EFFECTS OF INTERNATIONAL ALLIANCES ON AIR TRAFFIC: A CASE STUDY OF US AND INTERNATIONAL CARRIERS

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A DISSERTATION

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ACADEMIC HISTORY

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DEDICATION

To my parents, Oswaldo and Patricia.

You have taught me to look up into and beyond the sky when the norm was to settle for the horizon; that integrity, intelligence, dedication and a never-give-up attitude can achieve the unlikely if not the impossible. In addition, you have been my greatest support, my voice of reason and, many times, the voice of my heart. You have never doubted me or what I could achieve even when I, myself, doubted. Last but not least, you have always put my dreams and goals above your own, being happy spectators when I succeeded and taking the front seat as my pillar of support when I did not. For these reasons and more, I dedicate this work to you as

"...a testimony of what a man can do when he decides not to succumb to defeat..." (Antonio Patino Ortega)

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It is my pleasure and honor to give recognition to those who contributed in one way or another to my academic development and, particularly, with the elaboration of this dissertation.

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PREFACE

The study of airline alliances, the subject of my dissertation, originated from my collaboration with Professor Attiat F. Ott, in a research project on alliances in general and airline alliances in particular as market integrating mechanisms. One of this research findings is reported in a paper titled "Alliances as an Integrating Market Instrument: A Case Study of Airline Alliances" which I have co-authored with Professor Ott which is forthcoming in the Review of Economics and Finance (February 28, 2011).

The joint collaboration culminated with the choice of the topic for my thesis was not only beneficial in formulating the thesis research but also for gaining access to the data files compiled by the US Department of Transportation. These files are: The Origin and Destination Surveys (Data Bank 1A) for 2003 and 2008 as their use is restricted to US citizens. Non US citizens like myself can have access only through cooperative research with a US citizen.

I am grateful to the Department of Economics at Clark University for providing me with the necessary funds to purchase these datasets. The use of these datasets in my study opens up new avenues for research as the datasets have yet to be fully used by researchers in the fields of Industrial Organization and International Trade.

1. INTRODUCTION

Demand for international travel flourished in the late 1980s and early 1990s. A 1995 study of US airline industry conducted by the Government Accountability Office (GAO) reports that the demand for international travel was growing faster than that for domestic travel. Over the period 1987 - 1993, the number of passengers traveling to and from an international location grew 47% while percentage growth of domestic travel in the US was 6%. However, due to intergovernmental restrictions and cost constraints, domestic and foreign airlines were unable to respond to the change in demand. These obstacles gave incentive to the emergence and proliferation of major airline alliances.

Airline alliances involve two or more domestic and/or international airlines. The most prevalent types of alliances are based on code-sharing and antitrust immunity. The first domestic airline alliance took place in the 1929 when two airlines—Pan American and Grace Airways—merged forming Pan American Grace Airways (PANAGRA) which until 1968 serviced the West Coast to South American routes.[1] The first international alliance was formed between Northwest (US carrier) and KLM Royal Dutch Airlines with negotiations starting in 1989.[2] In 1991 both companies entered a code-share agreement and, in 1993, the two airlines were granted antitrust immunity.

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[1] Source: http://www.panamair.org/History/earlydays.htm
[2] Source: http://corporate.klm.com/en/about-klm/history

Major international alliances that emerged in the late 1990's were *Star Alliance* founded in 1997 by Air Canada, Lufthansa, Scandinavian Airline Systems, Thai Airways International and United Airlines; *Sky Team* launched in 2000 by Aeromexico, Delta Airlines, Air France and Korean Air and *One World* alliance founded in 1999 by American Airlines, British Airways, Cathay Pacific and Qantas. Their goal was to expand the market of member airlines by creating a global network. Moreover, major alliances presented the passenger with more options to choose from and in most cases lower fares.

International aviation is controlled by bilateral agreements between countries. These agreements often delineate the routes that can be covered within member countries, whether airline fares require government approval, the flight frequency of approved airlines and the number of airlines from each country that can service the routes established. An example of these bilateral agreements, commonly known as Open Skies Treaties, is the one signed by the US and the Netherlands in 1992. This agreement gave both countries unrestricted landing rights on each other country's soil. Some of these agreements are negotiated in such way that they reduce or eliminate restrictions. Others have extensive limitations mainly because of the desire to protect national carriers from competition.[3]

[3] For instances the US has had agreements with Austria, Belgium, Canada, Iceland, Israel, Jamaica, Korea, Luxembourg, Singapore, and Switzerland where restrictions were reduced or eliminated. However, agreements with Japan and the United Kingdom had severe limitations.

The literature on airline alliances offers both theoretical and empirical models that investigate a wide range of issues related to the effects of airline alliances. Traditionally, the study of airline alliances has focused on the effects of alliances on ticket prices and airline output (Oum, Park and Zhang (1996); Park (1997); Park and Zhang (2000); Hassin and Shy (2000) and (2004); Brueckner and Whalen (2000); Brueckner (2001); Bamberger, Carlton and Neuman (2004); Bilotkach (2005) and (2007); Ito and Lee (2007) and Whalen (2007)). Other issues considered in the literature are the effects of alliances on profits (Park (1997); Hassin and Shy (2000) and (2004)), capacity (Whalen (2007)), welfare (Park (1997); Hassin and Shy (2000) and (2004); Richard (2002) and Park and Zhang (2000)) and flight frequency (Hassin and Shy (2000) and Richard (2002)).

This research offers a novel approach to the study of airline alliances by integrating theoretical structures from the fields of International Trade and Industrial Organization. This study models and tests the effects of airline alliances (domestic and international) on the volume of traffic, using data for the US and international air carriers. In addition, it investigates the effect of alliances on profitability using US data only. The first model explores the effects of alliances treating the alliance as a market integrating device. The empirical model employs the gravity equation to determine whether or not airline alliances increase market share for airlines in the alliance at the expense of non-members or that alliances increase the volume of traffic for all airlines in the industry. The second model uses a profitability set up to show whether or not airline alliances are indeed beneficial for its members in the domestic market.

The empirical analysis utilizes three sets of data: Origin and Destination Survey (price data), T-100 Segment Data (traffic data) and Air Carrier Financial Reports (airline profit data), Schedule P-12. The thesis is organized as follows: Chapter 2 provides a history of airline alliances both domestic and international and reviews the theoretical and empirical literature. The research in this thesis consists of two essays. The first essay, Chapter 3: Airline Alliances as a Market Integrating Mechanism, provides empirical evidence on whether an alliance creates or diverts traffic. The second essay, Chapter 4: Effects of Major Airline Alliances on US Carriers' Net Income, explores the effects of major alliance membership on net income of carriers in alliances. Due to lack of data on international carriers, the empirical analysis will be limited to domestic carriers. The thesis concludes in Chapter 5 with identifying the contribution of the research and recommendations for future study.

2. A BRIEF HISTORY OF AIRLINE ALLIANCES

2.1 A Brief History

The airline industry market is characterized by imperfect competition and constant returns to scale for "trunk" carriers. The term trunk carrier is a generic name used to identify common air carriers that provided scheduled local and international flights (Caves, Christensen and Tretheway, 1984, pp. 471-472).

In the US market, the regulation of commercial aviation began with the Civil Aeronautics Act of 1938 which created the Civil Aeronautics Authority (CAA). Later on, with the enactment of the Federal Aviation Act of 1958, the CAA was renamed as the Civil Aeronautics Board (CAB). This government agency was given the power to regulate all domestic interstate air transport routes as public utility.[4] Among its many responsibilities, the CAB was in charge of setting fares, routes and schedules. Thus, not only the CAB could tell each airline which products to sell but it also dictated the ways in which they could be sold and the prices charged for them. The CAB however had to ensure that airlines receive a rate of return on their investment equal to 12 percent.

Regulating the airline industry was viewed by many as inefficient and bureaucratic. Airlines experienced lengthy delays when applying for new routes or fare changes, which were often rejected by CAB. For example, World Airways applied for a low-fare route between New York and Los Angeles in 1967 and after six years of study the CAB

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[4] Intrastate routes were not regulated by the CAB but by the governments of the different States.

dismissed the application. According to Borenstein, in the early 70's the "government intervention in the airline industry reached its peak (1992, p. 46)." A route moratorium was put into place which meant that the CAB stopped giving permission to established airlines to serve new city pairs and also prevented many airlines from vacating some routes. In addition, fare discounts such as student discounts and accompanying spouse discounts were reduced or eliminated, the argument being that this form of discriminatory pricing is against fair and equitable prices.

In 1976, a movement towards deregulating the industry took place. In response, the CAB began reducing the restrictions on fare discounts and allowed some entry of certified carriers into few selected routes. Also, restrictions on charter services were relaxed which opened a window for competition since this service was a close substitute for scheduled airlines. Airlines responded to this situation by suing the CAB for allowing "too much competition".

Concerns over the future of the airline industry, led to the implementation, of the Airline Deregulation Act which was signed into law on October 24, 1978. The purpose of the act was to eliminate government control over fares, routes and market entry of commercial aviation. After this act was signed, there was a gradual transfer of regulatory authority from the CAB (now dissolved) to the US Department of Transportation.[5]

[5] The Federal Aviation Administration (FAA) still has control of the safety inspections and air traffic control.

With deregulation, market forces were unleashed on one segment of the air travel industry. New entry accelerated and prices declined, especially for long distance routes. On the other hand, shorter and unprofitable routes, which had been cross-subsidized before deregulation they were either eliminated (Worcester, New York route) or experienced no price reduction and in some cases there were price increases. In 1978, Airline profits reached record levels. However, while schedules and fares have been deregulated, many aspects of the airline industry remained highly regulated. Critical infrastructure of which airlines depend on, like airports and therefore access to gates and runways, remained government owned.

In 1979, the oil crisis hit the airline industry hard by raising their cost of operation. The recession of the early 1980s compounded this effect leading to a fall in profits, a slowdown in market entry, numerous airline mergers and bankruptcies. According to Borenstein there were eight airline mergers between 1986 and 1987 (1992, p.50).

A notable effect of deregulation is that it brought fundamental changes in the business strategies implemented by major airlines. For example, there was a shift in operation from a point-to-point system to a **hub-and-spoke** system.[6] The concept of hubbing improved the efficiency of the connections for passengers from small and mid-sized cities, but it also increased the airline concentration at the hub cities. The net effect of

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[6] A hub is an airport used by an airline as a transfer point to get passengers to their intended destinations. A hub is considered as a major airport whereas a spoke airport is considered a local airport. Delta Airlines was the first airline that pioneered the concept of hubbing by applying it in Atlanta in 1955. http://deltamuseum.org/M_Education_DeltaHistory_Facts_Firsts.htm

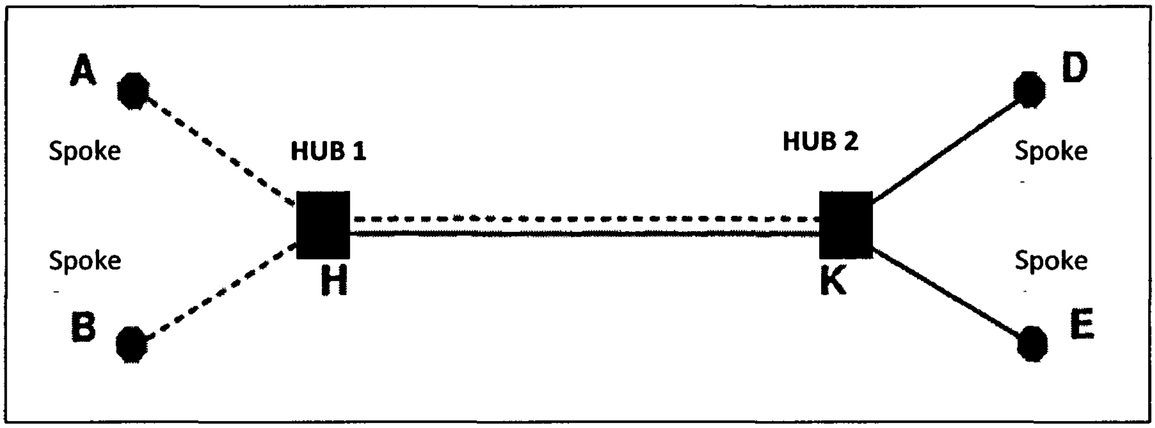
this system was an increase in the choices of carriers at non-hub cities, increase of flight frequency and an increase of major airline concentration at hub cities. A drawback of the hub–and-spoke system is that passengers, especially those traveling long distances, have to stop at hubs instead of continuing directly to their destination. Some concern was voiced about anticompetitive effects of this system since hub airports typically accommodate large-scale operations of one or a few airlines. Figure 2.1 depicts a hub-and-spoke system in domestic travel.

2.1.1 Movement towards "super" alliances

A 1995 study by the Government Accountability Office (GAO) reports that in the late 1980s and early 1990s, the demand for international travel was growing faster than that for domestic travel. The study showed that between 1987 and 1993, the number of passengers traveling to and from an international location grew by 47% while percentage growth of domestic travel in the US was only 6% (p.2). Domestic and foreign airlines were unable to respond to the change in the structure of demand because of intergovernmental restrictions imposed on them as well as cost constraints.

International aviation is controlled by bilateral agreements between countries. These agreements often delineate the following: (1) which routes can be covered between the member countries and to third countries; (2) if airline fares require government approval; (3) flight frequency and (4) the number of airlines from each country that can fly

Figure 2.1: Domestic Hub-and-Spoke System



the routes. Some of these agreements are negotiated in such way that they reduce or eliminate restrictions. Others have extensive limitations often to protect national carriers from competition.[7]

These provisions may be said to have given incentive for the emergence and the proliferation of alliances between domestic and foreign airlines. Alliances usually refer to agreements that involve two or more airlines.

2.1.1.1 Types of Alliances

The most prevalent types of alliances are based on code-sharing and antitrust immunity.

2.1.1.1.1 Code-sharing

Code-sharing takes place when an airline, by agreement, uses its two-character designator code to market, as its own, flights that are operated by another carrier.[8] In other words, code-share agreements mean that a carrier (operating carrier) allows it code-share partner to market and sell seats on 'some' of the operating carrier flights. This type of alliance can be either domestic or international. An example of a domestic code-share alliance is the one that exists between American Airlines and Alaska Airlines on routes to

[7] For instances the US has had agreements with Austria, Belgium, Canada, Iceland, Israel, Jamaica, Korea, Luxembourg, the Netherlands, Singapore, and Switzerland where restrictions were reduced or eliminated. However, agreements with Japan and the United Kingdom had severe limitations.
[8] The designator code is given by the Air Transport Association (ATA) and is utilized in ticketing, schedules and reservations.

and from Los Angeles, Portland, San Francisco and Seattle. An example of international alliance is one between Delta Airlines and Air France on the route between Providence Rhode Island and Warsaw, Poland. It is worthwhile to note that this international route was not possible with either airline's previous networks. Table 2.1 lists current domestic code-share agreements among some of the major US airlines.

The following example illustrates the expansion of airline networks as a side effect of a code-share alliance, consider three airports A, B and C and assume that the route A-B can only be served by airline 1 and route B-C can only be served by airline 2. Once the two airlines agree to enter a code-share alliance and pair their exiting flights, both airlines will be able to offer to their potential customers the route A-C without having to actually fly the whole route.

Ito and Lee (2007) distinguish three types of code-sharing agreements: Traditional code-sharing, semi virtual code-sharing and fully virtual code-sharing. Traditional code-sharing, takes place when an itinerary has two segments, is interline and has a code-share segment. An example of this would be an itinerary between Delta and Continental which is marketed only by Delta. Semi virtual code-sharing is described as a two-coupon itinerary with the same operating carrier throughout the whole trip and one code-share segment. Considering the Delta/ Continental alliance, Semi virtual code-sharing would imply that a connecting itinerary operated only by Delta and marketed partly by Delta and partly by

Table 2.1: Domestic Airline Code-Sharing

Carriers	*Date and Brief Description*
Continental/Delta/Northwest	Began in 2003. Three-way code-sharing which excludes local hub markets
United/US Airways	Began in January 2003
American/Alaska	Began in 1999. Code-share on flights to and from Los Angeles/Portland/San Francisco/ Seattle.
American /Hawaiian	Began in March 1998. American code-shares with Hawaiian within Hawaii and Hawaiian code-shares on American Eagle services at Los Angeles.
Northwest/Alaska	Began on August 1999. System wide code-sharing except selected flights to and from Mexico and transcontinental flights.
Continental /Alaska	Began March 1999
Northwest/Hawaiian	Began in 1995. Code-shares on intra Hawaii flights and trans-Pacific flights.
Continental/ Hawaiian	Began August 1999. Code-shares on inter-island flights.

Source: Ito, H. and Lee, D. (2007) p. 361

Continental. The third type of code-sharing, fully virtual code-sharing, takes place when an itinerary shows the same marketing carrier throughout the entire trip, the trip is online and code-share is reported for all segments of the itinerary. For example, a trip operated solely by Continental but marketed by Delta Airlines.

In terms of compensation schemes, most of the code-share agreements use a free-sale agreement. Under this arrangement, the operating carrier retains control over the seat inventory but allows its code-share partner to market and sell seats on code-share routes under their own marketing code. The operating carrier is entitled to all revenues, regardless of which carrier actually sells the seat. As compensation for selling a seat on a code-share flight, the operating carrier pays the "marketing" carrier a commission to cover the costs of marketing said flight. Code-share agreements are carefully negotiated so that the benefits from the partners, whether they perform the role of operating or marketing carrier, are similar.

Since both airlines are "sharing" a code, the flights covered by this type of alliance are considered as "online" flights rather than "interline"—single airline flight vs. multiple airline flights.[9] Thus, if the trip requires the passenger to switch airlines, the whole trip is regarded as a single airline trip.

