to match fares in competitive markets and renew strategies as an answer to low-cost competition. Despite the efforts taken by established carriers, to keep these entrants out of the market or compete heavily with them, the market share of low-cost carriers in the US has been rising over the last few decades (Borenstein & Rose, 2013). A difference with low-cost carriers in the US, compared to Europe, is that US low-cost carriers stated to operate on dense routes and hereby used mainline airports as opposed to European low-cost carriers using mainly secondary airports.

Pender & Baum (2000) also describe in their research the rise of the low-cost carriers in Europe. First of all it should be taken into account again that the US market is different compared to the European market. European carriers have had more time to prepare themselves for competition and the market has additional institutional barriers to new entrants. However financial weaknesses of national carriers and high fares created a gap in the market for which low-cost carriers were eager to react on. Ryanair was the first low-cost carrier to operate flights in the European market. Ryanair was set up in 1985 in Ireland. It started with operating flights within the UK only and in its first year it served 5000 passengers. Since then the volume of passengers and air traffic has increased dramatically. Figure two below shows the increase in passenger volume.

**Figure 2**: Passenger volume Ryanair in millions (Ryanair, 2013).



By 2013 it is operating 1500 flights per day and has a fleet of over 290 Boeings with which it serves 168 destinations (Ryanair, 2013). No other low-cost carrier has succeeded to penetrate the European market in such a speed and with such a success as Ryanair did before the mid-1990s (Pender & Baum, 2000). Many low-cost carriers were inspired by the success of Ryanair though and more of these carriers entered the market afterwards. Examples of other European low-cost carriers are Vueling from Spain, Transavia from the Netherlands and Easyjet from the UK. Easyjet is the second largest European low-cost carrier and also this carrier is established in the UK. Low-cost airlines are attracted by the "flexible workforce, liberalised aviation sector and relatively low social security costs (Pender & Baum, 2000, p. 247)" in the UK.  Therefore, it is no coincidence the largest two carriers started operations and based themselves in the UK.

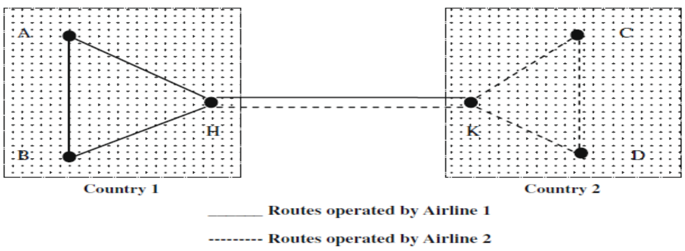
# 3. Theoretical framework

This chapter will discuss related literature and relevant theoretical background. Accordingly several hypotheses will be formed. Sub-section one will discuss academic papers on airline alliances and the second section will include research on low-cost carriers.

### *3.1 Airline alliances*

There has been quite some amount of research done on the effect of airline alliances on airline fares. Most research focused on the US airline industry though. A distinction can be made on the effect of an alliance on complementary routes versus parallel routes. Alliances on complementary routes are non-overlapping. Parallel routes however used to overlap these are routes from hub to hub of alliance partners. Figure 2 graphically shows the difference between parallel and complementary routes. This figure shows the connected hub-and-spoke networks for two alliance partners from two different countries. Point H is the corresponding hub of airline 1 and point K is a hub for airline 2. Complementary routes are those routes which go, for example, from point B to point D. These routes go through at least one of the hubs of the alliance partners to further destinations. Parallel routes are those routes in which airlines operate between two hubs. In figure 2 the route from point H to K is a parallel route. For parallel routes it is the case that two airlines compete in the absence of an alliance and collude with the presence of an alliance. This can be seen in figure 2 in which both airlines operate flights from point H to K in the absence of an alliance. The solid line being operated by airline 1 and the dotted line being operated by airline 2. In the presence of an alliance though only one airline will operate the route between hubs H and K. Passenger benefits from an alliance arise from the benefits associated to the network complementarities of the complementary routes. Passengers may or may not benefit from alliances in the parallel routes, as the effect in parallel routes is less straightforward as compared to complementary routes (Wan et al., 2009; Brueckner & Whalen, 1998). The benefit in these routes will be a tradeoff between anti-competitive effects and cooperation benefits (Wan et al., 2009; Zou et al., 2011). This research will focus on these parallel routes, as shown in the figure those routes from point H to K. This is the European interhub market which is an important and constantly increasing market for business travelers as well as leisure consumers.

**Figure 2**: Airline networks (Brueckner & Whalen, 1998).



A significant amount of research on alliances and fares is related to complementary routes. A large part of these papers finds a negative effect of the formation of an alliance on the price level. Oum, Park & Zhang (1996) claim to be the first systematic and econometric study to do research on the effect of code-sharing agreements on international airline fares. They make use of panel data from 57 transpacific routes and find an increase in the equilibrium quantity of passengers and a decrease in the equilibrium price by 83 dollars per passenger as a consequence of code-sharing agreements. Brueckner & Whalen (1998) use data from the US Department of Transportation to measure the effect of international alliances on US interline fares. They conclude in their research to have found strong evidence that international airline alliances have a price decreasing effect on interline fares. More precisely they find that alliance partners charge interline fares that are 18-28 % below those charged by carriers that are not in an alliance. Whalen (2007) is one of the few researchers making use of panel data in order to estimate the effect of alliances on transatlantic complementary routes between the US and Europe. The results are similar and in line with previous literature. It is found that alliances with antitrust immunity are associated with fares that are 13 to 20 % lower compared to traditional fares. For alliances that benefit from code-sharing only fares are decreased by 5 to 9 %. In both cases equilibrium output is higher as well.

Park (1997) and Park & Zhang (2000) do research on the effect of an alliance on fares in complementary routes as well as in parallel routes between the US and Europe. In total equilibrium passenger volume is increased by around 36.000 and equilibrium airline fares are decreasing by on average 41 dollars in the presence of an alliance. This is especially due to the overall price decreasing effect on complementary routes, since they find parallel alliances to reduce total output and consumer welfare. Taken together consumers are better off and welfare is increasing due to the positive effect gained in the interline (complementary) markets. Brueckner (2001) also does research on the two type of routes and hence two sort of alliances. It is found that total consumer welfare is increasing. Once again this is due to the decreasing level of fares in interline markets which is greater than the increasing level of fares in the interhub markets. It is found that in parallel routes fares are increasing since competition is eliminated in this market. Brueckner suggests that the positive effect for consumers in the interline markets outweighs the negative effect and harm done in the interhub market. Overall consumers as well as producers benefit from alliances.

Differences in forms of alliances are taken into account by Bilotkach (2005). He namely considers alliances with antitrust immunity as well as alliances without antitrust immunity, and he does this for the US. The results show that the establishment of an alliance without antitrust immunity leads to lower fares for interline passengers as compared to no alliance. Moreover, granting antitrust immunity to the alliances does not lead to additional decreases in airline fares and hence no additional consumer benefits. For alliances in parallel routes Bilotkach (2005) finds an increase in airline fares for those who are granted antitrust immunity. No such change is found for alliances without antitrust immunity. In line with previous literature Bilotkach (2005) suggests that the benefits gained in the interline market outweigh the negative effect and harm done in the parallel routes.

Czerny (2009) concludes that the results of his research are not in line with previous literature. He shows that the welfare effects of code-sharing alliances are not straightforward in complementary routes. He considers code-sharing alliances with and without antitrust immunity. Some of his results are in line with previous literature, as it is showed how interline passengers are better off in the case of code-sharing alliances and the practice of price discrimination (antitrust immunity). Moreover, the non-interline passengers are found to be worse off. However contrary to previous research he argues that the positive effect of price discrimination and code-sharing practices on airline fares in parallel routes can be greater than the negative price effect gained in the interline market. This is even more the case in the absence of antitrust immunity for code-sharing alliances. Therefore, the overall welfare improving effect of consumers found in previous literature can be questioned according to Czerny (2009). And this will depend on the positive and price increasing effect in parallel markets.

The focus of this research is on parallel routes and in contrast to previous literature the focus will be on the European market solely. However the effect of alliances is not expected to differ for the European market and therefore expectations are formed in line with previous literature on the US or transatlantic markets. Thereby, the first hypothesis is as follows:

**H1**: The formation of an airline alliance has a price increasing effect on airfares in parallel routes, relative to no airline alliance.