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[9] Online flights refer to itineraries that are flown by a single carrier.
Interline flights take place when there are two or more carriers on an itinerary.

Code-sharing is not favored by some. It is argued that it may restrict competition. The Department of Transportation does not regulate the number of times that a flight can be listed on the Computer Reservation System (CRS). The problem with this practice is that the CRS often lists the same code-share flight several times before other flights which gives preference to online flights. This produces a "crowding out" effect because competing airlines without code-share have their listing move down on the monitor screen. Travel agents, who are responsible for a great part of the air travel booking, usually book flights that appear first on the screen.

2.1.1.1.2 Antitrust Immunity

Another type of alliance is the "antitrust immunity" provision and it is international in character as it is formed only between airlines of different countries. Antitrust laws in a country limit foreign ownership and prevent mergers. However, these laws can be sidestepped when two carriers are granted antitrust immunity by the relevant government agencies in their countries. In the US, the DOT is the institution that is allowed to grant immunity from US antitrust laws in cases where agreements between the participating airlines benefit the public interest. If the alliance is found to reduce or eliminate competition, DOT can still grant immunity if the agreement is needed to meet transportation needs or if the transportation need and/or the public benefit could not be achieved by available alternatives that were less anti-competition.

Antitrust immunity is given to pairs of carriers. It allows them to integrate their scheduling, pricing, yield-management systems and share revenues from the alliance. Thus, immunity simulates a merger between two airlines. Whalen (2007) show that mergers will lead to the spread of online pricing because immunity internalizes the double marginalization problem.[10] This suggests that immunized alliances will have prices lower than those with code-share or online prices. Table 2.2 reports the code-sharing agreements as well as antitrust immunity between major US carriers and some European carriers.

The existence of Open Skies treaties is a necessary condition for immunity grants. In other words, the US has to have a bilateral agreement with another country for DOT to grant immunity to the US and the foreign carrier. However, the opposite is not true since many non-trust immunized carriers carry passengers to countries with Open Skies treaties. For example, the US has Open Skies treaties with Finland, Denmark, and Norway, but there are no trust immunized alliances with carriers based in those countries.

2.1.1.1.3 Major Alliances

The airline industry has three major alliances, involving more than two major carriers from the US and the world. These are: Star Alliance, Sky Team and One World Alliance. Of note is that the members of these alliances may have code-sharing

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[10] Double marginalization occurs when a carrier of an interline flight attempts to maximize profits from its own segment on the itinerary independently from the other carrier. As a consequence, interline carriers tend to charge fares that are higher than the ones charged by a single decision maker who can decide the price of all the segments in the itinerary.

Table 2.2: Code-Share and Antitrust Immunities between US and European Carriers

US Carrier	European Carrier	Code-Share	Antitrust Immunity
American Airlines	British Midland	1994-1999	
	Finnair	Mar 1999	
	Iberia Airlines	May 1998	
	LOT Polish Air	September 1996	
	Sabena	November 1999	November 1999
	Swiss Air	November 1999	November 1999
American West	British Airways	April 1996	
Continental Airlines	Air France	April 1997	
	Alitalia	May 1994	
	British Midland	August 1998	
	CSA Czech Air	April 1996	
	Virgin Atlantic	February 1998	
Delta Airlines	Ari France	1996	
	Australian Air	1994-1999	1996-1999
	Malev	May 1994	
	Sabena	1993-1999	1996-1999
	Swiss Air	1993-1999	1996-1999
	Virgin Atlantic	1995-1997	
Midwest Express	Virgin Atlantic	1997	
Northwest Airlines	Alitalia	May 1999	
	Braathens	1998	
	KLM	1991	1993
TWA	Air Malta	May 2000	
United	Australian Air	April 2000	
	British Midland	April 1992	
	Lufthansa	June 1994	1996
	Scandinavian Air	April 1995	1996
	Spanair	October 1999	
USAir	British Airways	1993-1996	
	Deutsche BA	1996	

Source: Whalen. T. (2007). A Panel data analysis of code-sharing, antitrust immunity, and open skies treaties in international aviation markets". *Review of Industrial Organization,* vol. 30:39-61 agreements, antitrust immunity, both or none of these arrangements. The main goal of such alliances is to expand the reach of its members by presenting the traveler with more options. Alliances promote consumer loyalty with the different services they provide such as access to lounges and the coordination of the different frequent flyer programs. A brief word about the three alliances:

Star Alliance: "The way the Earth connects"

The Star Alliance was launched in 1997 with five members—Air Canada, Lufthansa, Scandinavian Airline Systems, Thai Airways International and United Airlines. The objective is to provide a global alliance offering customers worldwide reach and a smooth travel experience. Currently, the Star Alliance has 26 members and serves 1,077 airports in 175 countries.

Sky Team "Caring more about you"

On June 22 of 1999, Aeromexico, Delta Airlines, Air France and Korean Air formed an alliance called Sky Team which was launched in 2000 in an effort to compete with the Star Alliance. It currently has 9 full member airlines that serve 169 countries covering 905 destinations. Delta and Northwest merged in 2008. Continental Airlines and Copa Airlines who were members of Sky Team announced their departure from this alliance on October 24, 2009.

One World Alliance "Oneworld resolves around you"

The One World Alliance was founded on February 1, 1999 (a few months before the Sky Team Alliance) by four major airlines—American Airlines, British Airways, Cathay Pacific and Qantas. This alliance currently has 11 full members which cover over 727 destinations in 142 countries. Table A.1 in the appendix lists the members of these alliances and the date the alliance was formed.

2.2 Modeling the Alliances in the Airline Industry: A Brief Review of the Literature

Two types of models are given: Theoretical and empirical. The theoretical models are those commonly presented in the Industrial Organization literature. Some of these models were estimated, others were not. Major theoretical contribution to the literature are found in models by Oum, Park and Zhang (1996); Park and Zhang (2000); Brueckner and Whalen (2000); Brueckner (2001); Hassin and Shy (2000) and Bilotkach (2005). The empirical literature most often consists of estimating demand and price equations derived from the theoretical models to determine the effects of alliances on output and prices.

2.2.1 Theoretical Models

Oum, Park and Zhang (1996) henceforth referred to as OPZ model oligopolistic interaction between airlines to determine the effects of "code-sharing" among non-market leaders on the market leaders' price and passenger volume. The theoretical model follows a

Stackelberg setup where there is a leader and followers in the market under the assumption of complementary code-sharing.[11]

OPZ's model considers a city-pair with *n* airlines or firms. Firm 1 is assumed to have the largest share of passengers, thus it is the market leader. It follows that there are *(n-1)* followers or non-market leaders. Demand (passenger volume) is represented by the following equation:

$$Q = Q\ (P, P^*, \Gamma; \alpha) \qquad (2.1)$$

Where P is the leader's price; P^* is *(n-1)* price vector for the followers; Γ represents exogenous variables that affect the leader's demand and α is a parameter vector.[12]

The demand for non-market leaders is given by:

$$Q^* = Q^*\ (P, P^*, \Gamma^*; \alpha^*) \qquad (2.2)$$

The inverse demand for the leader firm is given by:

$$P = P\ (Q, Q^*, \Gamma; \alpha) \qquad (2.3)$$

[11] Complementary code-sharing refers to two carriers which have entered a code-sharing agreement and serve the different yet "complementary" routes. Thus, while one airline serves from point A to point B, another will serve point B to point C. Together they serve market AC.

[12] It should be noted that the Γ^* and α^* represent the followers' exogenous variables and the parameter vector in equation 2.

The same process is followed to obtain the inverse demand for the non-market leaders.

The profit function of firm 1 is:

$$\Pi = Q\,P\,(Q, Q^*, \Gamma;\alpha) - C\,(Q,\cdot) \qquad (2.4)$$

Where $C(Q,\cdot)$ is firm 1's total cost.

Supply relations for both the leader and the followers are given by equations (2.5) and (2.6):

$$P - t\,Q = MC(Q, W;\ \beta) \qquad (2.5)$$

$$P^* - t^*\,Q^* = MC^*(Q^*, W^*;\ \beta^*) \qquad (2.6)$$

Where t and t^* are defined by $\frac{(P-MC)}{Q}$ and $\frac{(P^*-MC^*)}{Q^*}$ respectively. These are the ratios of the price–cost markup to quantity. In addition t indicates the "degree of competitiveness" of the firm(s). Also, W represents input prices.

Using equations (2.2) and (2.6) the authors derive an expression for P* as a function of P, which can be written as:

$$P^* = P^*\,(P, \Gamma^*, W^*;\alpha^*,\beta^*) \qquad (2.7)$$

Substituting (2.7) into (2.1) the residual demand for the market leader is derived. This equation is represented as follows:

$$Q=R\ (P,\ \Gamma,\ \Gamma^{*},\ W;\alpha,\ \alpha^{*},\ \beta^{*}) \qquad (2.8)$$

The residual demand function of the market leader takes into account the actions of the non-market leaders. Thus, it depends not only on the leader's own variables or parameters but also on the non-leaders variables or parameters.

2.2.1.1 Models based on Cournot Competition

Three models are reviewed in this section: Oum, Park and Zhang (2000), Brueckner and Whalen (2000) and Brueckner (2001).

Oum, Park and Zhang (2000) offer a variant of the OPZ model by using a Cournot Competition model instead of the Stackelberg (follower – leader) model. The Cournot model investigates the effects of four airline alliances on air fares, passenger volume and consumer welfare assuming that market demand and price equations are affected by alliance variables.

The demand function is represented by equation (2.9).

$$Q_d = Q_d\ (P,\ A,\ X) \qquad (2.9)$$

Where Q_d is a function of market ticket price (P), (A) is a vector of alliance variables and (X) a vector of exogenous variables.

The market price equation can be written as follows:

$$P = MC_i(q_i, B, Y) \bullet \left[1 + \left(\frac{1}{\eta}\right) MS_i(q_i)\right]^{-1} \quad (2.10)$$

Equation (2.10) shows that the market price can be expressed as the product of a carrier's marginal cost and its markup ratio. Where MC_i is the marginal cost of airline *i*. The marginal cost is a function of q_i which is the output of airline *i*; *B* is a vector of alliance variables and *Y* represents other variables that affect the cost function.

The second part of the price equation is the markup ratio where $\eta \equiv \left(\frac{\partial Q_d}{\partial P}\right)\left(\frac{P}{Q_d}\right)$ is defined as the price elasticity of market demand and $MS_i(q_i) = \frac{q_i}{Q}$ represents firm *i*'s market share.

Brueckner and Whalen (2000) assume that a Cournot model of competition exists for two international alliances that possess antitrust immunity and horizontal product differentiation through brand loyalty. There are four airlines in the model. Of these four carriers, two airlines, 1 and 2, compete in the domestic markets (formed by cities A and B), and the international markets (formed by cities D and E) are served by the other two carriers, 3 and 4. International flights require interline trips (domestic as well as international) whereas the domestic carrier 1 is assumed to always pair with the international carrier 3. Domestic carrier 2 always pairs with international carrier 4. For simplicity, it is assumed that all carriers operate out of the same hub, H. Passengers are assumed to have brand loyalty implying that airlines sell differentiated products.

Carries i and k serve a city-pair market and charge fares p^i and p^k. Carrier i's traffic (number of passengers) is given by the following equation:

$$q^i = D(p^i, p^k) \tag{2.11}$$

Carrier k's traffic is given by

$$q^k = D(p^k, p^i) \tag{2.12}$$

The function D (•) is the symmetric demand function which decreases in its first argument and increases in the second.

In a non-cooperative scenario (no alliance), interline fares are generated by independent choices of subfares. Thus, for example, airline 1's subfare for the city-pair AD is s^1_{AD} and for airline 3 is s^3_{AD} . The fare in the market is $s^1_{AD} + s^3_{AD}$ and carrier 1's AD traffic is given by $q^{13}_{AD} = D(s^1_{AD} + s^3_{AD}, s^2_{AD} + s^4_{AD})$ which is also carrier 3's traffic. Carrier 1's revenue is $s^1_{AD} D(s^1_{AD} + s^3_{AD}, s^2_{AD} + s^4_{AD})$ and for carrier 3's revenue, D is multiplied by s^3_{AD}.

Symmetry of city pairs is assumed so the carrier 1's fares and traffic levels will be the same in markets AH and BH. Because of this symmetry, the authors are able to substitute subscripts A and B for X. Also, airline 1's subfares and traffic in each market AD, AE, BD and BE are the same. The representation of these variables is s^1_{XX} and q^{13}_{XX}, respectively.

Airline 1's revenue for the case where there is no cooperation is represented by the following equation:

$$2p^1_{XH}D(p^1_{XH}, p^2_{XH}) + p^1_{AB}D(p^1_{AB}, p^2_{AB}) + 4s^1_{XX}D(s^1_{XX} + s^3_{XX}, s^2_{XX} + s^4_{XX}) \qquad (2.13)$$

When alliances are made, partners set a total fare in each international market and split the revenue. Fares are symmetric across international markets and are denoted by p^{13}_{XX} and p^{24}_{XX}. Carrier 1's cooperative revenue is given by the following equation:

$$2p^1_{XH}D(p^1_{XH}, p^2_{XH}) + p^1_{AB}D(p^1_{AB}, p^2_{AB}) + 2p^{13}_{XX}D(p^{13}_{XX}, p^{24}_{XX}) \qquad (2.14)$$

The cost of operating a single spoke is C(Q), where Q is the traffic density or total traffic on a spoke. Economies of density imply that c'>0 and c''<0 so that the cost per passenger decreases with traffic density. The carrier 1's cost for operating its networks equals to:

$$2c(q^1_{XH} + q^1_{AB} + q^{13}_{XX}) \qquad (2.15)$$

The objective of each firm is to maximize profits. In the case of carrier 1, to set up the profit functions for both the non-cooperative and cooperative case the authors use the revenue equations (2.13) and (2.14) and the cost equation (2.15). Taking the first order conditions of the profit function the following equations are obtained:

For the non-cooperative case:

$$2q_{XX}^{13}\left(\frac{\partial q_{XX}^{13}}{\partial p_{XX}^{13}}\right)^{-1} + p_{XX}^{13} - 2c' = 0 \tag{2.16}$$

For the cooperative case:

$$q_{XX}^{13}\left(\frac{\partial q_{XX}^{13}}{\partial p_{XX}^{13}}\right)^{-1} + p_{XX}^{13} - 2c' = 0 \tag{2.17}$$

The first two terms of equation (2.16) and equation (2.17) give the marginal revenue of the non-cooperative and cooperative case, respectively. The third term in both equations indicates the marginal cost. Since $\frac{\partial q_{XX}^{13}}{\partial p_{XX}^{13}}$ is negative the marginal revenue of the non-cooperative case is smaller than the one for the cooperative case. This indicates that airlines are better off by establishing alliances for interline trips.

In the next paper, **Brueckner (2001)** models the welfare effects of a single alliance with antitrust immunity where the partners operate a simple overlapping hub-and-spoke networks. There are only two airlines 1 and 2. Airline 1 (domestic carrier) is assumed to provide service only in the domestic market for cities A and B, while airline 2 (international carrier) serves cities B and C. Together they can serve the market AC.

Symmetry between markets is assumed such that the distance between A and B is equal to the distance between B and C. In addition, constant returns to scale is assumed so that the cost per passenger on a route segment is given by c. The travel demand function is given by equation (2.18).

$$D\ (P_{AC}) = q_{AC} \tag{2.18}$$

Where q_{AC} is defined as the total traffic in the market AC. P_{AC} is the interline fare for travelling between AC.

Two types of pricing behavior are considered in the model: non-cooperative and cooperative behavior. In the non-cooperative setting airlines 1 and 2 choose subfares S_{AB} and S_{BC} independently. This implies that the $P_{AC} = S_{AB} + S_{BC}$. The non-cooperative profits for airline 1 are given by the following equation:

$$(S_{AB} - c)\ D\ (S_{AB} + S_{BC}) \tag{2.19}$$

After taking the first order conditions for both airlines and adding both profit functions, the profit maximizing condition is obtained.

$$2q_{AC} \frac{\partial P_{AC}}{\partial q_{AC}} + P_{AC} = 2c \tag{2.20}$$

Where the left-hand-side of equation (2.20) is the marginal revenue and the right-hand-side is the marginal cost.

With cooperative behavior assumed, the overall fare is set to maximize total profit of the two airlines. In this case, the combined profit of the two carriers is given by the following:

$$2\left(\frac{P_{AC}}{2}-c\right)D(P_{AC}) \qquad (2.21)$$

After taking the first order condition the following expression is obtained:

$$q_{AC}\frac{\partial P_{AC}}{\partial q_{AC}}+P_{AC}=2c \qquad (2.22)$$

Since $\frac{\partial P_{AC}}{\partial q_{AC}}$ in both equations (2.20) and (2.22) are negative, then non-cooperative revenues given in equation (2.20) are smaller than cooperative revenues given in equation (2.21) at any level of q_{AC}.

2.2.1.2 Duopoly and heterogeneous consumers (Hotelling's Linear city model and Bertrand model)

Two models are reviewed in this section. The first is by Hassin and Shy and the other by Bilotkach.

Hassin and Shy (2000) investigate the "market consequences" of code-sharing between two airlines (effects on fares, profits, passengers' welfare and aggregate social welfare) assuming heterogeneous consumers. An important feature of this paper is that, unlike other papers it defines the unit of output for airlines as flight frequency. It is important to note that in the model only overlapping international routes are considered—parallel code-sharing operations.

The model developed is based on Hotelling's linear city model where two competing firms (airlines) are placed at both ends of a line of a unit length. This implies that the basic assumption is that passengers can rank airlines according to their preferences.

There are two countries A and B. Each of these countries has one national airline designated by α and β, respectively. Since only parallel operations are considered, both firms provide flights in both directions (AB and BA) for n passengers who wish to fly between A and B. The output of airline α is denoted by f_α (flight frequency provided by α). Similarly, output of firm β is given by f_β. The price charged by airline i ($i=\alpha, \beta$) is given by p_i.

Passengers are indexed by x and are distributed on an interval [0, 1]. The utility of each customer is given by the following expression:

$$U(x)=\begin{cases} f_\alpha-\tau x-p_\alpha & \text{flies with carrier } \alpha \\ f_\beta-\tau(1-x)-p_\beta & \text{flies with carrier } \beta \\ 0 & \text{does not travel} \end{cases} \tag{2.23}$$

where $\tau > 0$ indicates the degree of differentiation between α and β. From (2.23), it can be seen that flight frequency positively affects consumer utility. Passengers who have a low x prefer to fly with α and those with high x prefer to fly with β. Moreover, from expression (2.23) demand is derived for consumers that are indifferent between airlines, indifferent about flying with α or not flying at all and those that are indifferent between flying with β or not at all.

The cost structure consists of two types of costs: costs associated with the operation of the aircraft (denoted by $\delta(f_i)^2$) and costs associated with serving passengers (denoted θq_i where θ= cost per passenger and q_i= number of passengers). Total cost for airline i is given by the following equation:

$$TC(f_i) = \delta(f_i)^2 + \theta q_i \qquad (2.24)$$

Using consumer demand functions and total cost functions, the profit functions for both airlines are derived. To solve the model, the authors assume a two-stage game. In the first stage, an airline chooses its frequency in a particular route. In the second stage, the airlines compete in airfares. According to the study, it appears that code sharing changes the nature of competition between airlines. Without code sharing airlines use flight frequencies as their major strategic instrument. With code-sharing airlines use fares as strategic instruments. The model suggests that airline profits decline with the increase of passengers when there is no code sharing and profits rise in the presence of code sharing.

Bilotkach (2005) develops a model of price competition (Bertrand Model) between two international airline alliances where three different setups are analyzed: two competing alliances with antitrust immunity, price competition without alliances and two competing alliances without antitrust immunity. The model assumes that consumer preferences are vertically differentiated by the number of airline stops. Bilotkach analysis differs from other studies (for example Brueckner and Whalen (2000) and Brueckner (2001)) in that by replacing the Cournot structure with a Bertrand setting, the author is able to compare price effects of alliances with and without antitrust immunity.

Four airlines are considered in this model. Each of these airlines operates in a single hub airport denoted by H_i (i=1,...,4) so that airline 1 operates in hub H_1. Airlines 1 and 3 serve the domestic market which is assumed to have two hub airports (H_1 and H_3) as well as two spoke cities (S_1 and S_2). Airlines 2 and 4 serve a foreign market which has the same structure as the domestic market. Alliances are formed between a domestic carrier and a foreign carrier. Thus, one alliance consists of carriers 1 and 2 and the other is formed with carriers 3 and 4. The alliance agreements connect the domestic market with the international market.

The indirect utility function of the consumer who chooses an alliance J on a market between cities *i* and *j* is given by

$$V_{ij}^{J} = \theta_{ij} - \left(p_{ij}^{J} + \beta\eta_{ij}^{J}\right) \tag{2.25}$$

Where p_{ij}^{J} is the fare charged by airline(s) in alliance J; η_{ij}^{J} is the number of segments to be flown while traveling with alliance J; θ_{ij}^{J} represents the consumer's reservation utility which is a random variable distributed normally over the interval [0, 1] and β is a positive parameter. The indirect utility of not flying is assumed to be zero. A consumer will choose alliance J over alliance K if $V_{ij}^{J} \geq 0$ and $V_{ij}^{J} > V_{ij}^{K}$. This implies that $p_{ij}^{J} < p_{ij}^{K} + \beta\left(\eta_{ij}^{K} - \eta_{ij}^{J}\right)$.

Demand is determined by the number of consumers who obtain non-negative indirect utility. Given the distribution of θ_{ij}^{J} the expression for demand is given by the following equation:

$$D\left(p_{ij}^{J} + \beta\eta_{ij}^{J}\right) = 1 - \left(p_{ij}^{J} + \beta\eta_{ij}^{J}\right) \qquad (2.26)$$

Where the expression ($p_{ij}^{J} + \beta\eta_{ij}^{J}$) is the full price of flying.

The expected demand of alliance J under the assumption of price competition with product differentiation is given by the following expression:

$$q_{ij}^{J} = \begin{cases} 0 & \text{if} \quad p_{ij}^{J} > p_{ij}^{K} + \beta\left(\eta_{ij}^{K} - \eta_{ij}^{J}\right) \\ \frac{1}{2} D\left(p_{ij}^{J} + \beta\eta_{ij}^{J}\right) & \text{if} \quad p_{ij}^{J} = p_{ij}^{K} + \beta\left(\eta_{ij}^{K} - \eta_{ij}^{J}\right) \\ D\left(p_{ij}^{J} + \beta\eta_{ij}^{J}\right) & \text{if} \quad p_{ij}^{J} < p_{ij}^{K} + \beta\left(\eta_{ij}^{K} - \eta_{ij}^{J}\right) \end{cases} \tag{2.27}$$

With respect to the cost structure, several assumptions are made: with constant returns to scale, costs can be separated across segments of the networks and symmetry of all segments and carriers. The cost of carrying a passenger from one segment to another is given by *c*. If there are *n* segments in an itinerary then the total cost will be *nc*.

The equilibrium price under all three scenarios is given by

$$p_{ij}^{*} = cr_{ij} + \beta\left(r_{ij} - R_{ij}\right) \tag{2.28}$$

Where R_{ij} denotes the number of segments and r_{ij} is the next highest number of flight segments. The second term on the right-hand-side of equation (2.28) indicates the passenger's loss from additional route segments in the next-best route.

The profit maximization functions are solved under the three setups enumerated above. From the model structure, Bilotkach reports that competition between two alliances without antitrust immunity would lead to lower fares for interline travel. In addition, he finds that unlike the case of Cournot-type models (Brueckner (2001)), granting antitrust immunity to both alliance partners increases fares for non-stop flights between the hub airports of the alliance partners without any additional benefits to interline passengers.

2.2.2 Empirical Models: A Brief Review

The theoretical models reviewed above provide the framework for deriving testable hypothesis about airline alliances. Using data obtained, mainly, from the US Department of Transportation empirical models were estimated. An overview of the models findings are summarized in Table A.2 in the appendix.

In their paper **Oum, Park and Zhang (1996)** estimated the effect of alliances, namely code-sharing of non-market leaders on market leader's output and fares. For this purpose the following demand (equation (2.29)) and price equations (equation (2.30)) were estimated:

$$Q_d = a_0 + a_1 P + a_2 F + a_3 NF + a_4 NW + a_5 FEED + a_6 CS + \varepsilon_d \qquad (2.29)$$

Where P represents market price, F is the number of non-stop flights served by the market leader on a route, NF is the total number of non-stop flights provided by the other carriers on a route, NW is an input price index of non-leaders, $FEED$ is a dummy variable indicating that one or more non-leader carriers use their feeder carrier in order to provide connecting services on the route. CS is a dummy variable which equals one for complementary code-sharing between non-leader carriers and zero otherwise. The variable CS is expected to shift the market leader's residual demand function.

$$P = b_0 + (b_1 + c_0) \cdot Q + b_2 W + b_3 D + c_1 COM \cdot Q + c_2 MS \cdot Q + c_3 FEED \cdot Q + c_4 CS \cdot Q + \sum_{t=1}^{10} d_t YR_t + \sum_{t=1}^{2} e_t RG_t + \varepsilon_t \qquad (2.30)$$

Where Q is the passenger volume, W is the market leader's input cost index, D is the distance between two cities, $COM \cdot Q$ is the product of the number of airlines competing in non-stop markets and passenger volume, $MS \cdot Q$ represents the product of the leader's market share and passenger volume, $FEED \cdot Q$ is the product of the dummy variable indicating presence of connecting services between a non-leader airline and its affiliates with passenger volume, $CS \cdot Q$ is the product of the dummy variables that indicates the presence of code-sharing among non-leader airlines with passenger volume, *YR*s represent the year dummy variables and *RG*s are the route group dummy variables.

The leader's residual demand, equation (2.29), and the leader's price function, equation (2.30), were estimated using Non-linear Three Stage Least Squares. The data used is a panel data of 57 transpacific air routes for the period of 1982-92. There are two endogenous variables in this equation, P and Q, which influence each other. Equation (2.30) also has three multiplicative terms that involve Q. Thus, equation (2.29) was estimated first and then substituted in equation (2.30).

In equation (2.29), the coefficient for the code-sharing variable (7,489) was positive and significant. Therefore, code-sharing among non-market leaders shifts demand upward.

The results obtained for the leader's supply function, equation (2.30), show that the coefficient of the variable representing the product of between non-market leaders code-share and passenger volume (-0.0008) is negative and significant. Since the value of the coefficient for passenger volume is 0.0042 and the coefficient for code-sharing is -0.0008. The slope of the supply curve when code-sharing between non-market leaders is present decreases to 0.0033.[13] This implies that when non-market leaders code-share, the supply curve of the market leader shifts to the right.

These estimates point out that code-share among non-market leaders increases equilibrium passenger volume (*Q*). Unfortunately, the effect on equilibrium price is still uncertain. To deal with this issue, the authors measured the changes in the leader's equilibrium price and passenger volume with and without code-sharing agreements. The estimated mean values for the changes in prices and quantity are equal to -83 and 10,052, respectively. These results suggest that code-sharing between non-market leaders lead to a more competitive behavior of the market leader since the leader's price fell, on average by $83 and passenger volume increased, on average, by 10,052 passengers.

Park and Zhang (2000) provide estimates for the theoretical model proposed in their study. It investigates the effects of four North Atlantic alliances—British Airways/USAir, Delta/Sabena/Swissair, KLM/Northwest and Lufthansa/United Airlines—on air fares, passenger volume and consumer welfare. Like Oum, Park and Zhang (1996),

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[13] This slope is the result of subtracting 0.00085 from 0.00419.

this study estimates demand and price equations. However, what distinguishes this study from the previous one is that the variables of interest are a set of dummy variables that represent the four specific alliances. The data used corresponds to a panel data covering the period of 1990-1994. This study used similar econometric techniques to the ones used in OPZ, as the Non-linear least squares method was used to estimate the demand and price equations.

The demand is represented by equation (2.31):

$$\ln Q_{jt} = D\,(P_{jt}, POP_{jt}, INC_{jt}, BAUS, DLNR, KLNW, LHUA; \alpha) + \sum R_j RT_j + \sum Y_t YR_t + \omega_{jt} \qquad (2.31)$$

The dependent variable is the natural log of the aggregate annual traffic in a city pair (*Q*). The subscripts *j* and *t* represent a particular route and year, respectively. The independent variables are: *P* which is the weighted average of fare on a route; *POP* represents the product of the population of the origin city with the population of the destination city; *INC* is the product of the per capita GDP of the origin country with the per capita GDP of the destination country; *BAUS, DLNR, KLNW* and *LHUA* are dummy variables that indicate if British Airways and USAir, Delta, Sabena and Swissair, KLM and Northwest or Lufthansa and United Airlines have a code-share agreement on a particular route , the *RT*s are route specific dummy variables and the *YR*s are year specific dummy variables.

The price equation is represented by equation (2.32):

$$\ln P_{ijt} = P\,(Q_{ijt},\ INP_{it},\ DST_{jt},\ SIZE_{ijt},\ BPAR,\ DPAR,\ KPAR,\ LPAR;\ \beta) +$$

$$\sum f_1 F_1 + \sum R_j RT_j + \sum Y_t YR_t + e_{ijt} \qquad (2.32)$$

The dependent variable is the natural log of the average fares by firm and route (*P*). The subscripts *i*, *j* and *t* represent a particular carrier, route and year, respectively. The independent variables are: *Q* which is firm *i*'s annual traffic on the route, *INP* is carrier *i*'s the overall input price index, *DTS* is the route distance, *SIZE* is carrier *i*'s average aircraft size, *BPAR, DPAR, KPAR* and *LPAR* are dummy variables that indicate if British Airways and USAir, Delta, Sabena and Swissair, KLM and Northwest or Lufthansa and United Airlines have a code-share agreement on a particular route, the *F*s are carrier-specific dummy variables, the *RT*s are route specific dummy variables and the *YR*s are year specific dummy variables.

The results for the demand equation corresponding to the variables of interest, alliance variables, show that the coefficients for the British Airways/USAir, KLM/Northwest and Lufthansa/United Airlines alliances are significant and have the values of 0.126, 0.354 and 0.132, respectively. This implies, for example, that the alliance between British Airways and USAir shifts aggregate demand by 13 percent. The opposite can be said about the Delta/Sabena/Swissair alliance as the coefficient estimate (-0.250) is negative and significant.

The estimates for alliance variables in the price equation show that the coefficients for the Delta/Sabena/Swissair alliance and KLM/Northwest alliance are statistically significant and negative. The former has a value of -0.189 and the latter has a value of -0.218. Therefore, the Delta/Sabena/Swissair alliance reduces fares by 19 percent and the KLM/Northwest alliance reduces price by 22 percent. The remaining two alliances—British Airways/USAir and Lufthansa/United Airlines—show coefficients that are not statistically significant.

Following the procedure used in OPZ to measure changes in equilibrium passenger volume and fares, with- and without-alliance equilibrium quantities and prices are compared. The overall pattern shows that passenger volume increased by an average of 35,998 passengers. The equilibrium price fell, on average by $41 dollars.

Consumer surplus are also calculated for each of the alliances as well as for the four alliances as a whole. Individually, threes of the alliances--British Airways/USAir, KLM/Northwest and Lufthansa/United Airlines—have a positive effect on consumer surplus. The Delta/Sabena/Swissair alliance has a negative effect on consumer surplus. As a whole, the alliances have a positive effect on consumer surplus as they report a total consumer benefit of $130 million per year.

Brueckener (2001) analyses the effects of different levels of airline cooperation—code-sharing, antitrust immunity and alliance membership—on airline fares using data from the Origin and Destination Survey for the year of 1999 provided by the US

Department of Transportation.[14] The estimated equation provides a test for the effects of alliances on fares ($LNFARE_{ij}$). The specification is:

$$LNFARE_{ij}= \beta_0 + \beta_1 LDIST_{ij} + \beta_2 POPTOT_j + \beta_3 REGIONS_j + \beta_4 COUPON_{ij} + \beta_5 BCLASS_{ij} + \beta_6 CODESHR_{ij} + \beta_7 ALLY_{ij} + \beta_8 IMMUNITY_{ij} + \beta_9 TOTCOMP_j + \beta_{10} ALLYCOMP_j + \beta_{11} AIRLINE\ EFFECTS_{ij} + (v_j + \varepsilon_{ij}) \quad (2.33)$$

Where the subscript *j* refers to the city-pair market and *i* refers to the itinerary within that market. Airline fares are considered to be a function of distance, market size, competition, regional and directional effects, fare category, airline specific effects, and cooperation measures. In estimating equation (2.33), the expectation was that the cooperation measures would have a negative effect on fares for interline flights paid by international passengers.

The independent variables used in the estimation are:

LDIST is the natural logarithm of the distance traveled.

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[14] This study expands the findings reported in Brueckner and Whalen (2000) where it was shown that alliances have a negative impact on air fares. The difference between the two studies is that Brueckener (2001) provides a better airline "cooperation" measure because the data used had additional information that was not available for the previous study. The new information indicates both operating carrier (airline that takes the passenger from one place to another) and ticketed carrier (airline that issues an itinerary). These two kinds of carriers are not always the same, especially when there is an alliance and on interline flights.
It is noteworthy to point out that datasets from the US Department of Transportation before 1999 (Data Bank IA and 1B) did not distinguish between ticketed and operating carriers. Since by definition code-sharing involves these two types of carriers, measures of code-sharing tend to be more accurate after 1999.

POPTOT is the variable that indicates market size and equals the geometric mean of the endpoint populations potential.

REGIONS set of dummy variables that indicate the region and direction.

COUPON is equal to the number of ticket coupons in an itinerary.

BCLASS represents the passenger-weighted fraction of segments for the given itinerary that are in business class.

CODESHR is a dummy variable that takes the value of one if two carriers have a code-share agreement. This means that the operating carrier and ticketed carrier differ in at least one of the itinerary's route segments.

ALLY is a dummy variable that indicates if two carriers belong to one of the four alliances: Wings (Northwest, KLM, and Continental), Star Alliance (United, Lufthansa, SAS, Air Canada, Varig, Thai Airlines, Ansett Australia and Air New Zealand), One World Alliance (American, British Airways, Qantas and Cathay Pacific) and Atlantic Excellence (Delta, Swissair, Sabena and Austrian Airlines). It should be noted that the variable ALLY is not used in most of the estimated regressions because its effect is difficult to disentangle from the effect with antitrust immunity.

IMMUNITY is a dummy variable which equals one if two carriers posses antitrust immunity.

TOTCOMP is the total competition measure which is based on the number of airlines competing with the itinerary's airline in the given city-pair market.

ONLNCOMP indicates the number of carriers that provide online service.

ALLYCOMP equals the number of alliance pairs that provide competing interline service in the market, with an alliance pair counted only if both members differ from each of the itinerary's carriers.

Several methods of estimation were used to estimate equation (2.33). The first method used is OLS. The variables of interest *CODESHR, IMMUNITY and ALLY* turned out to be significant and negative. The coefficient results for *CODESHR*, using OLS as estimation method, range between -0.067 and -0.097. The results for the *IMMUNITY* variable coefficients range from -0.162 to -0.215. The variable *ALLY* is only used in one specification of equation (2.33) with a reported coefficient of -0.041. The second method is that of a passenger-weighted regression. This type of regression was used in order to deal with the potential presence of heteroscedasticity as there are different numbers of passengers in the original itineraries. The results turned out quite close to the highest values (in absolute terms) as the first ones. *CODESHR* has a coefficient of -0.097 and *IMMUNITY* has a coefficient of -0.213.