Wan, Zou & Dresner (2009) conduct a research in which they focus on parallel transatlantic routes between the US and Europe in 2007. Similar to this research the data is collected at one point in time. Interestingly they include a distinction between the three alliances in their research. It is found that Star Alliance and SkyTeam do not impose statistically significant price increases or decreases. It is found however that Oneworld has a significant and negative coefficient. This means that routes between Oneworld alliance hubs have significantly lower airline fares than other routes do. They suggest this is possible since the efficiency gains from the Oneworld alliance are large enough to outweigh any negative effects of anti-competitive behaviour that is present in parallel routes. Thereby, the resulting outcome is seen as a sum of anti-competitive effects (positive price effect) and efficiency gains (negative price effect).

Zou, Oum & Yu (2011) focus on complementary routes between Northeast Asia and the United States in 2007. Also they distinguish in their research between the three different worldwide alliances: Skyteam, Oneworld and Star alliance. They argue that although previous literature finds mainly negative effects on price levels in complementary markets a positive effect can still be possible as well. Since service improvements, such as improved scheduling coordination, increases the consumers' willingness to pay the overall effect is not clear a priori and hence negative price effects should not be assumed. In line with this they find that overall the positive effect, of the increased willingness to pay, on the fare of the flight outweighs the airfare reduction from cooperation benefits. Therefore, contrary to previous literature they state that airline alliances are not beneficial for consumers and actually increase the fare on complementary routes. Interestingly they find the effect to differ between the different alliances. Star Alliance and Skyteam Alliance members charge higher fares on interline markets, as compared to the sum of segment fares on complementary markets. Members of the Oneworld Alliance do not impose a statistically significant increase in the markup on the fares of their complementary routes. They suggest this might be due to a lack of competitive strength in the North trans-Pacific market.

In line with Zou et al. (2011) and Wan et al. (2009) the effect of the formation of an airline alliance on price is expected to differ between the different alliances. Besides the expectation that the formation of an alliance has a price increasing effect it is also expected that this effect is different for the three worldwide alliances. Therefore the second hypothesis is as follows:

**H2**: The price effect, of the formation of an airline alliance, differs between the different airline alliances Oneworld, Skyteam and Star Alliance.

More precisely Zou et al.(2011) suggest that this difference is the result of a difference in competitive strength between the three alliances. Within Europe Star Alliance has relatively most market power. Table 1 shows that most European carriers are members of Star Alliance. Within the sample of European hubs and parallel routes Star Alliance is overrepresented and relative market power is the largest. Therefore, the competitive strength of Star Alliance within Europe is expected to influence the relative price effect. In line with this the third hypothesis is the following:

**H3**: The price effect, of the formation of an airline alliance, is larger for Star Alliance as compared to Skyteam and Oneworld.

### *3.2 Low-cost carriers*

Empirical literature on low-cost carriers has been growing in recent years. The relationship between low-cost carriers and airfares charged by incumbents has been extensively researched on. However also here most empirical literature is on the US market. The link between airline alliances and the behavior of these alliances towards the threat of low-cost carriers in the European market is not yet defined clearly and most research on European low-cost carriers is from a theoretical point of view.

Strassmann (1990) is one of the first to conduct an empirical research on the relationship between competition and prices in the airline industry. More precisely this research is investigating the link between price, entry and concentration. It is found that concentration has a large and significant impact on the price, as a decrease in concentration caused by entry will lead to decreasing airfares.

More empirical papers have been focusing on the link between prices and concentration and more precisely by focusing on the effect of a low-cost entrant on the airfare. Whinston & Collins (1992) focus on the effect of US low-cost entrant Peoples Express on prices. They found that the entry of this carrier led to an average drop in airline fares of 34% of 15 routes in the US in the period 1984-1985. As described in Dresner, Lin & Windle (1996) also Bennet & Craun (1993) focus in their research on the effect of one specific low-cost carrier, namely Southwest Airlines. The study is conducted for the United States Department of Transportation. It is found that the entry of Southwest led to lower airline fares in the routes in which it is present. Dresner, Lin & Windle (1996) extend these previous researches as they say by conducting a research in which they focus on the entry of Southwest in US routes specifically. They also include a more general analysis in which other low-cost carriers are included as well. At first they show how prices fell dramatically on routes that Southwest had entered, as prices fell by approximately 53 %. Moreover, passenger traffic increased on these routes. For the general analysis they used data for the top 200 routes in the US. Also here they found that the presence of a low-cost carrier led to lower prices and higher traffic. More precisely prices fell by approximately 38%. These numbers correspond to the effect of direct competition. They also find an effect for more indirect competition, also competitive routeings. Competitive routeings are those routes in which the low-cost carrier competes with the established carrier by operating flights from an airport nearby (secondary airports). If Southwest served the competitive route the price reductions ranged between 8 and 45% and for other low-cost carriers this effect ranged from 0 to 41%. Dresner and Windle conduct more researches on this specific effect later as well. In 1998 they focus on high-cost carrier Delta specifically and its reaction towards pricing when low-cost carrier Valujet is entering a route they are serving. It is found that Delta lowered its fares in reaction to competition of Valujet and since they did not raise prices on other routes, in which there was no competition of low-cost carriers, they conclude that consumers welfare is increased.

Vowles (2000) has done a  research on the different determinants of airline pricing and among these determinants he also expected low-cost carriers to play a role. He included a dummy in the regression in order to capture the effect of the presence of a low-cost carrier and found that the average fare in the market is lowered by 45.47 dollars when a low-cost carrier is present. However it is noted that this effect might be misleading as it does not take into account the number of flights and seats offered by the low-cost carrier. Even so also this research shows the remarkable high impact of low-cost carriers on prices. In 2008 Goolsbee & Syverson publish a paper in which they examine the effect of the threat of entry by low-cost carrier Southwest. The likelihood of Southwest entering a route rises quickly when Southwest announces it will start operations in the second endpoint airport. The research looks at the reaction of incumbents in such routes and finds that these incumbents drop fares significantly before entry has even occurred. Moreover, they claim this is not due to any airport-specific cost shocks. These decreasing fares are accompanied by an increase in passenger traffic. They are careful with drawing conclusions on the actual motivations of the established carriers, as they say evidence is mixed on whether these airlines want to defect or accommodate entry.

More recent researches on the effect of low-cost entry on airfares has been done and all come up with similar results as their precedents. Namely that the entry of a low-cost carrier reduces the airfare in the market. (Tan, 2012; Murakami, 2011; Mertens & Vowles, 2012)

Alderighi, Cento, Nijkamp & Rietveld (2012) are among the few to conduct empirical research on the European aviation market solely. They use data on published airfares by Lufthansa, KLM, British Airways and Alitalia for the main city-pairs between Germany, the UK and Italy for the period 2001-2003. They use a dummy variable in order to capture the effect of a low-cost carrier. Among their hypotheses is the expectation that the entry of low-cost carriers reduces the average airfare in that market. They find that established carriers reduce the airfare in the market for leisure consumers as well as in the market for business consumers when at least one low-cost carrier is present. This result is in line with literature on the US market.

Franke (2004) noticed in his theoretical article on competition between network carriers and low-cost carriers that "airline alliances of network carriers have failed to prepare their members for the low-cost challenge." Strategists from network carriers are said to have found three different mistakes or errors in their initial perceptions of low-cost carriers. Among these is the recognition that low-cost carriers do not only attract new passengers, who would not have flown before, but they also alienate regular travelers and business travelers from network carriers. Those who are price sensitive are inclined to switch to low-cost carriers. Thereby, strategists of network carriers might take the moves of these low-cost carriers into account and adapt operations or strategies to it. Castillo-Manzano, Lopez- Valpuesta & Pedregal (2012) have done an empirical research on the subject of low-cost carriers and high-cost carriers in which they focus on the airline industry in Spain solely. They are investigating the future role of hubs and whether or not their role as large geographical nodes is in doubt due to the rise of the point-to-point- connections by low-cost carriers. They find how LCCs have been replacing full service network carriers (FSNCs) at the hubs for international European flights while at the same time the Spanish hubs have continued to strengthen their dominant position. This is possible since they remained dominant in the national market as LCCs attracted mostly additional demand instead of substituting for FSNCs services. Since this thesis focusses on intra-European flights the result found by Castillo-Manzana et al. (2010) is interesting and it can be expected that FSNCs adapt pricing strategies in this market. Since a gradual substitution effect has taken place between hubs by low-cost-carriers making use of secondary airports around these cities. However also within Europe they state the substitution effect is rather small, as LCCs mostly attract new demand in this market as well.