A problem that was likely to arise, unobserved market-level heterogeneity, led Brueckner to estimate a fixed effects regression, which gathers the effects of omitted variables. Again, the results for this regression were similar to the ones obtained with the OLS estimation method. These findings suggest that unobserved heterogeneity is not a source of bias in the main coefficients of interest (cooperation variable estimates).

Brueckner next investigated the possibility for endogeneity of *CODESHR*. This may arise because carriers that have a code-share agreement do not necessarily code-share on every single market they serve. Thus, code-share may depend on market characteristics, which makes *CODESHR* an endogenous variable. To address this problem a two-stage least squares estimation was carried out where the fitted probabilities from a probit model estimated for *CODESHR* are substituted in equation (2.33). The results show significant change in the magnitude of coefficient estimates of *CODESHR* and *IMMUNITY* when compared to the other regressions (-0.166 and -0.152, respectively). The former is larger and the latter is smaller in absolute values. However, the coefficients were still negative and significant, thus supporting the results obtained in the other regressions.

Bamberger, Carlton and Neuman (2004) model the effects of domestic alliances (code-share) on fares and traffic for two domestic alliances: Continental/ America West (CO/HP) and Northwest/ Alaska Airlines (NW/AS). This is done by comparing the changes in average and total traffic from a pre-alliance period to a post-alliance period on cities were the alliances operated to the corresponding changes on a set benchmark city pairs where the alliances did not operate.

The two estimated equations were structured such that the first (equation (2.34)) estimates the effects on LN (average $fare_{post\text{-}alliance}$/average $fare_{pre\text{-}alliance}$), while the second (equation (2.34a)) estimates the effects on LN (total $traffic_{post\text{-}alliance}$/total $traffic_{pre\text{-}alliance}$). Three samples for these dependent variables are used: (a) all carriers, (b) alliance partners and (c) partners' rivals.

Equations (2.34) and (2.34a) have the same independent variables; the only difference is the dependent variables (percentage change in average fare and percentage change in total traffic). The average fare equation and the total traffic equation have the following specification:

LN(average $fare_{post\text{-}alliance}$/*average* $fare_{pre\text{-}alliance}$) $=\alpha_0+\alpha_1$*ALLIANCE DUMMY*$+\alpha_2$*CHANGE IN PERCENT ROUND TRIP*$+\alpha_3$*ENTRY BY SOUTHWEST*$+\alpha_4$ *CHANGE IN PERCENT NON-ALLIANCE DIRECT* $+\alpha_5$ *CHANGE IN CITY-PAIR NON-ALLIANCE HHI* $+\varepsilon$ (2.34)

LN(total $traffic_{post\text{-}alliance}$/*total* $traffic_{pre\text{-}alliance}$) $=\alpha_0+\alpha_1$*ALLIANCE DUMMY*$+\alpha_2$*CHANGE IN PERCENT ROUND TRIP*$+\alpha_3$*ENTRY BY SOUTHWEST*$+\alpha_4$ *CHANGE IN PERCENT NON-ALLIANCE DIRECT* $+\alpha_5$ *CHANGE IN CITY-PAIR NON-ALLIANCE HHI* $+\varepsilon$ (2.34a)

Where the dependent variables in equations (2.34) is the percentage change in fares in the pre-alliance and post-alliance periods and the dependent variable for equation (2.34a) is the percentage change in traffic from the pre-alliance and post-alliance periods. The independent variables include:

ALLIANCE DUMMY is a dummy variable that indicates whether the city-pair is an alliance pair.

CHANGE IN PERCENT ROUND TRIP indicates the change in the percentage of passengers flying on round-trip tickets.

ENTRY BY SOUTHWEST is a dummy variable that indicates entry by Southwest Airlines during the alliance period. This variable takes the value of one if Southwest's share in a city pair was greater than or equal to 5 percent and zero otherwise.

CHANGE IN PERCENT NON-ALLIANCE DIRECT represents the change in the percentage of non-alliance partners flying direct, adjusted for the non-alliance share of traffic

CHANGE IN CITY-PAIR NON-ALLIANCE HHI is the change in the percentage in the passenger-based city-pair non-alliance Herfindahl-Hirschman Index. [15]

For each of the two domestic alliances of interest (CO/HP) and (NW/AS), a series of OLS regressions were estimated using three samples: The first sample includes all carriers, the second includes only alliance partners and the third only considers the rivals.

Three specifications of equations (2.34) and (2.34a) are estimated for both percentage changes in fares and total traffic. The first type only considers the alliance dummy; the

15 The Herfindahl-Hirschman Index (HHI) is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases.

second adds three explanatory variables to the regression: change on the percent non-alliance direct and entry by Southwest and the third type adds the change in city-pair non-alliance HHI.

The results for CO/HP alliance show that the alliance effect on fares is "negative and significant". The addition of explanatory variables does not substantially change the alliance effect in terms of magnitude for each of the three samples considered. The coefficient values for the alliance dummy range from -0.065 to -0.082. Similarly, the results for the NW/AS alliance show a "negative and significant effect" of the alliance variable on fares but only for the sample that considers both alliance members and rivals. The samples that take into account only alliance members or only rivals, though they have negative coefficient estimates, they are not statistically significant. The results for the 'overall' sample range from -0.051 to -0.062. In addition, when the other explanatory variables are considered, the estimates for the alliance effect do not vary substantially.

The same types of regressions are estimated for the percentage change in traffic. In the case of the CO/HP alliance, the alliance effect is found to be "positive and significant" in all the regressions and all of the samples. The coefficient results for the alliance dummy range from 0.033 to 0.356. From this set of coefficients, it is also found that traffic increases more for alliance partners than for rivals in city-pairs where the alliance operates. When the NW/AS alliance is considered, the results are also positive but not statistically significant.

Whalen (2007) empirical model provides estimates of the effects of code-sharing, antitrust immunity and Open Skies treaties on fares, output (number of passengers for a carrier) and capacity (number of departures and also total available seats) using international panel data for the period of 1990 – 2000. The data used in the estimation was aggregated in two ways: at the route-carrier level (each observation is unique to the origin and destination pair and the carrier) and at the route level (data aggregated to the origin and destination level).

Equations (2.35) and (2.36) are estimated using price as the dependent variable. Equation (2.35) was estimated using the route-carrier data set and equation (2.36) was estimated using the route level data. Equation (2.35) is specified as:

$$LnFare_{i,m,t} = \alpha_0 + \alpha_1\, Online_{i,m,t} + \alpha_2\, Immunity_{i,t} + \alpha_3 CS_{i,t} + \alpha_4\, AvgCoup_{i,m,t} + \alpha_5 AvgDist_{i,m,t} + \alpha_6 PctOW_{i,m,t} + \alpha_7 HHI\_OA_{m,t} + \alpha_8\, HHI\_INT_{m,t} + \alpha_9 Opensky_{m,t} + \alpha_{10} USPop_{m,t} + \alpha_{11} USInc_{m,t} + \alpha_{12}\, EU\, Pop_{m,t} + \alpha_{13}\, EU\, GDP/Pop_{m,t} + \tau_t + \delta_i + \eta_m + \varepsilon_{i,m,t} \quad (2.35)$$

The dependent variable in equation (2.35) is the natural log of average fare. The subscript i refers to the carrier, m indicates the route and t represents the year. The independent variables in (2.35) are:

Online is a dummy that indicates if the itinerary is served by a single airline.

Immunity is a dummy variable that shows if an alliance has antitrust immunity.

CS is a dummy that indicates if there is a code-share agreement.

AvgCoup is the average number of coupons in an itinerary.

AvgDist is the average distance travelled.

PctOW is the percentage of one-way travel.

HHI_OA is the Herfindahl-Hirschman Index for carriers offering online or alliance service.

HHI_INT is the Herfindahl-Hirschman Index for those who offer non-alliance interline service.

Opensky dummy that controls for the effects of Open Sky Treaties.

USPop is population of US city.

USInc is the US metropolitan statistical area per capita income.

EU Pop refers to the population of a European city.

EU GDP/Pop is the European country GDP per capita.

τ_t Represent year-specific effects.

δ_t Represent carrier-specific effects.

η_m Represent route-specific effects.

Equation (2.36) is:

$$LnFare_{m,t} = \alpha_0 + \alpha_1\, Pct\ Online_{m,t} + \alpha_2\, Pct\ Immunity_{m,t} + \alpha_3\, Pc\ tCS_{m,t} + \alpha_4\, AvgCoup_{m,t} + \alpha_5 AvgDist_{m,t} + \alpha_6 PctOW_{m,t} + \alpha_7 HHI\_OA_{m,t} + \alpha_8\, HHI\_INT_{m,t} + \alpha_9 Opensky_{m,t} + \alpha_{10} USPop_{m,t} + \alpha_{11}\, USInc_{m,t} + \alpha_{12}\, EU\ Pop_{m,t} + \alpha_{13}\, EU\ GDP/Pop_{m,t} + \tau_t + \delta_t + \eta_m + \varepsilon_{m,t} \tag{2.36}$$

The dependent variable is the natural log of average fare (same as in equation (2.35)). The subscript *i* refers to the carrier, *m* indicates the route and *t* represents the year. The independent variables for equation (2.36) are given below:

Pct Online indicates percent of traffic traveling online.

Pct Immunity indicates percent of traffic traveling on code-sharing

Pct CS indicates percent of traffic traveling on immunized alliances

AvgCoup is the average number of coupons in an itinerary.

AvgDist is the average distance travelled.

PctOW is the percentage of one-way travel.

HHI_OA is the Herfindahl-Hirschman Index for carriers offering online or alliance service.

HHI_INT is the Herfindahl-Hirschman Index for those who offer non-alliance interline service.

Opensky dummy that controls for the effects of Open Sky Treaties.

USPop is population of the US city.

USInc is the US metropolitan statistical area per capita income.

EU Pop refers to the population of a European city.

EU GDP/Pop is the European country GDP per capita.

τ_t Represent year-specific effects.

δ_i Represent carrier-specific effects.

η_m Represent route-specific effects.

It is important to note that the structure of both equations is similar but that some variables (*Online*, *Immunity* and *CS*) of equation (2.36) are transformed into percentages (*Pct Online, Pct Immunity* and *Pct CS)* in equation (2.36) since data is not arranged by carrier.

For output effects, the dependent variable is the natural log of the number of passengers and the independent variables are the same as the ones in equations (2.35) and (2.38).

As the focus of the empirical analysis is the determination of the effect on fares and output and the estimation involves the use of panel data, fixed effects regressions were used. The variables of interest in these regressions are *Immunity/Pct Immunity* and *CS/Pct CS*. These variables are expected to have negative effects on prices and positive effects on output.

The regressions for (2.35) and (2.36) have several specifications. For equation (2.35), two OLS regressions were used (one includes route- and time-specific effects and the other adds carrier-specific effects); two instrumental variable regressions (IV) which repeat the structure followed in the OLS regressions but control for the possibility of endogeneity of the HHIs and a third regression which takes into account the possibility of an endogenous *CS*. The estimated results show that the variables of interest have the expected sign and are significant all regressions. However, magnitudes did vary with the estimation method used. In equation (2.35), the estimated coefficients for *Immunity* were in the range of -0.182 to -0.232 and the ones for *CS* were in the range of -0.041 to -0.099.

The price regressions for equation (2.36) include two OLS regressions and two IV regressions that follow the same structure as the ones used for equation (2.35). The estimated coefficients of the variables of interest are not comparable to the results of equation (2.35) since they are converted to percentage of traffic. Nevertheless, these estimates are also negative and significant. In equation (2.36), the ranges for the coefficients for *Pct Immunity* went from -0.143 to -0.269 and the ones for Pct CS went from -0.046 to -0.056.

Four regressions were estimated for the effect of alliances on output. Two of those regressions used the route-carrier data and the other two used the route level data. In addition, the dependent variable varies according to the dataset used. For route-carrier data the dependent variable is the natural log of the numbers of passenger for a carrier on a route. The regression for the route level data uses the natural log of total passengers on the route. The results of these regressions confirmed expectations since the variables *Immunity* and *CS* turned out to have positive and significant effects on output in all regressions. The estimated coefficients for *Immunity* where in the range of 0.415 to 0.628 and those for *CS* were in the range of 0.197 to 0.363.

The variable *Opensky* turned put to have unexpected effects on fares and output in the regressions. For both, equations (2.35) and (2.36), the coefficient estimates of this variable were positive, significant and with values that ranged from 0.032 to 0.049. In the case of output, the coefficients were not statistically significant.

To further understand how Open Skies treaties affect capacity, Whalen estimated a series of regressions using datasets of transatlantic gateway-to-gateway capacities.[16] Capacity is measured as the number of departures and the total number of available seats. Accordingly, there are two dependent variables in the estimation.

Equation (2.37) and (2.37b) estimate the capacity effects when the number of departures and number of available seats, respectively, are considered. They have the following form:

$$Ln\ Dep_{i,m,t} = \alpha_0 + \alpha_1\ Cld\text{-}CS_{i,t} + \alpha_2\ Open\text{-}Int_{i,t} + \alpha_3\ Open\text{-}CS_{i,t} + \alpha_4\ Open\text{-}Immune{:}\ Hud\text{-}Hub_{i,m,t} + \alpha_5 Open\text{-}Immune{:}Other_{i,m,t}, + \alpha_6 USPop_{m,t} + \alpha_7\ USInc_{m,t} + \alpha_8\ EU\ Pop_{m,t} + \alpha_9\ EU\ GDP/Pop_{m,t} + \tau_t + \delta_i + \eta_m + \varepsilon_{i,m,t} \qquad (2.37)$$

$$Ln\ Seat_{i,m,t} = \alpha_0 + \alpha_1\ Cld\text{-}CS_{i,t} + \alpha_2\ Open\text{-}Int_{i,t} + \alpha_3\ Open\text{-}CS_{i,t} + \alpha_4\ Open\text{-}Immune{:}\ Hud\text{-}Hub_{i,m,t} + \alpha_5 Open\text{-}Immune{:}Other_{i,m,t}, + \alpha_6 USPop_{m,t} + \alpha_7\ USInc_{m,t} + \alpha_8\ EU\ Pop_{m,t} + \alpha_9\ EU\ GDP/Pop_{m,t} + \tau_t + \delta_i + \eta_m + \varepsilon_{i,m,t} \qquad (2.37a)$$

The dependent variable for equation (2.37) is the natural log of the number of departures and for (2.37a) it is the natural log of available seats. The subscript *i* refers to the carrier, *m* indicates the route and *t* represents the year. The independent variables are:

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16 Gateway –to-gate routes are the one that involve a domestic and foreign gateway airport, typically hubs, where.

Cld-CS indicates that there is no Open Skies treaty between two countries and the carrier has a code-sharing agreement with a carrier based in the destination country.

Open-Int indicates that there is an Open Skies agreement and the carrier has no alliances with carriers from the destination country.

Open-CS shows that there is an Open Skies agreement and the carrier has a code-share agreement with a carrier from the destination country.

Open-Immune: Hub-Hub indicates that there is an Open Skies agreement and the carrier has an immunized alliance with a carrier from a destination country and the route traveled is between hubs.

Open-Immune: Other indicates that there is an Open Skies agreement and the carrier has an immunized alliance with a carrier from a destination country and the route is not between hubs.

USPop is population of the US city.

USInc is the US metropolitan statistical area per capita income.

EU Pop refers to the population of a European city.

EU GDP/Pop is the European country GDP per capita.

τ_t Represents year-specific effects.

δ_i Represents carrier-specific effects.

η_m Represents route-specific effects.

The Open Skies treaty effects on capacity are due to expansion by immunized alliances on trunk (major airline carrier) routes between hubs since coefficients for *Open-Immune:*

Hub-Hub were positive and significant. When the number of departures is considered as the dependent variable the coefficient estimates of *Open-Immune: Hub-Hub* ranged from 0.183 to 0.175. When the number of available seats was considered, the estimates ranged from 0.261 to 0.311. There was no statistically significant change in capacity after Open Skies for carriers with antitrust immunity for cities other than between the partners' hubs. Also, there was no statistically significant effect for code-sharing alliances or for non-alliance carriers. However, carriers with code-sharing alliances in countries without Open Skies agreements had a positive and significant effect on capacity.

To summarize:

Out of the five empirical studies that were reviewed in this section, only three of them dealt with output as well as price effects. The other two, focused mainly on price effects. Oum, Park and Zhang report that code-sharing has a positive effect on output and a negative effect on price of a ticket of a market-leader as a response to cooperative behavior of non-market leaders. The overall finding of this paper, which is supported in a later research done by Park and Zhang, is that prices fall and quantity increases for the entire market and not just for alliance members. Brueckner's estimated model also shows that alliances have a negative effect on fares. His findings differ from those reported in OPZ in that he uses a more accurate measure of airline cooperation. Bamberger, Carlton and Neuman results show that alliances decrease fares and that some traffic, depending on the alliance, increases. Finally, Whalen's empirical estimates show that prices fall with cooperation and that output increases. Overall, the empirical literature shows that alliances lead to reduction in ticket prices and that output tend to rise on interline flights.

3. AIRLINE ALLIANCES AS A MARKET INTEGRATING MECHANISM

3.1 Introduction

Integration, whether it is social, political and/or economic, among agents such as individuals, industries or countries has become a popular subject among scholars. Particularly, the interest resides in determining not only if forming a "group" will have a positive effect among its members (benefits of joining a group outweigh the cost of joining) but also if the existence of such a group will make non-members worse off. A common example of integration can be found in the European Union which is an economic and political union of 27 European countries. In the airlines industry, integration can be found in several forms and sizes. The most popular groupings formed are code-share and antitrust immunity. These two tend to be relatively small in size as they generally have no more than two members. However, larger groups can be found in international alliances such as Star Alliance, Sky Team and One World.