Previous literature, although mostly on US market, all showed a clear decrease in the airline fare charged by incumbents when a low-cost carrier entered or expected to enter particular routes. Theoretical research on the European aviation market showed this effect might only be moderate as LCCs attract additional demand mostly and do not steal away customers as much. However in line with previous empirical results some effect can be expected as secondary airports are also taken into account. Thereby, the fourth hypothesis is stated as follows:

**H4**: The presence of a low-cost carrier will decrease the price of airline fares charged by alliance members.

This effect has been extensively researched upon for the US. The link between price increases due to alliances and prices decreases due to low-cost carriers has not yet been made though. In line with the literature as listed above it is expected that the positive effect, of the formation of an airline alliances, is reduced when a low-cost carrier is operating on that particular route. In line with Zou et al. (2011) and as discussed before it can be expected that members of an alliance will make less use of their marker power when they are faced with tougher competition by low-cost carriers and this would dampen the positive effect of the formation of an airline alliance. In line with this the last hypothesis is as follows:

**H5**: The price effect caused by the formation of an airline alliance is lower when a low cost carrier is presently operating on the same route, relative to no presence of a low-cost carrier.

# 4. Data and Methodology

In this section the data and methodology used for this research will be explained. More details on data will be given in the next sub-section and secondly the methodology will be explained.

### *4.1 Data*

The data for this research had to be collected at first, as no such data on European flight information and prices exists readily. Therefore, the dataset used for this research is had to be collected first. Hence, it is a completely new dataset on the European airline industry. The process of data collection will be described at first. Afterwards more details on the data and corresponding variables will be provided.

#### *4.1.1. Data collection*

In order to estimate the effect of the formation of an alliance on airline pricing relevant details and characteristics of direct airline routes in Europe from city to city or also hub to hub were collected. As a start comparable routes that we were going to analyze within Europe needed to be chosen. At first it is important to have two groups of routes. One group in which the flights are from hub to hub of airlines belonging to the same alliance and a second group in which the flights are from hub to hub of airlines belonging to a different airline alliance. For example the first group contains routes such as Amsterdam – Paris. These are corresponding hubs of KLM and Air-France who both belong to the SkyTeam alliance. The second group is composed of routes such as Amsterdam – Barcelona. These are corresponding hubs of KLM (SkyTeam) and Iberia (Oneworld) and these are not members of the same alliance, as they belong to two different alliances. This distinction allows us to compare the relative prices between these two groups and calculate any potential price effect of the formation of an alliance. Secondly within these two main groups another distinction needed to me made. Namely that some of the routes need to be operated by a low-cost carrier and other routes need not to be operated by a low-cost carrier. This will enable us to find the effect of low-cost carriers on pricing strategies of alliance members. Moreover, it is important that within both groups all three alliances are represented. It is not necessary that they are equally distributed among the sample, however they should be at least well represented relative to the routes they serve within Europe. Star Alliance serves most routes within Europe and therefore it is no surprise this alliance will be relatively overrepresented in our sample.

Table 2 summarizes the construction of the dataset. As a starting point 75 routes were collected. From these 75 routes 42 routes are from hub to hub of airlines belonging to the same alliance. In 16 of these 42 routes a low-cost carrier is operating between the two cities (note that it is not necessarily the same airport) and in 26 of these routes no low-cost airline is presently operating on the same route. The remaining 33 routes are routes which are from hub to hub of airlines that do not belong to the same alliance. Thus, this second group serves as a control group. Again in this group some of these routes are also operated by a low-cost carrier, namely 20 of these routes. The remaining 13 routes are not operated by a low-cost carrier. The fares for these flights were collected at one point in time and represent one week return tickets for flights booked five days in advance as well as for flights booked one month in advance. Due to this last fact the total sample for this research consists of 150 routes. These routes are all comparable routes within Europe. Hence, this sample consists of nearly the complete hub to hub system or interhub market within Europe.

**Table 2**: Construction of routes in the dataset. Group 1 are routes from hub to hub of alliance partners. Group 2 are routes from hub to hub of members of a different alliance.

| **Routes** | **Total** | **Low-cost carrier** | **No low-cost carrier** |
|---|---|---|---|
| 1) Alliance partners | 42 | 16 | 26 |
| 2) Non-alliance partners | 33 | 20 | 13 |
| Booked one month in advance | 75 | 36 | 39 |
| Booked five days in advance | 75 | 36 | 39 |
| **Total** | **150** | 72 | 78 |

Data on hubs and airline alliances were taken  from the websites of the alliances. Fares for the particular flights were collected from the website of the airline belonging to the departure hub. Different control variables were added to the equation which are hypothesized to have an influence on the price of airline tickets. These variables and the source they were retrieved from can be found in table A1 in de appendix. Some variables enter the regression as a natural logarithm to overcome problems of potential outliers and to make the distribution of these variables close or equal to normal.

The data is cross-sectional as all data is collected at one point in time, namely on the 22nd of March. The variation in the dataset is expected not to vary over time and including more observations later in time is not expected to make a significant difference or contribution.

### *4.1.2 Description of the variables*

All the variables collected for this research will be described in this sub-section. Moreover, table 7 at the end of this section summarizes the descriptive statistics for the variables. Also two-group mean comparison tests have been performed for some independent variables and the results will be discussed in this section.

**Dependent variable**

*lnPrice*: The dependent variable of this research is *lnPrice*. It is the airline fare or also the price for a one week return ticket on a particular route. This variable is a continuous variable and will be measured in natural logarithm to overcome the problem of outliers in the sample. Prices were taken from the websites of the airlines themselves and more specifically from those belonging to the departure hub. For example the price for the route Amsterdam - Paris was collected from the website of KLM since the departure hub Amsterdam Schiphol airport is the hub belonging to KLM. All prices include taxes and other fees. Moreover, the fares include check-in of one piece of luggage and hand luggage. The dependent variable *Price* ranges in between 98.85 and 1192.96 euro.

**Main independent variables**

*Alliance:* The first main independent variable for this research is *Alliance.* This is a dummy variable which equals 1 (56%) when the endpoints of a route belong to hubs of airlines in the same alliance and 0 otherwise (44%). Table 3 summarizes the mean statistics and two-group mean comparison test results, also known as t-test on equality of means, of the variable *Alliance* relative to the dependent variable *Price* divided by *Distance*. *Price* is divided by *Distance* here since it is more interesting and valuable to compare the price per kilometer of the different sort of routes as compared to the mean price overall. From table 3 it can be seen that those routes in between endpoints of hubs of airlines in the same alliance are associated with a larger mean and standard deviation relative to those routes which are in between hubs of airlines belonging to a different alliance. Before econometrically testing this difference a two-group mean comparison test has been performed. This test is shown in table 3. This two-group mean comparison test examines whether or not the mean price per kilometer charged for routes in between hubs of alliance members differs from the mean price per kilometer charged on routes in between hubs of airlines belonging to a different alliance. As shown in table 3 the mean price per kilometer charged in between hubs of alliance members belonging to a different alliance (0) equals 0.26 while the mean price per kilometer charged in between hubs of airlines belonging to the same alliance (1) equals 0.32. However it cannot be rejected that this difference equals zero and therefore this difference is not statistically significant according to this t-test on equality of means.

**Table 3**: Two-group mean comparison test of the price (in euros) per kilometer for the dummy alliance.

| Members same alliance | Observations | Mean | Standard deviation |
|---|---|---|---|
| **NO (0)** | 84 | 0.26 | 0.13 |
| **YES (1)** | 66 | 0.32 | 0.34 |
| **Diff = Mean (0) – Mean (1)** | | -0.06 | |
| | | | |
| **Ha: diff < 0** | **Ha diff = 0** | | **Ha: diff > 0** |
| **Pr (T<0) = 0.066** | **Pr (T=0) = 0.132** | | **Pr(T>t) = 0.934** |

*Star; Sky; OW:* Three dummies have been made in order to distinguish between the three different airline alliances: Star Alliance, SkyTeam and Oneworld. These dummies will equal 1 if the hubs (endpoints) of the route belong to airlines who are both members of the corresponding alliance and 0 otherwise. Relatively most routes, 58, are routes in between hubs of members of Star Alliance. Oneworld and SkyTeam both represent 14 routes in the sample. Table 4, 5 and 6 below show the results of the two-group mean comparison tests performed for each separate alliance. From tables 4, 5 and 6 it can be seen that the mean of Star Alliance is the largest. Moreover, the two-group mean comparison test shows that the price per kilometer of routes in between hubs of Star Alliance members are associated with a significantly higher price level relative to routes which are not in between hubs of Star Alliance members. This effect is found insignificant for routes in between hubs of SkyTeam members (table 5 ). At last table 6 provides the results of the two-group mean comparison test for routes in between hubs of Oneworld alliance members, relative to routes that are not in between hubs of Oneworld alliance members. Interestingly it shows a significant positive difference of 0.1 and therefore this two-group mean comparison test shows that routes in between hubs of Oneworld alliance members are associated with a significantly lower price level per kilometer as compared to routes that are not in between hubs of Oneworld alliance members. Therefore, it is interesting to empirically test the effect of Star alliance, SkyTeam and Oneworld separately on the price level and compare the different alliances, as the mean comparisons already reveal a difference among these three.