Since their creation in the late 1990's the major alliances—Star Alliance, Sky Team and One World—have continued to expand their reach as new strategic domestic and international air carriers become members. In fact, Star Alliance's membership grew from 6 members in 1997 to 24 in 2008; Sky Team, the second largest alliance in terms of the number of members, expanded from 4 members in 2000 to 14 in 2008 and One World's membership rose from 7 members in 1999 to 11 members in 2008.[17] This increase in membership signals that the benefits from joining one of these alliances outweigh the costs of joining. This is not surprising since the goals of airline alliances can be summarized in: expansion of member operations to parts of the world where they cannot afford to go to on their own and encouraging passenger volume as well as loyalty by offering 'standard' services, frequent flyer programs and coordination of schedules and use of airport facilities (lounges and gates).

Most of the empirical models provided in the literature (Oum et al (1996), Park and Zhang (2000) and Whalen (2007) to name a few) focus on the effect of small alliances such as code-sharing and antitrust immunity on prices and passenger volume (output) in order to establish is these alliances are beneficial to its members as well as consumers. The majority of these studies agree that integration among airlines results in both the airline members and passengers being better off as it reduces fares and raises output.

The contribution of this study to the literature is it that it explores the effects of the three major alliances in domestic and international markets, particularly, their effects on the market share of their members as well as non-members. In other words, in this essay I provide and test a model which integrates theories from international economics and industrial organization. The model selected is the gravity model. By estimating this model

[17] Table A.3a, b and c provide the membership evolution by year of the three alliances discussed in this chapter.

I can ascertain whether or not airline alliances increase market share for airlines in the alliance at the expense of others (non-alliance airlines) or that alliances increase the volume of passengers through efficiency gains (trade creation). The model and estimation methods are spelled out below.

The structure of the paper is as follows: Section 3.2 provides a brief review of the gravity model as well as the definitions of trade creation and trade diversion. Section 3.3 spells out the model estimated. Section 3.4 presents a description of the datasets used and explains how the variables in the model were constructed. Section 3.5 presents and interprets the findings. The last section concludes.

3.2 The Gravity Model

The gravity model uses the gravitation force concept as an analogy to explain different types of flows (for example: migration, commuting, tourism, trade, etc). In the field of international trade, it was first introduced by Tinbergen (1962) and it is commonly used to describe trade patterns between countries. The basic model, shows that bilateral trade between countries i and j is directly proportional to their GDP and population and inversely proportional to the distance between them. Corollary, countries that are similar in their relative size will tend to trade more than those of different size (Feenstra, 2004, p. 144-145).

According to Ott *et al* (2003), there are three basic variables involved in this model: variables that portray the "potential demand" of the importing country (GDP and GDP per capita of the importing country), variables that represent the "potential supply" of the exporting country (GDP and GDP per capita of the exporting country) and variables that represent factors that may aid or hinder trade (distance, languages, borders, etc) (p.31). A general form of the gravity model is given by the following equation:

$$x_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} YP_i^{\alpha_3} YP_j^{\alpha_4} D_{ij}^{\alpha_5} \qquad (3.1)$$

where

x_{ij} = Trade flows from country *i* to country *j*
Y_i = GDP of country *i*
Y_j = GDP of country *j*
YP_i = GDP per capita of country *i*
YP_j = GDP per capita of country *j*
D_{ij} = Distance between country *i* and country *j*

The concepts of traffic creation and traffic diversion are borrowed from Viner's analysis of trade creation and trade diversion (the theory of custom unions).[18] Viner offered a framework for assessing whether a regional integration would tend to "trade creation" (addition of the volume of trade) or "trade diversion" where the volume of trade is increased by diverting trade from trading partners outside the integrating markets to partners within the integrating market. The effect is a "zero" gain in international trade.

[18] Viner, J. (1950). "The Customs Union Issue". Carnegie Endowment for International Peace, New York.

Further applications of these concepts are provided in Balassa (1967), Pelzman (1977), Krueger (1999), Musila (2005) and Magee (2008).

3.3 The Gravity Model Estimation

A gravity model is used to estimate the effects of traffic volume. Due to data availability, passenger volume is used as a proxy for volume of traffic as a higher number of passengers may imply higher traffic. Following Musila (2005) and Magee (2008), I estimate the gravity equation using sets of dummy variables to determine whether airline alliances formation creates or diverts passenger volume.

Alliances, like regional integration, may be beneficial or harmful depending on the airline joining the alliance and the extent of trade creation and trade diversion; moreover, whether or not an alliance benefits its members will depend on parameter values and initial conditions. As Burfisher *et al.* (2001, p. 139) put it "this is essentially an empirical issue that must be settled by data analysis."

The model is represented by the following equation:

$$Ln\ passenger\ volume_{i,j,m,t} = \alpha_0 + \alpha_1\ lnDist_m + \alpha_2\ ln\ (Price_{m,t}) + \sum_k\ (\alpha_3 k\,1_{i,j,t} + \alpha_4 k2_{i,j,t})$$

$$+\alpha_5 OrigenPop_{m,t} + \alpha_6 DestPop_{m,t} + \alpha_7 Hub_{ij} + \alpha_8 Route\ effects_m + \alpha_9 Year\ effects_t + \varepsilon \quad (3.2)$$

The dependent variable is the natural logarithm of passenger volume which denotes the passengers transported by airline *i* and *j* in a specific route *m*. Passenger volume on a city-pair or route is assumed to be a function of distance, average fare, population, alliances defined by variables *k1* which takes the value of 1 if airline *i* and *j* are members of alliance k (this variable captures the traffic creation effect for the members) and k2 which is 1 if either airline *i* or *j* are a member of alliance k (this variable captures the trade diversion effect), and whether an origin city is a hub city for either carrier *i* or *j*. Table 3.1 lists the model variables and provides a brief description of them.

3.4 Data and Construction of Variables

3.4.1 Data Description

The data on passengers, fares and distances flown between cities used in the estimations of the gravity equation come from the Origin and Destination Survey which is compiled by the US Department of Transportation (DOT). It is available for two different samples: international and domestic carriers (Data Bank 1A) and domestic carriers only (Data Bank 1B). Data Bank 1A is restricted by DOT and can only be obtained with its permission. It is worth noting that Data Bank 1A not only includes domestic and international routes that have a US city as an origin or destination but also international routes that have foreign cities as both origin and destination.

Both datasets (Data Bank 1A and 1B) contain a sample that consists of 10% of all airline tickets in a particular quarter. From the first quarter of 1998, airlines are required to report both the advertised ticketed carrier and the actual operating carrier for each coupon. Thus, Data Bank 1A and 1B contain the dual carriers for each coupon in the itinerary. They also include cities, states and/or countries or origin and destination, the number of coupons

Table 3.1: Gravity Model Variables

Dependent Variable	Description
Ln Passenger	The dependent variable is the natural log of passengers transported by airline *i* and airline *j* on a route *m* (city-pair or from point A to B) at time *t*.
Independent Variables	**Description**
Ln Dist	Natural log of the distance flown between the origin and the destination city for any route *m*.
Ln (Price)	Natural log of average fare charged on a route *m*
k1	Dummy variable that takes the value of 1 if airlines *i* and *j* are contemporaneous members in alliance *k*. This variable captures the "traffic creation" effect from a particular alliance (Star Alliance, One World or Sky Team).
k2	Dummy variable that takes the value of 1 if one and only one of the airlines is a member of alliance *k* at time *t*. This variable complements the previous variable in the sense that it portrays the "traffic diversion" effect.
Ln Origin Pop	Natural logarithm of population of origin city
Ln Dest Pop	Natural logarithm of population of the destination city.
Ln Origin Inc	Natural logarithm of median household income for origin city (domestic sample). Natural logarithm of GDP per capita of origin country (international sample).
Ln Dest Inc	Natural logarithm of median household income for destination city (domestic sample). Natural logarithm of GDP per capita of destination country (international sample).

Table 3.1: ***continued***

Hub	Variable that represents whether the origin city of a route *m* is a hub for airline *i* and/or *j*
Route/region Effect	Set of dummy variables that take into account route/region specific effects
Year Effects	Set of dummy variables that take into account year specific effects

used between the origin and destination, the mileage for each trip, the dollar amount paid by each passenger in the sample, the fare class, the number of passengers and the airports of origin and destination.

Three samples were used in the estimations. The first sample, taken from Data Bank 1B, is the domestic sample which covers a 9 year period (1999-2007). The set of airlines in this sample is formed by 27 domestic airlines serving 209 routes or markets. Unfortunately, since the majority of the alliance members are international carriers the domestic sample is bound to have a few of the total alliance members. The other two samples were taken from Data Bank 1A. These samples will be referred to in this paper as the international sample since it is formed by both domestic and international carriers. This sample will provide a better sense of the effects of the major alliances on passenger volume. The international sample is divided into two subsamples because only two years of the Data Bank 1A were provided by DOT—2003 and 2008. The sample obtained from both of these years consists of 111 domestic and international carriers serving 395 routes. Tables 3.2a and 3.2b provide summary statistics of the model variables for the domestic and the international sample respectively. Close examination of Table 3.2a reveals that the log of passenger volume in the 209 domestic routes considered is decreasing over time. In fact, after exploring the total number of passengers in the sample from Table A.4a in the appendix, over a 9 year period (1999-2007), the total number of passengers reports a negative average growth rate of 5 percent. Out of the six 'legacy' carries that belong to a

Table 3.2a: Descriptive Statistics: Domestic Sample for 1999 and 2007

	1999 N=71,672		2000 N=74,084		2001 N=74,900		2002 N=67,954		2003 N=71,588		2004 N=75,838		2005 N=81,722		2006 N=83,206		2007 N=83,842	
Variables	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Ln Passenger	6.93	3.16	6.97	3.13	6.84	3.04	6.86	3.07	6.49	3.21	6.38	3.29	6.15	3.34	6.03	3.27	6.01	3.25
Ln Dist	7.18	0.62	7.19	0.61	7.20	0.63	7.20	0.61	7.20	0.60	7.19	0.60	7.19	0.59	7.19	0.59	7.18	0.61
Ln (Price)	5.28	0.43	5.30	0.42	5.23	0.40	5.21	0.36	5.24	0.35	5.19	0.35	5.20	0.36	5.30	0.34	5.27	0.36
Star Alliance 1	0	0	0	0	0	0	0	0	0	0	0.11	0.31	0.11	0.31	0.11	0.32	0.12	0.32
Star Alliance 2	0.15	0.35	0.14	0.35	0.14	0.35	0.15	0.36	0.15	0.35	0.47	0.49	0.47	0.49	0.48	0.49	0.48	0.49
Sky Team 1	0	0	0	0	0	0	0	0	0	0	0.07	0.26	0.07	0.25	0.07	0.25	0.07	0.25
Sky Team 2	0	0	0.14	0.35	0.13	0.34	0.15	0.35	0.14	0.35	0.44	0.49	0.42	0.49	0.42	0.49	0.42	0.49
One World 1	0	0	0	0	0	0	0	0	0	0	0.01	0.06	0.01	0.06	0.01	0.06	0.01	0.07
One World 2	0.14	0.34	0.14	0.34	0.13	0.34	0.14	0.35	0.13	0.34	0.18	0.38	0.17	0.38	0.17	0.37	0.17	0.38
Ln Origin Pop	13.73	1.01	13.78	1.01	13.80	1.00	13.79	1.00	13.78	0.99	13.78	0.98	13.80	0.98	13.81	0.98	13.82	0.98
Ln Dest Pop	13.74	1.06	13.78	1.06	13.78	1.07	13.77	1.05	13.77	1.05	13.77	1.04	13.78	1.04	13.80	1.04	13.81	1.03

Table 3.2a: *continued*

Ln Origin Inc	10.96	0.14	11.01	0.15	11.06	0.15	11.11	0.16	11.08	0.18	11.10	0.18	11.11	0.17	11.14	0.15	11.11	0.16
Ln Dest Inc	10.94	0.13	10.99	0.13	11.04	0.14	11.09	0.15	11.05	0.15	11.07	0.15	11.08	0.14	11.11	0.14	11.08	0.15
Hub	0.22	0.41	0.21	0.41	0.21	0.41	0.23	0.42	0.22	0.41	0.21	0.41	0.21	0.40	0.20	0.40	0.20	0.40

Note: The zeros reported for Star Alliance 1, Sky Team 1 and One World 1 denote are explained by the fact that only one US carrier was a member of these alliance. In 2004, once other members as well as affiliate members are considered, positive numbers are reported.
Descriptions of these variables are given in Table 3.2.1.

Table 3.2b: Descriptive Statistics: International Sample for 2003 and 2008

	2003 Sample N=254,040		2008 Sample N=234,196	
Variables	**Mean**	**St. Dev.**	**Mean**	**St. Dev.**
Ln Passenger	4.349	2.654	4.779	2.589
Ln Dist	7.594	1.068	7.641	1.045
Ln (Price)	6.712	0.597	6.935	0.528
Star Alliance 1	0.041	0.198	0.071	0.257
Star Alliance 2	0.397	0.485	0.422	0.494
Sky Team 1	0.005	0.073	0.028	0.167
Sky Team 2	0.161	0.367	0.324	0.468
One World 1	0.014	0.116	0.019	0.138
One World 2	0.242	0.428	0.274	0.446
Ln Origin Pop	7.668	1.217	7.766	1.045
Ln Dest Pop	7.695	1.309	7.805	1.209
Ln Origin Inc	9.875	1.065	10.304	0.895
Ln Dest Inc	10.176	0.715	10.532	0.579
Hub	0.332	0.471	0.364	0.481

major alliance, four of them—US Airways, Delta, United Airlines and Continental—showed an annual average decline of 13, 12, 10 and 6 percent respectively.19 Only Northwest shows no change in this period. It is worth noting that American Airlines is the only legacy carrier that reports an average growth rate of 6 percent in the total number of passengers. The overall decline in the number of passengers may imply that airlines are reducing or eliminating traffic in these routes because they were no longer profitable or as profitable as before. The reduction of passenger volume may be attributed to outside factors such as the effects of the terrorist attacks of September 11 which left a deep wound in the airline industry since many airlines began to experience great losses in their net income; the higher level of competition that was sprouted after the deregulation of the US airline industry in 1978 which made it difficult for many airlines to keep themselves profitable and the higher input price such as fuel which deepened the already large dent in the airlines' profits.

On the other hand, Table 3.2b shows that over a six year period, the log of passenger volume increased for the 395 intentional routes considered. The number of total passengers for the international routes grew at an annual average growth rate of 4 percent for the 6 year period (between 2003 and 2008). Furthermore, in contrast to the decline in passengers for the six main US legacy airlines in the previous sample, there is an increase

[19] Legacy carriers are those that were in operation before the deregulation of the US Airline Industry in 1978.

in the average number of passengers for all but one of the six major US carriers. Table A.4b in the appendix shows the numbers of passengers for 2003 and 2008 as well as the growth rates of some of the members of Star Alliance, Sky Team and One World in the 395 international routes. Delta reports the largest gain in passengers among the US carriers with an average growth rate of 8.97 percent followed by Continental with 6.80 percent and American with 5.11 percent. Only United shows an average decrease in passengers of 1.46 percent. This implies that foreign air travel demand was is less responsive to changes in economic conditions than domestic demand. Additional support can be found in the fact that demand for international travel has been growing faster than domestic demand since the late 1980s.

3.4.2 Construction of the Variables

In equation (2), the dependent variable is the natural log of passenger volume. This is defined as the natural logarithm of the number coach passengers transported by airline *i* plus the number of coach passengers transported by airline *j*.[20] This variable represents the carrier pair output for a particular route *m* at time *t*.

As mentioned earlier, the Origin and Destination Survey provides the number of coupons or stops for each itinerary reported on a trip from a city A to a city B. However, for this research, itineraries with more than four stops are dropped because a relatively small number of passengers in the sample show itineraries that exceed four stops.

[20] Business and first class passengers are not considered in this study.

Prices are defined as the weighted average of the market fares. The market fare corresponds to the price charged by an airline for the distance traveled between two cities (origin and destination) regardless of the number of stops. Since domestic and international markets differ in their pricing system, different price intervals were considered for domestic and international routes. Domestic market fares which were less than $US25 and above US$1,500 were dropped. On the other hand, for the international market, fares which were less than or equal to $US100 and above US$9,999 were dropped. Values below the lower limits of the price intervals of the domestic and international markets are dropped since, most likely, they correspond to itineraries acquired through frequent-flyer-mile programs or by airline employees. Also, data points above the upper limits of the intervals are dropped since they could be considered outliers. Thus, the intervals selected for both markets guarantee that dollar values that are outside credible limits are eliminated.[21] To obtain the average fare for each route by airline, weighted averages fares were calculated by airline for a particular route.

The variables that capture traffic creation and traffic diversion in equation (2) are are *k1* and *k2* respectively (where *k*= Star Alliance, One World Alliance or Sky Team). As stated above, the term *k1* indicates if two airlines *i* and *j* are contemporaneous members of an alliance *k*. A positive sign on the coefficient estimate for this variable implies that traffic among the members of alliance k has increased. The term *k2* indicates if one of the two

[21] In addition, the Origin and Destination Survey has a variable that reports which itineraries have a not credible reported fare.

airlines is a member of alliance *k*. If the coefficient of this variable is positive this would suggest that the overall traffic is rising. If the coefficient is negative then traffic is diverted from non-member airlines established in a market to members of the alliance. The overall effect of an alliance *k* on passenger volume is determined by the sum of the coefficients of *k1* and *k2*.

Each route *m* is defined as a city pair or market. The 209 routes considered for the domestic sample are those where both origin and destination are US cities. In this sample, combinations of only 30 of the most important US cities are considered. These cities are scattered over five US regions—Northeast, Southeast, Midwest, Southwest and West. For the international data sample, the 395 routes considered cover international flights that have a US city either as an origin or a destination as well as international flights where both origin and destination correspond to foreign cities. In this sample, 96 cities from different regions of the world—North America, Central America, Caribbean, South America, Europe, Africa, Asia and the Middle East—are set in pairs to create the international routes.[22] Tables 3.3a and 3.3b provide a list of the US cities used in the domestic sample and the cities used in the international samples respectively.[23]

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[22] It is important to note that a trip from a city A to a city B is not considered the same as a trip from city B to city A as they are different markets.

[23] Table A.5a and A.5b provide a complete list of the routes considered for the domestic and the international samples respectively.

Table 3.3a: List of cities in the domestic sample
(Number of cities=30)

	City	*State*	*Region*
1	Albany	NY	Northeast
2	Albuquerque	NM	Southwest
3	Atlanta	GA	Southeast
4	Austin	TX	Southwest
5	Birmingham	AL	Southeast
6	Boston	MA	Northeast
7	Buffalo	NY	Northeast
8	Chicago	IL	Midwest
9	Cleveland	OH	Midwest
10	Dallas	TX	Southwest
11	Denver	CO	West
12	Detroit	MI	Midwest
13	Houston	TX	Southwest
14	Indianapolis	IN	Midwest
15	Kansas City	MO	Midwest
16	Las Vegas	NV	West
17	Los Angeles	CA	West
18	Miami	FL	Southeast
19	Minneapolis	MN	Midwest
20	Nashville	TN	Southeast
21	New York	NY	Northeast
22	Newark	NJ	Northeast
23	Portland	ME	Northeast
24	Portland	OR	West
25	Salt Lake City	UT	West
26	San Francisco	CA	West
27	Seattle	WA	West
28	Tucson	AZ	Southwest
29	Tulsa	OK	Southwest
30	Washington	DC	Southeast

Table 3.3b: List of cities in the international sample
(Number of cities = 96)

	City	*Country*	*Region*
1	Abu Dhabi	United Arab Emirates	Middle East
2	Amsterdam	Netherlands	Europe
3	Aruba	Aruba	Caribbean
4	Asuncion	Paraguay	South America
5	Atlanta, GA	US	North America
6	Athens	Greece	Europe
7	Auckland	New Zealand	Oceania
8	Bangkok	Thailand	Asia
9	Barbados/Bridgetown	Barbados	Caribbean
10	Barcelona	Spain	Europe
11	Beijing	China	Asia
12	Beirut	Lebanon	Middle East
13	Belize City	Belize	Central America
14	Berlin	Germany	Europe
15	Bogota	Colombia	South America
16	Bombay	India	Asia
17	Boston, MA	US	North America
18	Brussels	Belgium	Europe
19	Bucharest	Romania	Europe
20	Budapest	Hungary	Europe
21	Buenos Aires	Argentina	South America
22	Cairo	Arab Republic Of Egypt	Africa
23	Calgary	Canada	North America
24	Can Cun	Mexico	North America
25	Capetown	Republic Of South Africa	Africa
26	Chicago, IL	US	North America
27	Cleveland, OH	US	North America
28	Copenhagen	Denmark	Europe
29	Dallas/Ft.Worth, TX	US	North America
30	Delhi	India	Asia
31	Denver, CO	US	North America
32	Detroit, MI	US	North America
33	Doha	Qatar	Middle East
34	Dubai	United Arab Emirates	Middle East
35	Dublin	Ireland	Europe
36	Frankfurt	Germany	Europe

Table 3.3b: ***continued***

37	Freeport	Bahamas	Caribbean
38	Guatemala City	Guatemala	Central America
39	Guayaquil	Ecuador	South America
40	Hong Kong	Hong Kong-China	Asia
41	Honolulu, HI	US	North America
42	Houston, TX	US	North America
43	Istanbul	Turkey	Europe
44	Johannesburg	Republic Of South Africa	Africa
45	Kiev	Ukraine	Europe
46	Kingston	Jamaica	Caribbean
47	Kuwait	Kuwait	Middle East
48	La Paz	Bolivia	South America
49	Las Vegas, NV	US	North America
50	Lima	Peru	South America
51	Lisbon	Portugal	Europe
52	London	United Kingdom	Europe
53	Los Angeles, CA	US	North America
54	Luxembourg	Luxembourg	Europe
55	Madrid	Spain	Europe
56	Managua	Nicaragua	Central America
57	Manchester	United Kingdom	Europe
58	Manila	Philippines	Asia
59	Melbourne	Australia	Oceania
60	Mexico City	Mexico	North America
61	Miami, FL	US	North America
62	Minneapolis, MN	US	North America
63	Montego Bay	Jamaica	Caribbean
64	Montevideo	Uruguay	South America
65	Montreal	Canada	North America
66	Moscow	Russia (European)	Europe
67	Nassau	Bahamas	Caribbean
68	New York, NY	US	North America
69	Newark, NJ	US	North America
70	Paris	France	Europe
71	Panama City	Panama Republic	Central America
72	Philadelphia, PA	US	North America
73	Phoenix, AZ	US	North America
74	Prague	Czech Republic	Europe

Table 3.3b: ***continued***

75	Quito	Ecuador	South America
76	Rio De Janeiro	Brazil	South America
77	San Francisco, CA	US	North America
78	San Jose	Costa Rica	Central America
79	San Salvador	El Salvador	Central America
80	Santiago	Chile	South America
81	Santo Domingo	Dominican Republic	Caribbean
82	Sao Paulo	Brazil	South America
83	Seattle, WA	US	North America
84	Seoul	South Korea	Asia
85	Shanghai	China	Asia
86	Singapore	Singapore	Asia
87	Stockholm	Sweden	Europe
88	Sydney	Australia	Oceania
89	Taipei	Taiwan	Asia
90	Tel Aviv	Israel	Middle East
91	Tokyo	Japan	Asia
92	Toronto	Canada	North America
93	Vancouver	Canada	North America
94	Warsaw	Poland	Europe
95	Washington, DC	US	North America
96	Zurich	Switzerland	Europe

3.5 Empirical Results

To test for the effects of the major alliances on passenger volume, two sets of regressions estimates are provided. The first set pertains to the domestic sample and the second corresponds to the international data samples.

3.5.1 Domestic Sample

As mentioned before, the data for this sample covers a period of 9 years (1999-2007). This panel data consists of 209 routes which are served by 27 domestic airlines. A list of these airlines is given in Table 3.4. This table also provides information on alliance membership of these domestic carriers. Of the 27 US carriers considered, 10 belong to Star Alliance, 6 to Sky Team and 2 to One World alliance. It is noteworthy to point out that there are only a few full members in the local market of the three alliances considered in this list—United Airlines and US airways from Star Alliance, Delta, Northwest and Continental from Sky Team and American Airlines from One World. However, in 2004 the alliances began recognizing regional carriers associated with full members as affiliate members.

The total number of observations for the dependent variable using the domestic sample is 648,806.[24] Since we are dealing with panel data, fixed and random effects

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[24] The total potential number of observations for each of the nine years considered is 1'320,462 which comes from the product of 27 airlines * 26 pairs * 9 year * 209 routes.

regression are estimated. The fixed effects model takes into account the variation 'within' a single agent or carrier-pair. The random effects model on the other hand, uses both 'within' and 'between' variation among agents as it is a weighted average of the within and between estimators. A Hausman Test is applied to determine whether the random effects estimator is unbiased. After performing the test, the random effects estimator is not rejected. Table 3.5 reports the coefficient estimates of the fixed and random effect models. The results for the regressions show that the estimates for Star Alliance and Sky Team are negative and significant under a 1 percent level. The One World alliance is the only one that reports positive and significant effects.

Even though the negative signs in the coefficients are not surprising as the total number of passengers in these routes fell on average 5 percent in a 9 year period, it is not likely that being in either the Star Alliance or Sky Team reduces passenger volume. A more reasonable explanation is that there are other factors that are not considered in the estimation that affect passenger volume and this effect is picked up in some part by the alliance variables.

Another pair of regressions was estimated in which time and route effects into account to determine if the effects of other factors are picked up by these variables. The results of these regressions are shown in Table 3.6 The first column in this table shows the results of regression (1) in which only year effects are considered. The next column reports the results of regression (2) which takes into account both year and route effects.

Table 3.4: List of airlines in the domestic sample

(N=27 airlines: Star Alliance (n=10), Sky Team (n=6) and One World (n=2)

	IATA Code	*Airline Name*	*Alliance Membership**
1	TZ	ATA Airlines	
2	FL	Air Tran Airways	
3	AS	Alaska Airlines	
4	HP	America West Airlines Inc.**	Star Alliance
5	AA	American Airlines	One World
6	GQ	Big Sky Airlines Inc.	
7	RP	Chautauqua Airlines	Star Alliance/One World/ Sky Team
8	9L	Colgan Air	Star Alliance/ Sky Team
9	C5	Commutair Aka Champlain Enterprises	Sky Team
10	CO	Continental Airlines	Sky Team
11	DL	Delta Airlines	Sky Team
12	F8	Freedom Airlines	
13	YV	Mesa Airlines	Star Alliance
14	NA	National Airlines	
15	NW	Norwest Airlines	Sky Team
16	P9	Pro Air Inc	
17	YX	Republic Airlines	Star Alliance
18	S5	Shuttle America	Star Alliance
19	OO	SkyWest Airlines	Star Alliance
20	WN	Southwest Airlines	
21	NK	Spirit Air Lines	
22	SY	Sun Country Airlines	
23	FF	Tower Air Inc.	
24	AX	Trans States Airlines	Star Alliance
25	TW	Trans World Airlines	
26	US	US Airways	Star Alliance
27	UA	United Airlines	Star Alliance

Note:
*The membership information in this table is not dynamic in the sense that it does not tell when a carrier enters or leaves an alliance. For precise information on this matter see Table A.2a, b and c.
**America West merged with US Airways in 2005 and thus joins Star Alliance through US Airways' original membership.

Table 3.5: Estimation Results of Gravity Model: Fixed and Random Effects for domestic sample (1999-2007)

Variables	Fixed Effects	Random Effects
Log average fare	-0.694*** (0.0088)	-0.690*** (0.0088)
Log of distance	1.266*** (0.0055)	1.265*** (0.0055)
Log of pop 1	0.266*** (0.0033)	0.265*** (0.0033)
Log of pop 2	0.577*** (0.0030)	0.577*** (0.0030)
Log of inc 1	1.053*** (0.0184)	1.049*** (0.0184)
Log of inc 2	2.763*** (0.0206)	2.758*** (0.0206)
Star Alliance 1	-0.494*** (0.0216)	-0.5017*** (0.0215)
Star Alliance 2	-0.311*** (0.0112)	-0.313*** (0.0112)
Sky Team 1	-0.846*** (0.0244)	-0.846*** (0.0243)
Sky Team 2	-0.533*** (0.0110)	-0.529*** (0.0110)
One World 1	1.122*** (0.0954)	1.162*** (0.0951)
One World 2	0.437*** (0.0309)	0.472*** (0.0304)
Hub	2.698*** (0.0084)	2.698*** (0.0084)
Constant	-53.169*** (0.3361)	-53.929*** (0.3398)
N	684,806	684,806

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

Note:

k1 is represented by alliance designated by the number 1 (i.e. Star Alliance); k2 is represented by alliance designated by the number 2.

Table 3.6: Estimation Results of Gravity Model: Domestic data with year and route-specific effects

Variables	Regression (1)	Regression (2)
Log average fare	-0.782*** (0.0089)	-0.715*** (0.0090)
Log of distance	1.296*** (0.0055)	0.841*** (0.0087)
Log of pop 1	0.302*** (0.0033)	0.353*** (0.0037)
Log of pop 2	0.612*** (0.0031)	0.599*** (0.0033)
Log of inc 1	1.673*** (0.0191)	1.393*** (0.0202)
Log of inc 2	3.476*** (0.0215)	3.257*** (0.0260)
Star Alliance 1	0.369*** (0.0236)	0.276*** (0.0211)
Star Alliance 2	0.232*** (0.0128)	0.257*** (0.0115)
Sky Team 1	0.045* (0.0257)	0.180*** (0.0238)
Sky Team 2	0.105*** (0.0124)	0.249*** (0.0113)
One World 1	0.597*** (0.0931)	1.222*** (0.0872)
One World 2	0.214*** (0.0279)	0.777*** (0.0198)
Hub	2.689*** (0.0084)	2.738*** (0.0087)
Constant	-68.728*** (0.3594)	-60.670*** (0.4066)
Year Effects	Yes	Yes
Route Effects	No	Yes
N	684,806	684,806

*p<0.1 **p<0.05 ***p<0.01
Note: Year and route-specific effects were taken out of the table due to space issues.
k1 is represented by alliance designated by the number 1 (i.e. Star Alliance); k2 is represented by alliance designated by the number 2.

We begin our discussion by looking at the estimates of the variables of interest—*k1* and *k2*—reported in Table 3.6. The effects of the alliance formation on "traffic creation" and "traffic diversion" are given by the sum of the coefficients α_3 and α_4 in equation (2). Particularly, the traffic creation effects among alliance members are given by the coefficients of the dummy variables Star Alliance 1, Sky Team 1 and One World 1. On the other hand, the traffic diversion effects are given by the coefficients of Star Alliance 2, Sky Team 2 and One Worlds 2. If both coefficients are positive, then alliance formation expands passenger volume for both the members and non-members. However, if $\alpha_3>0$, $\alpha_4<0$ then the effect of passenger volume diversion reduces the "trade creation" effect of the alliance.

The results reported in Table 3.6 are worth looking into. The coefficients for Star Alliance 1 and 2 are positive and significant under 1 percent level for regressions--(1) and (2). Moreover, results for Sky Team 1 and 2 show positive signs for both sets of coefficient estimates. Only one of coefficient estimate for the Sky Team dummy variables is significant at the 10 percent level (Sky Team 1 when route effects are fixed) and the rest are significant under a 1 percent level. This contrast the negative signs found in both the fixed and random effects estimations reported in Table 3.5. Again, estimates for One World 1 and 2 show positive signs and are significant under a 1 percent level for both regressions. The overall effect of the Star Alliance—the sum of α_3 and α_4—is positive in both regressions but is slightly smaller in the second regression (0.601 and 0.533, respectively). For Sky Team, the total effect of the first regression (0.150) is smaller than the one found in the second regression (0.429). Since regression 2 includes route effects, the fall in the coefficient estimates may be due to reallocation of resources among the routes. For One World, the effects are large in magnitude and become larger once both year and route effects are taken into account since the sum of the alliance coefficients is 0.811 and 1.999 for regressions 1 and 2, respectively. If we consider that its major domestic member, American Airlines, is the only major carrier that reported a positive average annual growth rate (6 percent) over the 9 year period covered it is not surprising to see such a positive effect for One World alliance.

The rest of the explanatory variables performed as expected. The coefficients of the natural log of fare are negative and significant at the 1 percent level for both specifications. This is not surprising since we would expect passenger volume decrease if the price of air tickets increases—demand for air travel decreases as air fares rise. The distance variable reported positive and significant coefficients. This can be explained if we consider that airlines tend to use aircrafts with higher capacity (seats available) for longer flights in order to maximize profits due to the limited number of possible flights in a day. The estimates for the natural log of the origin and destination cities' population are positive and significant at the 1 percent level for both models. This is also the case for the coefficients of the logs of median household incomes. The coefficients for the Hub variable are positive and significant. The magnitude of this effect is higher than all other effects because hubs are points of passenger concentration and distribution for major and some regional air carriers.

It is perhaps opportune to take a slight detour to explore the performance of domestic carriers in terms of their net income as it was done for their passenger numbers. Table A.5 in the appendix reports total net income as well as net income by domestic and international service and operating expense for the domestic carriers that report revenues of $US20 million or more. Also, the six major domestic carriers considered previously are listed in the table. Overall, US carriers are not performing well in the domestic market as net income for the industry showed a negative average annual growth rate of 4 percent for a period of 9 year—1999 to 2007. On the contrary, in the international markets, domestic carriers seem to be thriving since a similar calculation reveals an overall growth rate of 19 percent in spite of economic conditions.

The six major carriers all report gains in net income for the international market and most of them show losses for the domestic market. This situation support the findings reported for these carrier's domestic and international passengers for the samples in the analysis. Corollary, we can assert that major alliances will have a higher effect in the international markets.

3.5.2 International Samples

After reviewing the domestic sample's regression results, it is pertinent to turn to the international sample analysis. The international data sample is richer than the domestic sample in terms of carriers and routes as it consists of 111 of domestic and international airlines serving 395 routes. However, since data for only two years (2003 and 2008) was available, cross-sectional subsamples of the two years were made. Table 3.7 shows the list of airlines used in the samples for 2003 and 2008. The table also reports the alliance membership of the carrier (if any). From the 111 carriers, 27 are members of Star Alliance, 15 are members of Sky Team and 12 are members of the One World Alliance. It is should be noted that not all of the carriers listed in this table are full members of the alliance as some are US regional carriers that are affiliate alliance members. For example, Mesa Airlines, a US regional carrier, is an affiliate member of Star Alliance.

The total number of observations on the dependent variable are 254,040 and 234,196 for 2003 and 2008, respectively.[25] The regression results for equation (3.2) using the subsamples for the years 2003 and 2008 are reported on Table 3.8. Two specifications are estimated for both years. The first holds route effects fixed and the second allow them to vary.

[25] The total potential number of observations for each of the two years considered is 4'822,950 which comes from the product of 111 airlines * 110 pairs * 1 year * 395 routes.