**Table 4**: Two-group mean comparison test of the price (in euros) per kilometer for Star Alliance.

| Members Star Alliance | Observations | Mean | Standard deviation |
|---|---|---|---|
| **NO (0)** | 92 | 0.25 | 0.1 |
| **YES (1)** | 58 | 0.37 | 0.41 |
| **Diff = Mean (0) – Mean (1)** | | -0.12 | |
| | | | |
| **Ha: diff < 0** | **Ha diff = 0** | | **Ha: diff > 0** |
| **Pr (T<0) = 0.017** | **Pr (T=0) = 0.034** | | **Pr(T>t) = 0.983** |

**Table 5**: Two-group mean comparison test of the price (in euros) per kilometer for SkyTeam alliance.

| Members SkyTeam | Observations | Mean | Standard deviation |
|---|---|---|---|
| **NO (0)** | 136 | 0.29 | 0.24 |
| **YES (1)** | 14 | 0.29 | 0.23 |
| **Diff = Mean (0) – Mean (1)** | | 0.005 | |
| | | | |
| **Ha: diff < 0** | **Ha diff = 0** | | **Ha: diff > 0** |
| **Pr (T<0) = 0.549** | **Pr (T=0) = 0.901** | | **Pr(T>t) = 0.450** |

**Table 6**: Two-group mean comparison test of the price (in euros) per kilometer for Oneworld Alliance.

| Members Oneworld | Observations | Mean | Standard deviation |
|---|---|---|---|
| **NO (0)** | 136 | 0.3 | 0.28 |
| **YES (1)** | 14 | 0.2 | 0.08 |
| **Diff = Mean (0) – Mean (1)** | | 0.1 | |
| | | | |
| **Ha: diff < 0** | **Ha diff = 0** | | **Ha: diff > 0** |
| **Pr (T<0) = 0.998** | **Pr (T=0) = 0.004** | | **Pr(T>t) = 0.002** |

*LCC:* Another important independent variable included in this research is low-cost carrier. This dummy variable will equal 1 if there is at least one low-cost carrier flying between the corresponding two cities as well and 0 otherwise. Note that in order to equal 1 this does not necessarily have to be the same airports or hubs in between which the low-cost carrier operates. Low-cost carriers make a lot of use of secondary airports as well. Therefore, these should be taken into account when we are trying to measure the competitive effect of low-cost carriers.

**Control variables**

Besides the main independent variables this research includes several control variables as well. These are the following:

*lnDistance:* The continuous variable distance enters the regression as a natural logarithm. It is expected that distance and price are positively related as an increase in distance is expected to increase the costs and hence the fare of airline tickets.

*Onemonth:* This dummy variable equals 1 if the ticket is booked one month in advance and 0 otherwise (five days in advance). Prices are expected to be lower when booked one month in advance. Airlines are known to increase prices towards approaching the date of the flight. Airlines can get away with charging higher prices now since consumers will have fewer other options available when a ticket is booked five days in advance as compared to one month in advance.

*lnPopdep:* This variable stands for the population of the city of departure. It is continuous and is transformed into a natural logarithm. The population of the city of departure is included in order to capture the effect of demand. The larger the population of the city of departure is the more demand there will be. However, the effect it has on the price level is not clear a priori. It can have a price increasing effect since demand will be higher. On the other hand it could be the case that there is also more supply and competition as a result to this, which would again lead to a decrease in prices.

*lnGDPdep:* This variable stands for GDP per capita of the city of departure and is also included to capture the effect of demand. This variable is continuous and enters the regression as a natural logarithm. Also here the effect is not clear a priori.

*lnPoparr:* Besides population for the city of departure, population for the city of arrival is included in this research as well order to control for any demand effects. Also this variable is continuous and enters the regression as a natural logarithm. The relationship with the price level cannot be determined a priori.

*lnGDParr:* GDP per capita for the city of arrival is included for the same reason as for the city of departure. And for the same reason as for city of departure the effect this variable has on the price level cannot be determined a priori. This variable is continuous and transformed into a natural logarithm as well.

*Coast:* This variable enters the regression as a dummy. It will equal 1 if the city of arrival is located near the coast and serves as a destination to other holiday areas (Barcelona & Lisbon) and 0 otherwise. It can be expected that the price of tickets to cities that serve as a gateway to other holiday areas are more expensive as demand to these airports will be higher. On the other hand it can be argued that more alternative transport to these cities and areas exists and as a cause of that prices can be expected to be lower as well.

*Comp:* This variable stands for competition. It is a count variable and measures the number of airlines that is, besides the low-cost carrier, also presently operating between the two cities. Since the low-cost carriers are already measured with *LCC* this variable measures all competitors minus one if at least one low-cost carrier is presently operating. This is necessary in order to capture the effect of competition most efficiently. It avoids problems of collinearity while at the same time includes competition effects by more than one low-cost carrier. The minimum number of competitors in the sample is one and the maximum number of airlines found is six. It is expected that airlines will reduce prices when there is more competition on the route, as customers will have better possibilities to switch. Therefore, competition and price are expected to be negatively related.

*Business:* This variable enters the regression as a dummy variable. It equals 1 when the city of arrival is considered a business city and 0 otherwise. A city is considered a business city when it is included in the top 10 of best cities to locate a business (Cushman & Wakefield, 2011). This variable is expected to be positively related to price, as demand is relatively high and inelastic between these cities.

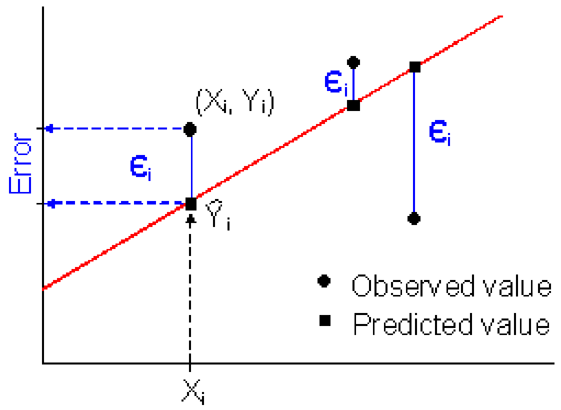
**Table 7**: Descriptive statistics of the variables. In the first row the total number of observations are displayed. In the second row the number of observations for either 0 or 1 is displayed for all dummy variables. In the next rows the mean, standard deviation, min and max are only displayed for the continues variables.

| Variable | Obs | | | Mean | St. dev. | Min | Max |
|---|---|---|---|---|---|---|---|
| | **Total** | **0** | **1** | | | | |
| *Price* | 150 | | | 297.32 | 148.71 | 98.85 | 1192.96 |
| | | | | | | | |
| *Alliance* | 150 | 66 | 84 | | | | |
| *Star* | 150 | 92 | 58 | | | | |
| *OW* | 150 | 136 | 14 | | | | |
| *Sky* | 150 | 136 | 14 | | | | |
| *LCC* | 150 | 76 | 74 | | | | |
| | | | | | | | |
| *Distance* | 150 | | | 1255.57 | 637.58 | 309 | 3418 |
| *Onemonth* | 150 | 75 | 75 | | | | |
| *Popdep* | 150 | | | 24896 | 23409 | 5117 | 66194 |
| *GDPdep* | 150 | | | 37592 | 6680 | 2300 | 55300 |
| *Poparr* | 150 | | | 24386 | 22379 | 5117 | 66194 |
| *GDParr* | 150 | | | 35980 | 7803 | 2300 | 55300 |
| *Comp* | 150 | | | | | 1 | 6 |
| *Business* | 150 | 76 | 74 | | | | |
| *Coast* | 150 | 134 | 16 | | | | |

### *4.2 Methodology*

In this section the model used for this research will be explained. Already mentioned before the variation in the dataset is cross-sectional and is expected not to vary over time. This means that it will make the method selection process for this research relatively easy and straightforward. The main method used to answer the research question through the different hypotheses will be Ordinary Least Squares (OLS) regression. OLS is a basic model to estimate unknown parameters in a linear regression model. Figure 3 shows how the model is tested. OLS estimates the beta's by minimizing the sum of the squared residuals ($\varepsilon^2$). The residual, ε, is the difference between the actual Y and the predicted Y and has a zero mean. In other words it can be said that OLS calculates the coefficients of the slopes in order to minimize the difference between the predicted Y and the actual Y (Studenmund, 2006).

**Figure 3**: Ordinary Least Squares regression (University of Victoria, 2001).




Three different regression equations will be used in this research in order to test the five hypotheses. The first and basic regression equation for this research will be the following:

(1) $lnPrice=\beta_0 + \beta_1(Alliance) + \beta_2(LCC) + \beta_3\ (Control\ variables) + \varepsilon$

The *Alliance* variable allows us to test the effect of the formation of an alliance on the independent variable *lnPrice*. Hence it allows us to test hypothesis one.

Regression equation 1 is the main model for this research and used to test hypothesis one, and as we will later show also hypothesis four. In order to test the other hypotheses more models will be estimated. The regression equation that is estimated and allows us to answer hypothesis two and three will be the following:

(2) $lnPrice=\beta_0 + \beta_1(Star) + \beta_2(Sky) + \beta_3(OW) + \beta_4(LCC) + \beta_5(Control\ variables) + \varepsilon$

The *Alliance* variable from equation 1 is now replaced by three separate alliance dummies. This regression allows us to compare the effects of the three different alliances: Star Alliance, SkyTeam and Oneworld. This would enable us to test hypothesis two. Moreover, the comparison of the three coefficients will allow us to see whether or not the effect for *Star* will be the largest and in line with this hypothesis three can be tested.

In order to test hypothesis four the same model as regression equation one will be estimated. Only now not *Alliance* will be our main independent variable to interpret but *LCC.* The coefficient of *LCC* will measure the effect of the presence of a low-cost carrier on the independent variable *lnPrice*. Regression equation one:

(1) $lnPrice=\beta_0 + \beta_1(Alliance) + \beta_2(LCC) + \beta_3 (Control\ variables) + \varepsilon$

At last several interaction terms will be included in the regression. These terms will allow for possible non-linearities in the above models. It is expected that the effect of the formation of an alliance is different when there is a low-cost carrier present, relative to a situation in which the airline faces no competition from a low-cost carrier. In other words we expect the variable *Alliance* to be significantly modified by the variable *LCC.* Thereby, the estimated equation for this hypothesis will look as follows:

(3) $lnPrice=\beta_0 + \beta_1(Alliance) + \beta_2(LCC) + \beta_3 (Alliance * LCC) + \beta_4 (Control\ variables) + \varepsilon$

In which (Alliance * LCC) represents the interaction term. Moreover, there will be interaction terms constructed and included for the three separate alliances as well. Thereby, the equation following from this is regression equation 4:

(4) $lnPrice=\beta_0 + \beta_1(Star) + \beta_2(Sky) + \beta_3(OW) + \beta_4(LCC) + \beta_5 (Star * LCC) + \beta_6 (Sky * LCC) + \beta_7 (OW * LCC) + \beta_8 (Control\ variables) + \varepsilon$

These two regression equations, 3 and 4, will be interpreted in order to test the last hypothesis.

In order to test if the models are correctly specified the Ramsey (RESET) test is conducted. This test is used in order to detect any misspecification such as nonlinearities or omitted variables. Conducting this test provides us with a p value of 0.6650 and from this we can conclude that there is no misspecification and that our main model is correctly specified.

Secondly we check for problems of multicollinearity by running a correlation matrix between all the variables. From this table no problematic collinearity problems seem to arise. It can be seen from table 8 that *Comp* and *LCC* are highly, however not problematically, correlated. From a theoretical point of view they are closely related since the routes on which a low-cost carrier is present will most likely and correspondingly be the routes on which competition is high.

**Table 8**: Correlation matrix

| | lnPrice | Alliance | LCC | lnDist~e | lnPopdep | lnGDPdep | lnPoparr | lnGDParr | Onemonth | Coast | Business |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alliance | 0.211 | | | | | | | | | | |
| LCC | -0.214 | -0.200 | | | | | | | | | |
| lnDistance | 0.339 | 0.129 | -0.013 | | | | | | | | |
| lnPopdep | -0.146 | -0.227 | 0.495 | -0.141 | | | | | | | |
| lnGDPdep | -0.113 | -0.126 | -0.092 | -0.447 | -0.230 | | | | | | |
| lnPoparr | -0.014 | -0.073 | 0.302 | -0.057 | 0.030 | 0.175 | | | | | |
| lnGDParr | -0.170 | 0.040 | -0.132 | -0.174 | -0.175 | 0.036 | -0.149 | | | | |
| Onemonth | -0.446 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | |
| Coast | 0.172 | 0.132 | 0.005 | 0.244 | 0.030 | 0.041 | 0.049 | -0.551 | -0.000 | | |
| Business | -0.024 | -0.200 | 0.093 | -0.218 | 0.019 | 0.150 | 0.467 | 0.107 | 0.000 | -0.082 | |
| Comp | -0.275 | -0.320 | 0.428 | -0.011 | 0.380 | 0.135 | 0.237 | 0.078 | 0.000 | 0.199 | 0.257 |

Finally the models are tested on the presence of heteroskedasticity for the dependent variables. When the model exhibits heteroskedasticity this can become problematic when performing an OLS-regression, since it can invalidate interferential statistics such as the t- and F-values. This is due to incorrect calculation of the standard errors by OLS and the calculation of the inferential statistics is mostly based on these standard errors. This does not mean that the entire OLS-analysis is biased it simply indicates that the inferential statistics cannot be trusted (Studenmund, 2006). Therefore, we test the regressions on heteroskedasticity by performing a Breusch-Pagan test. When performing the Breusch-Pagan test on the independent variables the resulting p value equalled 0.00. From this it can be concluded that these variables suffer from heteroskedasticity. In order to prevent the consequences from heteroskedasticity all the regressions will be run using White standard errors also known as robust standard errors.

# 5. Empirical results

In this chapter the results for the different regression equations will be discussed. The five hypotheses will be tested and results will be further elaborated on. Several robustness checks have been done as well in order to generate reliable results. At first the focus will be on the effect of the formation of an alliance on the airline fare which relates to hypothesis one, two and three. Secondly the effect of low-cost carriers and corresponding results will be discussed, which is related to the fourth hypothesis. At last these effects are combined and it is tested whether or not the effects influence each other as hypothesised in hypothesis five.

## *5.1 Regression results airline alliances*

Table 9 summarises the main regression results used in order to test hypothesis one. Different regressions were run and robustness checks were incorporated. Regression equation one in the table is the first regression run with only the main independent variable *Alliance* on the dependent variable *lnPrice* and no control variables added yet. In this regression the positive and statistically significant effect of *Alliance* can be seen immediately. Regression equation two adds the second main independent variable of this research *LCC*. It can be seen that *Alliance* changes slightly and remains significant. As a next step some of the control variables are added to the equation, which can be seen in the third column. In the fourth column all the control variables are added to the equation. Thus, the third column serves as a step in between. It can be seen from the table that the control variables *lnPopdep; lnGDPdep; lnPoparr;lnGDParr* were found insignificant in the fourth column. Also, it can be seen that the value of the adjusted R-squared is slightly larger in the third column, which already suggests these four control variables could be left out. In addition an F-fest has been performed in order to test whether or not these four variables are jointly significant. From this F-test it could be concluded that these four variables are not jointly significant. Hence they were left out of the equation in the third column in order to check whether *Alliance* is significant in this case. However, the variable *Alliance* is insignificant in the fourth column as well as in the third column. More robustness checks have been made and different regressions were run. The variable *Alliance* remained positive and statistically insignificant though. Therefore, we can conclude that the formation of an alliance does not seem to have an influence on the price of airline tickets. In line with this hypothesis one cannot be confirmed.

It can be seen from table 9 that the control variables: *lnDistance*, *Business, Comp,* and *Onemonth* are statistically significant and signs are in line with expectations. Especially the one month dummy has a remarkable large impact on the price level. Prices are 39% lower when tickets are booked one month in advance, as compared to five days in advance, ceteris paribus.