Table 3.7: List of airlines in the international sample
(N=111: Star Alliance (n=27) Sky Team (n=15) One World (n=12))

	IATA Code	*Airline Name*	*Airline Country*	*Alliance Mem.*
1	3M	Gulfstream	US	
2	4S	Sol Air	Honduras	
3	6A	Aviacsa	Mexico	
4	6C	Cape Smythe	US	
5	8P	Pacific Coastal Airlines	Canada	
6	A4	Air California	US	
7	AA	American Airlines	US	One World
8	AC	Air Canada	Canada	Star Alliance
9	AF	Air France	France	Sky Team
10	AI	Air India	India	
11	AM	Aeromexico	Mexico	Sky Team
12	AS	Alaska Airlines	US	
13	AT	Royal Air Maroc	Morocco	
14	AV	Avianca	Colombia	
15	AY	Finnair	Finland	One World
16	AZ	Alitalia	Italy	Sky Team
17	BA	British Airways	United Kingdom	One World
18	BD	British Midland	United Kingdom	Star Alliance
19	BE	FlyBe British European	United Kingdom	
20	BG	Biman Bangladesh	Bangladesh	
21	BI	Royal Brunei Airlines	Brunei	
22	BR	EVA Airways	Taiwan	
23	BW	BWIA West Indies	Trinidad & Tobago	
24	C5	CommutAir	US	Sky Team
25	CA	Air China	China	Star Alliance
26	CI	China Airlines	Taiwan	
27	CM	COPA	Panama	Sky Team
28	CO	Continental Airlines	US	Sky Team
29	CX	Cathay Pacific	Hong Kong	One World
30	CY	Cyprus Airways	Cyprus	
31	CZ	China Southern Airlines	China	Sky Team
32	DE	Condor	Germany	
33	DL	Delta Air	US	Sky Team
34	DM	Maersk Air	Denmark	

Table 3.7: ***continued***

35	EK	Emirates	UAE	
36	EI	Aer Lingus	Ireland	One World
37	ET	Ethiopian Airlines	Ethiopia	
38	F9	Frontier Airlines	US	
39	FI	Icelandair	Iceland	
40	FJ	Air Pacific	Fiji	
41	FL	Air Tran	US	
42	FM	Shanghai Airlines	China	Star Alliance
43	GF	Gulf Air	Bahrain	
44	HP	America West	US	Star Alliance
45	HY	Uzbekistan Airways	Uzbekistan	
46	IC	Indian Airlines	India	
47	JD	Japan Air System	Japan	
48	JJ	TAM Linhas Aeras	Brazil	
49	JK	Spanair	Spain	Star Alliance
50	JL	Japan Airlines	Japan	One World
51	JM	Air Jamaica	Jamaica	
52	JP	Adria Airways	Slovenia	Star Alliance
53	JU	JAT	Yugoslavia	
54	KA	Dragonair	Hong Kong	One World
55	KE	Korean Air	Korea	Sky Team
56	KL	KLM Royal Dutch Airlines	Netherlands	Sky Team
57	KU	Kuwait Airways	Kuwait	
58	LA	Lan Chile	Chile	One World
59	LB	LAB Lloyd Aereo Boliviano	Bolivia	
60	LH	Lufthansa	Germany	Star Alliance
61	LO	LOT Polish	Poland	Star Alliance
62	LR	LACSA	Costa Rica	
63	LX	Swiss	Switzerland	Star Alliance
64	LY	EI AI	Israel	
65	MA	MALEV	Hungary	One World
66	ME	MEA Middle East Air	Lebanon	
67	MH	Malaysian	Malaysia	
68	MP	Martinair	Netherlands	
69	MS	Egypt Air	Egypt	Star Alliance
70	MU	China Eastern	China	
71	MX	Mexicana	Mexico	Star Alliance
72	NH	ANA All Nippon	Japan	Star Alliance

Table 3.7: ***continued***

73	NW	Northwest Airlines	US	Sky Team
74	NZ	Air New Zealand	New Zealand	Star Alliance
75	OA	Olympic Airways	Greece	
76	OK	CSA Czech Airlines	Czech Republic	Sky Team
77	OO	SkyWest Airlines	US	
78	OS	Austrian Airlines	Austria	Star Alliance
79	OW	Executive Airlines	US	
80	OZ	Asiana	Korea	Star Alliance
81	PK	PIA Pakistan International Airlines	Pakistan	
82	PS	Ukraine International	Ukraine	
83	PR	Philippine Airlines	Philippines	
84	PU	Pluna	Uruguay	
85	QF	Qantas Airways	Australia	One World
86	IB	Iberia	Spain	One World
87	QR	Qatar Airways	Qatar	
88	QX	Horizon Air	US	
89	RA	Royal Nepal	Nepal	
90	RG	Varig Brasil	Brazil	Star Alliance
91	RJ	Royal Jordanian Airline	Jordan	One World
92	RO	Tarom	Romania	
93	RP	Chautauqua Airlines	US	Star Alliance/One World/Sky Team
94	SA	South African Airways	South Africa	Star Alliance
95	SK	SAS Scandinavian Airlines	Sweden	Star Alliance
96	SN	Brussels Airlines	Belgium	
97	SQ	Singapore Airlines	Singapore	Star Alliance
98	SU	Aeroflot Russian Airlines	Russian Federation	Sky Team
99	TA	Taca International	El Salvador	
100	TG	Thai Airways	Thailand	Star Alliance
101	TK	Turkish Airlines	Turkey	Star Alliance
102	TN	Air Tahiti Nui	French Polynesia	
103	TP	TAP Air	Portugal	Star Alliance
104	TZ	ATA - American Trans Air	US	

Table 3.7: ***continued***

105	UA	United Airlines	US	Star Alliance
106	UP	Bahamasair	Bahamas	
107	US	US Airways	US	Star Alliance
108	UX	Air Europa Lineas Aereas	Spain	Sky Team
109	VS	Virgin Atlantic Airways	United Kingdom	
110	WX	CityJet	Ireland	
111	YV	Mesa Airlines	US	Star Alliance

Table 3.8: Gravity Model Estimates of Alliance Effects: International Sample for 2003 and 2008

	Sample for 2003		Samples for 2008	
Variable	***OLS 1***	***OLS 2***	***OLS 1***	***OLS 2***
Log average fare	-0.681*** (0.009)	-0.614*** (0.011)	-0.663*** (0.011)	-0.409*** (0.013)
Log of Distance	0.359*** (0.005)	0.061*** (0.009)	0.329*** (0.005)	0.072*** (0.010)
Log of pop 1	0.201*** (0.004)	0.221*** (0.005)	0.137*** (0.005)	0.115*** (0.006)
Log of pop 2	-0.146*** (0.004)	-0.166*** (0.005)	-0.159*** (0.004)	-0.103*** (0.005)
Log of gdpp 1	0.168*** (0.005)	0.158*** (0.008)	0.065*** (0.006)	0.116*** (0.009)
Log of gdpp2	0.139*** (0.007)	0.121*** (0.012)	0.149*** (0.009)	0.141*** (0.015)
Star Alliance 1	-0.051* (0.026)	-0.042 (0.026)	0.154*** (0.023)	0.124*** (0.022)
Star Alliance 2	-0.105*** (0.111)	-0.104*** (0.011)	-0.011 (0.012)	-0.034*** (0.012)
Sky Team 1	0.292*** (0.070)	0.332*** (0.068)	1.174*** (0.032)	1.222*** (0.032)
Sky Team 2	0.165*** (0.014)	0.191*** (0.014)	0.801*** (0.012)	0.840*** (0.012)
One World 1	0.964*** (0.043)	1.062*** (0.043)	1.277*** (0.038)	1.287*** (0.038)
One World 2	0.692*** (0.122)	0.762*** (0.012)	0.866*** (0.013)	0.875*** (0.013)
Hub	1.312*** (0.011)	1.312*** (0.011)	0.903*** (0.011)	0.849*** (0.011)
Constant	2.091*** (0.110)	3.928*** (0.212)	3.909*** (0.142)	3.571*** (0.246)
N *Region Effects*	254,040 No	254,040 Yes	234,196 No	234,196 Yes

*p<0.1 **p<0.05 ***p<0.01
Note: k1 is represented by alliance designated by the number 1 (i.e. Star Alliance1); k2 is represented by alliance designated by the number 2.

As shown in the table, the coefficients for Star Alliance (1 and 2) are negative for the year 2003. Star Alliance 1 is significant at the 10 percent level and Star Alliance 2 at the 1 percent level once route effects are not taken into account. However, when the dummies for route effects are estimated, the effects are not so clear since the coefficient for Star Alliance 1 is not significant. Like in the domestic sample, there could be an outside factor that has not been taken into account that is pulling down the estimate for Star Alliance.

The values reported for the year 2008 show interesting results. The results without regional effects show that the coefficient estimate for Star Alliance 2 is not significant. On the other hand, when the regional effects are not fixed, the overall effect is 0.09 (0.124 – 0.034). However, the coefficient of Star Alliance 2 (-0.034) implies that there is passenger diversion. In other words, passenger volume is diverted from non-Star Alliance members to Star Alliance members.

The Sky Team variable coefficients were positive and significant at 1 percent level for both years 2003 and 2008 as well as both specifications—with and without route effects. In 2003, the total effect when routes effects are not considered is 0.457 (0.292+0.165) which slightly smaller than the total effect of 0.523 (0.332+0.191) when route effects are considered. On the other hand, results for 2008 show a higher effect for both specifications when compared to the results of 2003, especially when route effects are considered. As shown in the table, the “passenger-volume-creation” effect of Sky Team is stronger in 2008 than in 2003 suggesting that Sky Team's performance improved in terms of passenger volume (over time) not only among its members but for non-members as well.

The One World Alliance coefficient estimates are also positive and significant at the 1 percent level. In addition, they show the strongest positive effect among the alliances. In other words, not only do the positive effects increase significantly between 2003 and 2008 but the effects have a larger magnitude than the ones reported for the other two alliances. In 2003, the overall effect for the One World alliance was 1.824 (1.062+0.762) and in 2008 the effect on passenger volume was 2.162 (1.287+0.875). The rest of the variables have the expected signs, which entails that they have the same effects as the ones reported in the domestic sample estimates.

3.6 Conclusion

The objective of this paper is to determine whether the three major alliances—Star Alliance, Sky Team and One World—increase the market share of their members at the expense of non-members or increase overall passenger volume through efficiency gains. In order to make this assessment the gravity equation was used to estimate passenger flows. The Origin and Destination Survey was used to build unique domestic and international samples that were used in the estimations. The domestic sample consists of US airlines and routes over a period of 9 years and the international sample, which was divided into one subsample for 2003 and another for 2008, consists of a mixture of domestic and international airlines serving international routes. The use of these datasets allows for a more accurate estimation as all types of routes are covered: Domestic (US origin city and US destination city) and international (a US city paired with a foreign city either as origin or destination and both cities are foreign).

From the regressions performed on the domestic route sample, after controlling for year and route effects, all alliances demonstrate a positive effect on passenger volume for its members. In addition, the positive effects found in the 'diversion' dummies imply that non-members are not hurt by the presence on alliances in these routes. The One world alliance outperforms the other two major alliances reporting an effect of 1.999 compared to the 0.533 found for Star Alliance and 0.429 found for Sky Team. American Airlines' performance in the domestic market (in terms of the quantity of passengers) gives an upward push to the estimates of the One World variables as its average annual passenger number grew 6 percent on average over a 9 year period.

Exploration of net income data points out that large US carriers, overall, have been experiencing losses in the domestic market. The unfavorable economic conditions, the raise in input prices as well as a relentless competition from low cost airlines has had damaging consequences on major US airlines. On the contrary, large US carriers seem to be thriving in the international markets. This implies that alliances have a strong impact on foreign markets.

In the international market, once again, One World alliance shows a stronger performance than the other two alliances both as an agent that generates passenger volume for its members and non-members. Moreover, as new strategic members join both One World and Sky Team they signal stronger passenger volume effects overtime as their effects obtained for 2008 are larger than those of 2003. However, Star Alliance effects are not clear in 2003 and in 2008 it shows passenger diversion from non-members to members. This entails that the market share of Star Alliance members increases at the expense of competitors.

Overall, the three alliances seem to improve their total effect on passenger volume overtime as new members from strategic parts of the world are included to expand their already extensive networks. Thus, to answer the question portrayed above, alliances have a positive effect on passenger volume for its members both in the domestic and the international markets. Though the samples cannot really be compared as they have different sets of carriers, routes and years it can be said that due to the mishaps experienced in the local markets that the stronger effect will be found in the international arena. As for non-members, only Star alliances shows diversion effects on international routes.

4. EFFECTS OF MAJOR AIRLINE ALLIANCES ON US CARRIERS NET INCOME

4.1 Introduction: A look at the performance of Domestic Air Carriers

In this chapter, I begin by looking at the variables affecting the performance and net income of US domestic carriers. First, I look at departures recorded for six US carriers in the domestic market over the panel data 1999-2007. US carriers in alliances are: United and US Airways in Star Alliance; Delta, Continental and Northwest in Sky Team alliance and American Airlines in One World alliance. Next, I present data on passenger traffic. This is followed with a look at cost and net income of carriers in alliances.

Table 4.1 shows average annual growth rates of departures. For most US carriers, the growth rates are in the negative territory for most years between 1999 and 2007, the year 2003 being the exception for United Airlines (growth rate of 26 percent) and US Airways (17 percent). For Sky Team members, Delta had three years of good performances, a growth rate of 14 percent in 2000, 5 percent in 2002 and 6 percent in 2004. Continental Airlines did much better with positive growth rates (although modest in most years). Likewise, Northwest reported 4 years out of 9 recording positive growth rates with 2003 being the highest (12 percent). American Airlines, the only US carrier in the One World Alliance, had positive growth rates for only three years with 2002 being the highest (11 percent). In short, joining an alliance seems to have done some good in stimulating US carriers' traffic.

The next data set (Table 4.2) shed further light on air traffic in the domestic market. Once again, the data reinforces what was uncovered using departure data. The period 1999-2007 was marred by negative or zero growth rates of passenger traffic for six out of the 9 year period for United Airline, four years for US Airways, both carriers being members of the Star Alliance. Continental and Northwest, both members of Sky Team, recorded several consecutive periods of positive growth rates of passenger traffic with Delta Airlines trailing behind recording very small growth of passengers in only four years. American Airlines, a member of One World alliance did quite a bit better especially in 2002 where passenger traffic grew by 20 percent and by 8 percent in 2005. The story on passenger traffic then is neither alliance specific nor airline specific. Being a member of an alliance may have helped US carriers to withstand the rising cost of fuel and the recession but surely was not sufficient to produce gains for all carriers.

The next two tables enhance our assessment of what US carriers had to do to withstand adverse market conditions. In Table 4.3 passengers to seats available are reported. Looking at the passengers/seats ratios it is worth noting that "crowding out" of passengers seemed to have occurred in the second half of the period. In other words, US carriers found a way to fill their planes by increasing utilization of their seats capacity. This pattern is recorded for all carriers regardless of which alliance they belonged to. Of interest is the fact that the passengers/seats ratios which hovered around 65 – 67 percent at

Table 4.1: Departures: Domestic Market Carriers in Alliances, 1999-2007

Star Alliance									
	United Airlines			US Airways					
Year	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*			
1999	851			705					
2000	849	0.00		734	0.04				
2001	790	-0.07		661	-0.11				
2002	792	0.00		589	-0.12				
2003	1,030	0.26		698	0.17				
2004	1,039	0.01		718	0.03				
2005	837	-0.22		749	0.04				
2006	708	-0.17		636	-0.16				
2007	704	-0.01	-0.02	655	0.03	-0.01			
Sky Team									
	Delta			Continental			Northwest		
Year	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*
1999	1,115			667			786		
2000	1,282	0.14		691	0.03		800	0.02	
2001	1,248	-0.03		666	-0.04		760	-0.05	
2002	1,305	0.05		620	-0.07		758	0.00	
2003	1,250	-0.04		627	0.01		854	0.12	
2004	1,322	0.06		664	0.06		893	0.05	
2005	1,320	0.00		692	0.04		916	0.08	
2006	1,102	-0.18		745	0.07		810	-0.12	
2007	1,057	-0.04	-0.01	756	0.01	0.01	777	-0.04	0.00

Table 4.1: ***continued***

One World									
	American								
Year	*Departures (in thousands)*	*Growth rate deps.*	*Average growth rates deps.*						
1999	1,101								
2000	1,181	0.07							
2001	1,160	-0.02							
2002	1,292	0.11							
2003	1,179	-0.09							
2004	1,176	0.00							
2005	1,202	0.02							
2006	1,187	-0.01							
2007	1,160	-0.02	0.01						

Source: Origin and Destination Survey (Data Bank 1B) and T-100 Segment Data

Table 4.2: Passengers: Domestic Market Carriers in Alliances, 1999-2007

Star Alliance									
	United Airlines			US Airways					
Year	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*			
1999	80,895			55,965					
2000	77,693	-0.04		58,899	0.05				
2001	69,256	-0.11		53,806	-0.09				
2002	65,297	-0.06		45,735	-0.16				
2003	71,699	0.09		42,336	-0.08				
2004	75,324	0.05		44,292	0.05				
2005	68,413	-0.10		45,560	0.03				
2006	64,154	-0.06		41,145	-0.10				
2007	63,379	-0.01	-0.03	46,245	0.12	-0.02			
Sky Team									
	Delta			Continental			Northwest		
Year	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*
1999	105,903			43,593			53,432		
2000	111,880	0.05		44,898	0.03		55,655	0.04	
2001	100,013	-0.11		43,237	-0.04		51,549	-0.08	
2002	101,620	0.02		40,979	-0.05		50,425	-0.02	
2003	98,305	-0.03		42,029	0.03		53,934	0.07	
2004	102,667	0.04		44,527	0.06		58,099	0.07	
2005	102,646	0.00		47,798	0.07		60,771	0.04	
2006	87,344	-0.16		52,447	0.09		58,201	-0.04	
2007	85,211	-0.02	-0.02	53,048	0.01	0.02	56,521	-0.03	0.01