**Table 9**: Results regression equation alliances overall. All regressions incorporate robust standard errors.

| | (1)<br>lnPrice | (2)<br>lnPrice | (3)<br>lnPrice | (4)<br>lnPrice |
|---|---|---|---|---|
| Alliance | 0.186*** | 0.155** | 0.064 | 0.084 |
| LCC | | -0.157** | -0.079 | -0.121* |
| lnDistance | | | 0.282*** | 0.338*** |
| Onemonth | | | -0.390*** | -0.390*** |
| Coast | | | 0.216*** | 0.160 |
| Business | | | 0.135** | 0.136** |
| Comp | | | -0.112*** | -0.123*** |
| lnPopdep | | | | 0.065 |
| lnGDPdep | | | | 0.224 |
| lnPoparr | | | | 0.013 |
| lnGDParr | | | | -0.041 |
| _cons | 5.490*** | 5.585*** | 3.959*** | 0.913 |
| *N* | 150 | 150 | 150 | 150 |
| *Adj-$R^2$* | 0.038 | 0.063 | 0.414 | 0.412 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Hypotheses two and three can be answered with help of table 10 and the corresponding regressions and results. At first it can be seen from the table that the *Alliance* dummy is now replaced by the three different alliance dummies. The variables *Sky, OW* and *Star* represent the three worldwide airline alliances. It can be seen immediately from the table that these three variables differ in their coefficients and significance level. In table 10 three different regressions are shown. Regression one does not add any control variables yet and shows the effect of the main independent variables, *Star;Sky;OW*, on the dependent variable *lnPrice*. Regression two adds the second main independent variable of this research *LCC.* Signs and significance level of the three alliance dummies remain the same and coefficients change only slightly. Regression equation three is the correct regression to interpret as all the control variables are added to this equation. The coefficient of *Sky* is negative and statistically insignificant. *OW* has a positive coefficient, in line with the predictions of the two-group mean comparison test, however it is statistically insignificant now. The coefficient of *Star* is positive by 0.317 and, as the only one of the three, statistically significant at a 1% significance level. According to these results airline fares on routes in between hubs of Star Alliance members will be on average 31.7% higher, relative to routes which are not in between hubs of Star Alliance members, ceteris paribus. Members of SkyTeam and Oneworld do not impose a statistically significant increase or decrease on the price level. Hypothesis two and three are confirmed, as the price effects differ and Star Alliance has relatively the largest positive impact on the price level. This can be due to the relative market power of Star Alliance within Europe. This alliance network has the most members and serves the most routes within Europe and, as already shown before, consequently their routes are overrepresented in the sample. Star Alliance might benefit from their market power by being able to increase the prices on parallel routes they are serving within Europe.

Moreover it can be seen from the table that the control variables *lnDistance, lnPopdep, lnGDPdep, Onemonth, Business* and *Comp* are statistically significant. Interestingly *lnPopdep* and *lnGDPdep* were insignificant in table 9. Replacing the dummy *Alliance* by these three separate dummies turns these control variables significant. At last signs are in line with expectations.

**Table 10:** Regression results three different alliances. All regressions incorporate robust standard errors.

| | (1) | (2) | (3) |
|---|---|---|---|
| | lnPrice | lnPrice | lnPrice |
| Sky | -0.0318 | -0.023 | -0.145 |
| OW | 0.193 | 0.188 | 0.006 |
| Star | $0.321^{***}$ | $0.289^{***}$ | $0.317^{***}$ |
| LCC | | -0.094 | $-0.125^{**}$ |
| lnDistance | | | $0.386^{***}$ |
| lnPopdep | | | $0.172^{***}$ |
| lnGDPdep | | | $0.547^{***}$ |
| lnPoparr | | | 0.063 |
| lnGDParr | | | -0.071 |
| Onemonth | | | $-0.390^{***}$ |
| Coast | | | 0.013 |
| Business | | | $0.123^{*}$ |
| Comp | | | $-0.122^{***}$ |
| _cons | $5.455^{***}$ | $5.513^{***}$ | -4.068 |
| *N* | 150 | 150 | 150 |
| *Adj-R*$^2$ | 0.108 | 0.112 | 0.476 |

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

## 5.2 Regression results low-cost carriers

In order to answer hypothesis four table 11 shows us the regressions and corresponding results. Hypothesis four hypothesised low-cost carriers to have a negative effect on the price level. From all four regressions it can be seen immediately that hypothesis four is confirmed, as *LCC* has a negative and statistically significant coefficient in all four regressions. Regression equation one shows the effect of *LCC* on the dependent variable *lnPrice*. Regression equation two adds the second main independent variable *Alliance* and the coefficient of *LCC* slightly changes. All the control variables are added in the third regression. The coefficient *LCC* equals -0.121 and is statistically significant at a 10% significance level. According to these results the presence of a low-cost carrier in a particular route decreases the airline fare charged by alliance members by 12.1%, relative to a route in which no low-cost carrier is operating, ceteris paribus. Moreover alliance members take other competitors, besides the low-cost carrier, into account as well. The coefficient *Comp* equals -0.123 and is statistically significant at a 1% significance level. Meaning that an increase in competition by one carrier will decrease the airline fare charged by alliance members by 12.3%, ceteris paribus.

Table 11 displays a fourth column which represents the fourth regression. In this regression the *Alliance* dummy is replaced by the three separate dummies *Sky,OW* and *Star.* The coefficient of *LCC* becomes statistically significant at a 5% significance level and the effect increases slightly. From this regression it can be concluded that the presence of a low-cost carrier in a particular route will decrease the airline fare charged by alliance members by 12.5%, relative to a route in which no low-cost carriers is operating, ceteris paribus.

**Table 11**: Regression results low-cost carrier. All regressions incorporate robust standard errors.

| | (1)<br>lnPrice | (2)<br>lnPrice | (3)<br>lnPrice | (4)<br>lnPrice |
|---|---|---|---|---|
| LCC | -0.187*** | -0.157** | -0.121* | -0.125** |
| Alliance | | 0.155** | 0.084 | |
| Sky | | | | -0.145 |
| OW | | | | 0.006 |
| Star | | | | 0.317*** |
| lnDistance | | | 0.338*** | 0.006 |
| lnPopdep | | | 0.065 | 0.317*** |
| lnGDPdep | | | 0.224 | 0.547*** |
| lnPoparr | | | 0.013 | 0.063 |
| lnGDParr | | | -0.041 | - 0.071 |
| Onemonth | | | -0.390*** | -0.390*** |
| Coast | | | 0.160 | 0.013 |
| Business | | | 0.136** | 0.123* |
| Comp | | | -0.123*** | -0.122*** |
| _cons | 5.687*** | 5.585*** | 0.913 | -4.068 |
| *N* | 150 | 150 | 150 | 150 |
| *Adj-$R^2$* | 0.039 | 0.062 | 0.412 | 0.476 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

From table 11 it could be concluded that the presence of a low-cost carrier has a price decreasing effect on the airline fares charged by alliance members. In table 12 the effect of a low-cost carrier on the price level is looked into more specifically. The sample is now split into three different groups of routes. Previously each column represented a different regression for the whole sample. Now that the sample is split into three different groups of routes the first three columns represent these different routes and the fourth column is an extra regression run for the fourth group. This allows us to test whether the effect, of the presence of a low cost-carrier, differs among the different sort of groups within our sample. The firsts two groups are the main groups and first distinction made in our sample, as explained in the data section. Column 1 represents group one in the sample. This group consists of routes in between hubs of alliance members of SkyTeam, Oneworld or Star Alliance. For example Amsterdam – Paris which is in between hubs of SkyTeam members. The second column represents routes in between hubs of airlines who belong to a different alliance. For example Amsterdam – Barcelona (SkyTeam and Oneworld). And besides these two main groups a last group is taken into account in the third and fourth column. This third group consists of flights from hub to hub of airlines who both belong to Star Alliance. For example Frankfurt – Stockholm. This last group is taken into account since Star Alliance was the only alliance found to have a significant effect on the price level. Therefore it is interesting to test what the effect of the presence of a low-cost carrier is for those routes in between Star Alliance hubs only.

First taking a look at the first three regressions shows us that the coefficient *LCC* is found to be insignificant in all three groups. Interestingly however is that differences among three groups exists in significance level of other variables. This means that different variables have an influence on the price level. For example *Coast* is found to have a significant influence on the price level in groups one and two. However it is not significantly influencing the price level for flights operated by Star Alliance. For routes in between hubs of Star Alliance members *lnPoparr*, *Onemonth*, and *Business* are the only three variables found to significantly influence the price level in column 3. Notable is that population of arrival is not found significant in any of the other groups or any of the regressions over the whole sample. Even more surprising and questionable is the fact that *lnDistance* is found to significantly influence the price level for groups one and two however it is not found to have an influence on the price level of flights operated by Star Alliance, as the coefficient of *lnDistance* is insignificant in regression three. Distance can be expected to influence the price level in all different groups. This variable is related to an increase in costs and hence it can be expected that also routes operated by Star Alliance will be more expensive the further away they are. Therefore we have looked at the dataset more specifically and suspected that the variable *Business* might have driven this insignificant result. Routes operated in between business cities and hubs of Star Alliance were found to be, on average, strikingly higher. Therefore a fourth regression was run in which an interaction term is included to capture the effect of business on distance for Star Alliance members. The third variable in the fourth column, *lnDist*Business*, represents this interaction term. It can be seen immediately that this interaction term is statistically significant at a 1% significance level, moreover so is the variable *lnDistance* now. The signs of the coefficients are in line with expectations. The coefficient of *Business* changes and becomes more positive by a significant large difference and its significance level increases from 10% to 1%. From this we can conclude that for flights operated in between hubs of Star Alliance members distance has a smaller effect for those routes in between business cities. It is interesting to look at the different sort of routes more specifically however the sample would need to be larger to compare the three alliances.

**Table 12**: Regression results three different routes and four different regressions. Regression 1: Hub to hub of members belonging to same alliance. Regression 2: Hub to hub of members belonging to a different alliance. Regression 3: Hub to hub of members belonging to Star Alliance. Regression 4: Hub to hub of members belonging to Star Alliance with an included interaction term for business and distance. All regressions include robust standard errors.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | lnPrice | lnPrice | lnPrice | lnPrice |
| LCC | -0.00298 | -0.102 | 0.116 | 0.0245 |
| lnDistance | 0.301*** | 0.423*** | 0.169 | 0.431*** |
| lnDist*Business | | | | -0.668*** |
| lnPopdep | -0.00163 | 0.119** | -0.0842 | -0.0465 |
| lnGDPdep | 0.244 | 0.390 | 0.209 | 0.241 |
| lnPoparr | -0.0135 | 0.0988** | -0.186* | -0.146 |
| lnGDParr | 0.198 | -0.186 | -0.342 | -0.629* |
| Onemonth | -0.423*** | -0.349*** | -0.470*** | -0.470*** |
| Coast | 0.414*** | -0.304** | 0.218 | -0.0778 |
| Business | 0.287*** | -0.102 | 0.334* | 4.943*** |
| Comp | -0.207*** | -0.0520 | -0.165 | 0.0368 |
| _cons | -0.529 | -1.313 | 8.815 | 8.605 |
| *N* | 84 | 66 | 58 | 58 |
| *Adj-* $R^2$ | 0.464 | 0.403 | 0.339 | 0.467 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

### *5.3 Regression results alliances and low-cost carrier*

Finally several interaction terms were constructed and included in the regression, in order to check whether low-cost carriers modify the impact of the formation of an alliance on the price level. Results can be seen in tables 13 and 14. The interaction terms are printed bold in the tables**.** All these interaction terms are statistically insignificant. Therefore, it cannot be said that the effect of the formation of an alliance is modified by the presence of a low-cost carrier, not for an alliance overall nor for the three separate alliances. In line with this hypothesis 5 could not be confirmed. This can be due the fact that these interaction terms have relatively large standard errors.

**Table 13**: Regression results alliances and low-cost carrier interaction term included. All regressions incorporate robust standard errors.

| | (1)<br>lnPrice | (2)<br>lnPrice |
|---|---|---|
| Alliance | 0.270** | 0.156 |
| LCC | -0.031 | -0.052 |
| **Alliance*LCC** | -0.222 | -0.132 |
| lnDistance | | 0.336*** |
| lnPopdep | | 0.065 |
| lnGDPdep | | 0.262 |
| lnPoparr | | 0.022 |
| lnGDParr | | -0.045 |
| Onemonth | | -0.390*** |
| Coast | | 0.139 |
| Business | | 0.122* |
| Comp | | -0.120*** |
| _cons | 5.509*** | 0.447 |
| *N* | 150 | 150 |
| $Adj\text{-}R^2$ | 0.072 | 0.412 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

**Table 14**: Regression results different alliances with interaction terms. All regressions incorporate robust standard errors.

| | (1) | (2) |
|---|---|---|
| | lnPrice | lnPrice |
| Sky | -0.044 | -0.179 |
| OW | 0.288 | 0.103 |
| Star | 0.344*** | 0.379*** |
| LCC | -0.034 | -0.071 |
| **Sky*LCC** | 0.022 | 0.037 |
| **OW*LCC** | -0.169 | -0.175 |
| **Star*LCC** | -0.126 | -0.122 |
| lnDistance | | 0.385*** |
| lnPopdep | | 0.177*** |
| lnGDPdep | | 0.561*** |
| lnPoparr | | 0.071 |
| lnGDParr | | -0.056 |
| Onemonth | | -0.390*** |
| Coast | | 0.017 |
| Business | | 0.131* |
| Comp | | -0.122*** |
| _cons | 5.476*** | -4.530 |
| *N* | 150 | 150 |
| *Adj-$R^2$* | 0.099 | 0.470 |

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

# 6. Discussion & limitations and suggestions for further research

In the first part of this chapter the results as described in chapter five will be discussed further and will be related to the hypotheses and previous literature. Moreover, a more in depth explanation will be provided for those unexpected as well as expected results. At last, some societal and managerial implications in line with the results of this research will be discussed. In the second part of this chapter some limitations on this research will be provided. In line with these limitations suggestions for future research will be discussed as well.

### *6.1 Discussion and implications of the results*

At first the overall effect of the formation of an alliance on parallel routes has been found to be insignificant. Hypothesis 1 that needed to be tested is the following:

**H1**: The formation of an airline alliance has a positive and hence price increasing effect on the airfare, relative to no airline alliance.

This hypothesis could not be confirmed. This outcome was unexpected and not in line with previous literature, as these researches all found a price increasing effect of alliances in parallel routes (Park, 1997; Park & Zhang, 2000; Brueckner, 2001; Bilotkach, 2005; Czerny 2009). Interestingly this research found no effect at all of the formation of an alliance overall. Neither price increasing or decreasing effects, as the results were found to be insignificant. However, we looked into this more specifically and considered the effect of Oneworld SkyTeam and Star Alliance separately as well.

Before empirically testing the regressions we expected there to be a difference among the three large alliances. Previous literature (Zou et al., 2011; Wan et al., 2009) found the price effect to differ between the three alliances. This could be the cause of a difference in market power and trade-off between efficiency gains and anti-competitive effects. Hence this research tried to take a difference between the three large alliances into account. Thereby, a second hypothesis was introduced:

**H2**: The price effect, of the formation of an airline alliance, differs between the different airline alliances Oneworld, Skyteam and Star Alliance.

This hypothesis could be confirmed. Moreover within Europe Star Alliance serves relatively most routes. Also they are the largest alliance and have, relative to Oneworld and SkyTeam, most European members and therefore control a lot of European hubs. Taking competitive power into account, as suggested by previous literature, led us to introduce a third more specific hypothesis:

**H3**: The price effect, of the formation of an airline alliance, is larger for Star Alliance as compared to Skyteam and Oneworld.

This third hypothesis could be confirmed. Before empirically testing this effect taking a closer look at the dataset, and more specifically the airline fares, already revealed a difference among the three. Star Alliance had the largest mean and standard deviation. Also the highest price of a ticket belonged to a route served by Star Alliance. The effects of the formation of an alliance on the price level were found to be insignificant for Oneworld and Skyteam. Star Alliance is the only alliance which, according to the results, had a significant and increasing effect on the price level. Zou et al. (2011) and Wan et al. (2009) preceded this research in making a distinction between the three large alliances and in line with these researches and our results future research should continue to do so.

The unexpected insignificant effect found for hypothesis one is probably driven by the insignificant coefficients of SkyTeam and Oneworld. Thereby, it is important to make a distinction between the different alliances, as they might not behave similar across all regions. Their behaviour probably depends, among other factors, on the market power within a particular region. Star Alliance can get away with imposing price increases on routes within Europe, as they are overrepresented within Europe and hard to avoid for consumers. The price increase found to be present for Star Alliance routes was remarkably high. It can be questioned if Star Alliance members transfer part of the efficiency gains, created in the formation of an alliance, to the consumers. In line with the European Commission's rules anti-competitive behaviour should be avoided. However one can question now whether this is the case within the interhub network of Europe. Especially on those routes in which Star Alliance is overrepresented and market power is used or abused.

At last the growing competition of low-cost carriers was taken into account in this analysis. Empirical literature on the effect and consequences of low-cost carriers within Europe is still really slender. Even though the European airline industry has been swept by low-cost carriers such as Ryanair and Easyjet. Based on empirical literature on the US airline industry (Strassmann 1990; Whinston & Collins 1992; Dresner et al. 1996; Vowles 2000, Golsby & Sylverson 2008) and the European airline industry (Alderighi et al. 2012) the fourth hypothesis was formed:

**H4**: The presence of a low-cost carrier will decrease the price of airline fares charged by alliance members.

We could confirm hypothesis four. Overall the presence of a LCC, in a particular route, has a price decreasing effect on the airline fare charged by alliance members. We further tested whether or not this result differed among the different groups of routes. We checked whether or not the variable had another impact on routes which were from hub to hub of members in the same alliance compared to routes in between hubs of airlines belonging to different alliances. More specifically we tested the impact of a low-cost carrier on routes served by Star Alliance separately as well. Thereby, three different groups were taken into account. However no such effect for the specific routes was found to be significant. As a result no link with use of marker power could be found here. Interesting to note from the comparison of these three different routes is that different variables were found to have a significant influence on the price level. For example GDP per capita of the city of arrival is now suddenly found to have a significant and negative impact on the price level of routes in between Star Alliance hubs and not in any of the other routes. It could be the case that the supply of Star Alliance in these cities is larger. They may for example operate more flights to these 'wealthier' regions or operate on these routes with larger airplanes, which would enable a negative price effect.

At last it was questioned whether or not low-cost carriers had a dampening effect on the expected positive effect of the formation of an airline alliance. Hereby low-cost carriers were not only expected to decrease the prices charged by alliance members, they were also expected to influence the use of market power by alliance members. Hence the fifth hypothesis stated was the following:

**H5**: The price effect caused by the formation of an airline alliance is lower when a low cost carrier is presently operating on the same route, relative to no presence of a low-cost carrier.

However, no such effect was found. Since the alliance dummy was found to be insignificant this effect was also tested more specifically for Star Alliance, as this dummy was found to have a positive effect on the price level. However, neither for Star nor for other alliances this interaction term was found significant. Thereby, it cannot be said that the effect of forming an alliance is modified by the competition of low-cost carriers.

Overall it can be concluded that the formation of an alliance has a positive effect on the price level for routes in between hubs in Europe. However, this effect is only present when alliances reach a certain level of size in which they are large enough and well enough represented in the market to use their relative market power. In Europe this means that only the formation of Star Alliance has an increasing effect on the price level in the European interhub market. It might be the case that alliances behave in this way when they have reached a certain threshold of market power. Oneworld and SkyTeam would not yet have reached this threshold and hence do not impose price increases on their consumers. Moreover, low-cost carriers across Europe have a negative effect on the price level in the interhub markets. Overall their increasing presence decreases the fares charged by alliance partners in these routes.

The hub to hub system is widely used in Europe. Business trips and city trips have been increasing over the years and the formation of airline alliances has not benefited consumers. The effect of the formation of an alliance on the price level can be seen as a tradeoff between anti-competitive effects and cost reductions. Within Europe anti-competitive effects clearly dominate. The efficiency gains, created in the formation of an airline alliance, are not transferred to consumers in Europe. Since alliance members do not impose price reductions on airline tickets as a consequence of lower operating costs. It is even the case that when alliances have reached a certain level of size they impose price increases and (ab)use their relative market power. This is not in line with the rules set by the European Commission, as consumers welfare is at stake and market power should not be abused by alliances.

Besides the implications for society some managerial implications can be thought of as well. Being a member of Star Alliance enables airlines to impose price increases on parallel routes within Europe. If it is the case that alliances can impose these increases when they have reached a certain threshold of market power it is beneficial for airlines in an alliance to expand on the number of members and routes within a region. If they are large enough and hard to avoid for consumers they can use their market power and benefit from increasing prices while at the same time reducing costs.

### *6.2 Limitations and suggestions for further research*

This research was the first research to empirically test the effect of the formation of an alliance and increasing presence of low-cost carriers on European interhub airlines fares. This research can be seen as a stepping stone towards further research. No data on European airline fares exists readily. Therefore, the data had to be collected first and a new dataset has been created. The sample collected for this research is limited on several areas though.

At first, this research focused on parallel markets within Europe solely. We suggested that Star Alliance might (ab)use their relative market power and European Commission rules are not directly followed. Future research could extend this analysis on the European market by including an analysis on complementary markets as well. Since it could be that airlines have reduced airline fares in complementary markets as a consequence of forming an alliance. Secondly, the sample is still rather small. Increasing the sample would be a good start for further research to continue to compare the different alliances. In line with previous papers and the results of this analysis it is important to take the relative size of different alliances into account and make a distinction between the three large alliances. SkyTeam and especially Oneworld are relatively underrepresented within Europe. In order to generate reliable results and a more in depth comparison across these alliances an increase in the sample is needed. We hypothesized the effect of the formation of an alliance to be modified by the effect of the presence of a low-cost carrier. The interaction terms created had relatively large standard errors though and were found to be insignificant. An increase in the sample would allow to better test these interaction terms and might even make them significant. Moreover, this research already suggested that there is difference in the variables influencing the price level across these alliances. Hence, it would be interesting to further test this with a larger sample. Thirdly, this research only focused upon economy class tickets. Future research could make a distinction between economy class tickets and business class tickets. This would enable research to show whether or not airlines behave differently towards their different types of consumers. Moreover, this research did not make a distinction between the different types of alliances. However, previous research shows that price effects differ between those alliances that are granted antitrust immunity and those who don't. The same holds for code-sharing alliances and non-code-sharing alliances. Thereby, it might be interesting to take this into account in the future since these rights are not granted automatically among all alliance members.

We expected the effect of alliances and low-cost carriers not to vary over time and because of that the data was collected at one point in time. This made the model selection process relatively simple and a basic OLS model has been worked with. Future research could extend and enhance the credibility of the results of this research by including more moments in time and collect the fares for the same routes multiple times. This will lead to the construction of a panel data set and will extend this research. The models can then be estimated by different models such as a random effects (RE) model and between effects (BE) model.

At last, the airline industry is a fascinating industry. And even though liberalisation processes across Europe have increased competition it is important to keep in mind that national flag carriers of countries are still somewhat protected as they generate a significant amount of jobs, serve as a symbol for the countries and may contribute significantly to economic wealth. Therefore, it might be interesting for further research to investigate the impact of national flag carriers on economic wealth of European countries.

# 7. Conclusion

This research has been the first empirical research to empirically test the effect of the formation of an airline alliance on the airline fares within the hub to hub system of Europe. Moreover, the rising competition of low cost-carriers has been included in this analysis as well. The research question of this paper, as firstly shown in the introduction, was the following:

*"What is the effect of the formation of an airline alliance on the fares of flights, and do low-cost carriers affect the pricing of alliance members?"*

In line with the theoretical background five hypotheses have been formed in order to test the effect of alliances and low-cost carriers, and through these answer our main research question. The different models have been estimated through Ordinary Least Squares (OLS) regressions. It can be concluded that the formation of an airline alliance has a positive effect on the fares of flights when alliances reach a certain level of size. Star Alliance is the largest alliance and is relatively overrepresented within Europe, as well as in our sample. Their relative market power enables them to increase the fares on flights in between hubs of Star Alliance members. The formation of Oneworld and SkyTeam is not found to cause a significant increase or decrease on the price level of airline tickets. Moreover, low-cost carriers have a price decreasing effect on airline fares charged by alliance members.

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# Appendix

Table A1. Variable definitions.

| Notation | Description | Source |
|---|---|---|
| ***Dependent*** | | |
| **LnPrice** | **Price** | **Websites of the airlines** |
| ***Main independent*** | | |
| **Alliance** | **Alliance** | **Websites of alliance partners** |
| **Star** | **Star Alliance** | **www.staralliance.com** |
| **Sky** | **Sky Alliance** | **www.skyteam.com** |
| **OW** | **Oneworld Alliance** | **www.oneworld.com** |
| **LCC** | **Low-cost carrier** | **www.whichairline.com** |
| ***Control*** | | |
| **lnDistance** | **Distance** | **www.travelmath.com** |
| **lnPoparr** | **Population arrival city** | **Ameco database** |
| **lnGDParr** | **GDP arrival city** | **Ameco databse** |
| **lnPopdep** | **Population departure city** | **Ameco database** |
| **lnGDPdep** | **GDP departure city** | **Ameco database** |
| **Onemonth** | **One month booked in advance** | |
| **Coast** | **Coastal city (holiday area)** | |
| **Business** | **Business city** | **Cushman & Wakefield European cities monitor 2011** |