Table 4.2: ***continued***

One World									
	American								
Year	*Passengers (in thousands)*	*Growth rate pass.*	*Average growth rates pass.*						
1999	76,048								
2000	81,114	0.06							
2001	74,066	-0.09							
2002	90,209	0.20							
2003	85,539	-0.05							
2004	88,645	0.04							
2005	95,781	0.08							
2006	96,625	0.01							
2007	96,261	0.00	0.03						
Source: Origin and Destination Survey (Data Bank 1B) and T-100 Segment Data									

Table 4.3: Capacity: Domestic Market Carriers in Alliances, 1999-2007

Star Alliance									
	United Airlines			US Airways					
Year	Seats (thousands)	Passengers (thousands)	Pass/ Seats	Seats (thousands)	Passengers (thousands)	Pass/ Seats			
1999	119,268	80,895	0.68	87,538	55,965	0.64			
2000	113,379	77,693	0.69	92,673	58,899	0.64			
2001	102,620	69,256	0.67	85,894	53,806	0.63			
2002	95,215	65,297	0.69	72,838	45,735	0.63			
2003	98,884	71,699	0.73	65,609	42,336	0.65			
2004	102,430	75,324	0.74	67,319	44,292	0.66			
2005	89,216	68,413	0.77	69,837	45,560	0.65			
2006	82,148	64,154	0.78	57,967	41,145	0.71			
2007	80,157	63,379	0.79	62,715	46,245	0.74			

Sky Team									
	Delta			Continental			Northwest		
Year	Seats (thousands)	Passengers (thousands)	Pass/ Seats	Seats (thousands)	Passengers (thousands)	Pass/ Seats	Seats (thousands)	Passengers (thousands)	Pass/ Seats
1999	154,762	105,903	0.68	63,127	43,593	0.69	81,732	53,432	0.65
2000	161,872	111,880	0.69	64,323	44,898	0.70	83,441	55,655	0.67
2001	152,672	100,013	0.66	62,979	43,237	0.69	79,150	51,549	0.65
2002	148,804	101,620	0.68	58,892	40,979	0.70	76,943	50,425	0.66
2003	138,392	98,305	0.71	58,054	42,029	0.72	80,219	53,934	0.67
2004	143,286	102,667	0.72	60,387	44,527	0.74	83,236	58,099	0.70
2005	139,941	102,646	0.73	61,510	47,798	0.78	82,963	60,771	0.73
2006	114,156	87,344	0.77	65,583	52,447	0.80	75,474	58,201	0.77
2007	108,965	85,211	0.78	67,138	53,048	0.79	72,820	56,521	0.78

Table 4.3: ***continued***

One World									
	American								
Year	*Seats (thousands)*	*Passengers (thousands)*	*Pass/ Seats*						
1999	114,141	76,480	0.67						
2000	118,232	81,140	0.69						
2001	112,273	74,660	0.66						
2002	133,440	90,090	0.68						
2003	121,786	85,539	0.70						
2004	121,948	88,645	0.73						
2005	125,525	95,781	0.76						
2006	122,809	96,625	0.79						
2007	121,121	96,261	0.79						
Source: Origin and Destination Survey (Data Bank 1B) and T-100 Segment Data									

the beginning of the period rose to 78 – 79 percent for all carriers considered by the end of the period. Carriers that recorded the highest increase over the 9-year period were Northwest from Sky Team and American Airlines from One World. These steady cuts in capacity can be classified as attempts to cut down operating costs and improve the net operating income of the carriers.

4.2 The Effect of Alliances on Net Income

Given that the six US carriers in the alliances were successful in "filling out" their seats, the expectation is that operating costs would moderate, if not fall and hence operating net revenues would rise. This expectation can be tested by reference to the data reported in Table 4.4. Table 4.4 adds further insight into the US carriers' performance in both the domestic and international markets. The first column in the table shows the overall net income arising from both domestic and international services for the six major carriers considered. This figure clearly nets out operating expenses from revenues, hence it provides information on profitability of US carriers serving the domestic market.

The picture that emerges is not unexpected in light of the earlier data we have reported in tables 4.1 through 4.3. Most carriers have experienced net operating losses since 2001 with the profit picture rebounding for some at the end of the period. One noticeable finding is the performance of US Airways, a member of the Star Alliance. In the net income column, the airline was successful in achieving net gains in 5 out of 9 years. Its success in part can be attributed to its efforts in controlling costs. These costs have fallen from their highest level of $8,588 million in 2000 to $6,666 million in 2007. Of note also is the fact that only US Airways was successful in cutting its operating costs and achieving noticeable gains in the domestic market.

The numbers reported in the first column of Table 4.4 give little information on whether or not alliance membership has an effect on net income. Thus, overall net income was separated in two components: domestic and international. In addition to Table 4.4, Figures A.1 to A.7 in the appendix shed light on the progression of net income for all of US carriers in alliances. In the domestic market, the six carriers, United, US Airways, Delta, Continental, Northwest and American, considered experienced several years of negative net income. Only US Airways reported three consecutive years of positive net income—2005 to 2007. It is worth noting that, despite the adverse domestic market conditions, US Airways positive performance may be attributed to its membership of Star Alliance. American Airlines domestic net income, in spite of being negative for 7 consecutive years, did show sign of some improvement with its losses decreasing over the nine years.

In the international market the situation was a bit better. Continental Airlines, a member of Sky Team, reported positive net income for the entire 9 years period. Net income for Continental Airline increased significantly since joining in 2004 the Sky Team alliance. One World's member, American Airlines, reports 8 years of positive net income. US Airways also performed well in the international market with 5 consecutive years of positive net income. These three airlines show the best performance among the six carriers considered.

4.2.1 A look at Profitability

Unfortunately, there is very little empirical analysis of profitability of air carriers in alliances. The literature offers one model that attempted to estimate the effects of alliances (code-sharing and other market structures) on air carriers (domestic and international) profitability. Oum, T.H., Park, J.H. and Zhang, A. (2000) model the effects of these types of alliances on members' productivity, pricing and profitability expressed as an index of operating revenues over operating costs. The data used in the estimation is a panel data consisting of 22 international airlines with 215 observations covering the period of 1986-95. The period was outside the period where alliances were formed.

Their findings suggest that alliance membership slightly improved the ratio of operating revenues over operating costs.

Since the Oum, Park and Zhang model did not deal with major alliances such as Star Alliance, Sky Team and One World as the time period studied was outside the period of development of these alliances, I provide below some estimates of the effects of alliances on the profitability index of US carriers for the period 1999 -2008. The model is spelled out in equation (4.1). The estimations were performed using data for the US domestic market. The estimated equation is as follows:

$$PROF\ INDEX_{i,t}=\beta_0+\beta_1 CRGO_{i,t}+\beta_2 NSCH_{i,t}+\beta_3 OTHS_{i,t}+\beta_4\ LDRTES_{i,t}+\beta_5\ LIRTES_{i,t}+ \beta_6 ICAP_{i,t}+\beta_7 DCAP_{i,t}+\beta_8 ALLIANCE_{i,t}+\beta_9 LMILES_{i,t}+\beta_{10} YEAR_t+\varepsilon \quad (4.1)$$

Description of the variables in equation (4.1) are given in Table 4.5.

4.3 Data Description

The data used in the estimation come from the T-100 Segment sample and the Schedule P-12. Both of these datasets are compiled by the US Department of Transportation and are available online. The T-100 Segment data contains domestic and international non-stop segment data reported by both US and foreign carriers. Flights with both origin and destination in a foreign country are not reported. The variables given in this data set are: departures scheduled, available capacity, distance travelled, service class for passengers and city/country of origin and destination. The Schedule P-12 provides financial data on quarterly income and loss statements for US carriers with annual operating revenues of $20 million or more. The data include operating revenues, operating expenses, depreciation and amortization, operating income, income tax, and net income.

For the estimation, a 10-year sample over the period 1999-2008, was obtained by combining these two data sets. It consists of 35 domestic airlines of which 10

Table 4.4: Net Income and Operating Expenses: Domestic Market Carriers in Alliances, 1999-2007 (in millions)

Star Alliance												
	United				US Airways							
Year	Net Income	Operating Expenses	Domestic Net Income	International Net Income	Net Income	Operating Expenses	Domestic Net Income	International Net Income				
1999	1,203	11,513	840	363	273	7,717	264	9				
2000	51	12,666	-10	61	-254	8,519	-242	-12				
2001	-2,110	12,955	-1,278	-831	-1,989	8,588	-1,970	-19				
2002	-3,325	11,146	-2,168	1,157	-1,658	7,051	-1,591	-67				
2003	-2,002	10,156	-1,976	-1,109	1,452	6,242	1,442	9				
2004	-21,036	11,699	-1,699	-303	-577	6,383	-652	74				
2005	-22,658	11,690	-12,800	-8,203	159	6,408	50	109				
2006	348	12,687	13,500	9,152	445	5,606	201	244				
2007	-3,827	12,780	-40	389	334	6,666	222	111				
Sky Team												
	Delta				Continental				Northwest			
Year	Net Income	Operating Expenses	Domestic Net Income	International Net Income	Net Income	Operating Expenses	Domestic Net Income	International Net Income	Net Income	Operating Expenses	Domestic Net Income	International Net Income
1999	1,284	10,510	1,262	22	498	5,600	303	195	287	5,839	319	-31
2000	686	11,077	694	-8	340	6,215	68	272	269	6,507	320	-50

Table 4.4: *continued*

2001	-1,107	11,158	-847	-259	-95	6,192	-411	316	-418	6,755	-91	-326
2002	-1,294	10,393	-858	-436	-451	5,810	-853	402	-766	6,444	-436	-330
2003	-895	12,611	-771	-124	38	5,228	-321	359	478	6,213	-623	-145
2004	-3,362	13,635	-2,883	-478	-409	7,703	-1,091	681	-757	7,842	-359	-397
2005	-3,797	13,739	-3,109	-688	-67	8,175	-880	812	-2,309	8,920	-1,871	-438
2006	-5,996	12,721	-4,224	-1,772	343	8,948	-657	1,000	-2,798	7,825	-1,527	-1,270
2007	1,794	12,665	1,614	179	459	9,445	-908	1,367	2,387	7,652	1,349	1,038
One World												
	American											
Year	Net Income	Operating Expenses	Domestic Net Income	International Net Income								
1999	626	10,307	466	159								
2000	778	11,627	511	266								
2001	-1,317	12,973	-1,354	37								
2002	-3,495	14,121	-2,904	-590								
2003	-1,318	13,973	-1,819	501								
2004	-820	13,206	-1,314	493								
2005	-891	13,819	-974	83								
2006	163	13,971	-290	453								
2007	355	14,153	-290	646								

Source: US Department of Transportation Financial Data: Schedule P-12 airlines are members of a major alliance: 3 from Star Alliance, 4 from Sky Team and 3 from One World Alliance. The total number of observations in the panel is 802.

4.4 Results

The coefficient estimates are presented in Table 4.6. I begin the discussion by looking at the following variables: CRGO, NSCH and OTHS.[26] Of these three variables, the coefficient for OTHS (other revenue) is not statistically significant. The estimate for CRGO is positive and significant at the 1 percent level. Also, the coefficient estimate for NSCH is positive and significant at the 5 percent level.

The estimates for the number of domestic and international routes (LDRTES and LIRTES) are both negative and significant at the 5 percent level. The estimate for international capacity (ICAP) is not significant. On the other hand, domestic capacity (DCAP) had a positive and significant coefficient at 1 percent level. This finding suggests that airlines were successful in cutting their costs in the domestic market by filling up their planes. The coefficient estimates for the natural logarithm of distance flown (LMILES) is positive and significant at the 1 percent level. This result suggests, perhaps, that airlines tend to be more efficient over longer routes. The variables that

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[26] The proportion of revenues from passengers, as in Oum *et al* (2000), was considered as the default group.

Table 4.5: Profitability Index Model Variables

Dependent Variable	**Description**
PROF INDEX	The natural log of an airline's profitability. The profitability is giving by the ratio of operating revenue over operating cost. This is based on the formula for returns on sales.
Independent Variables	**Description**
CRGO	Proportion of revenue from airlines' cargo (baggage fees).
NSCH	Proportion of revenue from non-scheduled service revenue
OTHS	Proportion of revenue from other business
LDRTES	Natural log of number of domestic routes
LIRTES	Natural log of number of international routes
ICAP	Capacity (passengers/seats available) for international markets
DCAP	Capacity (passengers/seats available) for domestic markets
ALLIANCE	Set of dummies that represent membership to an alliance—Star Alliance, Sky Team and One World.
LMILES	Total miles flown
SIZE	Set of dummy variables that represent firm size (Major, National and Regional)
YEAR	Set of dummy variables that take into account year specific effects

Table 4.6: Effects of Major Alliances on member Profitability

Variables	Estimates
CRGO	0.580*** (0.1272)
NSCH	0.058** (0.0344)
OTHS	0.023 (0.0598)
LDRTES	-0.025** (0.0106)
LIRTES	-0.021** (0091)
ICAP	0.099 (0.0633)
DCAP	0.392*** (0.0658)
STAR ALLIANCE	0.009 (0.0307)
SKY TEAM	0.001 (0.0253)
ONE WORLD	0.102** (0.0482)
LMILES	0.044*** (0.0158)
NATIONAL	0.025 (0.0260)
REGIONAL	0.006 (0.0351)
CONS.	-0.417*** (0.0901)
YEAR EFFECTS	YES
N	802
*p<0.1 **p<0.05 ***p<0.01	

represent size of the firm (NATIONAL and REGIONAL) were not statistically significant.

The effect of alliances on the profitability index was not clear cut. The estimated coefficients for Star Alliance and Sky Team were both not statistically significant. This finding may be explained by the poor performance of United Airlines a member of Star Alliance and Delta and Northwest both members of Sky Team. The coefficient estimate for One World turned out to positive and significant at the 5 percent level. Being a member of the One World alliance in the domestic market did improve profitability of the carrier members by 10 percent.

4.5 Conclusion

In this chapter an attempt was made to ascertain the effects of three major alliances—Star Alliance, Sky Team and One World—on net income of US carriers. This research aimed at addressing the question: Did air carriers' alliances improve the profitability of US carriers in the domestic market? To address this question, I began looking at data on the performance of the six US carriers. Next, an empirical model was estimated using a profitability index spelled out in Oum, Park and Zhang model. Both methods were deemed necessary as most carriers had incurred losses over the period 1999-2008.

Data analysis on the performance of the six US carriers paints a poor picture for US carriers. Over this period they had incurred almost zero growth of departure and passenger traffic. A rising ratio of passengers to seats over the period suggests that airlines were filling up their planes to cut their costs of operation.

As to the net income of the six carriers in the alliances, over the entire operations the findings suggest that they have improved their performance during this period. It of note however, that the improvements seem to come from operations in the international markets where US Airways, Continental and American Airlines have done a great deal better than the other three carriers. The domestic market however, was very disappointing as most carriers in the alliances reported losses over most of the period.

The profitability index model results provide information on how well the alliances contributed to the income stream of carriers in the alliances. Unfortunately, in spite of the good performance of US Airways and Continental Airlines the coefficients for Star Alliance and Sky Team were not significant. One explanation for this finding may be that the poor performance by United Airlines in Star Alliances and Delta and Northwest members of Sky Team have pulled down the contribution of these variables in the profitability model. On a positive note, the estimates on One

World alliances was positive and significant implying that joining One World did improve member profitability index by 10 percent. In short, the results are consistent with the data analysis which clearly document the lack of profitability in the domestic market over the period examined. Further research might improve our understanding of the outlook of the alliances and their contribution to the profitability of US carriers.

5. CONCLUSION

Airline alliances constitute an important arrangement among individual carriers as they seek means to expand their network or market access, increase passenger volume and improve overall air travel related services. Over time, airline alliances have evolved from a two-member alliance—code-share and antitrust immunity—to a multi carrier alliances. In the late 1990's, three major alliances were formed—Star Alliance, Sky Team and One World—prompted in part by factors such as the deregulation of the airline industry, the proliferation of the demand for international travel, cost constraints as well as intergovernmental restrictions. Over the last 14 years, these three alliances have expanded considerably from a tally of 6 members in 1997 to 52 members in 2010.

The literature on airline alliances has focused primarily on the code-share and antitrust immunity setup. Studies on the effects of alliances offer two kinds of models: theoretical and empirical. The theoretical models are based on basic Industrial Organization models that assume a market structure characterized with imperfect competition. Examples are Cournout, Bertrand, the linear city model and Stackelberg. In the literature survey chapter some of these models were discussed and the estimated results reported.

The empirical literature reviewed in chapter 2, show that the model estimated, even though seem to cover a wide range of issues, often focused on estimating demand and supply equations to explore the effects of alliances on air carrier output and fares. Overall, the results reported show that alliances lead to a reduction of ticket prices, an increase in output (since alliances eliminated the double marginalization problem) and expansion of members' networks.

My research expands the literature by providing a novel approach to the study of major airline alliances by integrating theoretical structures from the fields of International Trade and Industrial Organization. Accordingly, in chapter 3 a gravity model was used to explore the effects of the three major alliances on the market share (passenger volume) of their members as well as non-members. To capture these effects, a set of dummy variables was used to estimate traffic creation and traffic diversion effects in order to determine whether alliance membership increases traffic for its members through efficiency gains or at the expense of non-members. For the purpose of estimating the models a dataset was obtained from the Origin and Destination Survey compiled by the US Department of Transportation. This sample was divided into three subsamples: a domestic sample covering the period of 1999 to 2007 and two international samples for the year 2003 and 2008.

From the estimated results it was found that in the domestic market, after controlling for year and route specific effects, all of the alliances demonstrate a positive effect on passenger volume for its members. Non-members were not adversely affected by the presence of alliances members in these routes. Moreover, in the international market, alliances had positive effects on passenger volume for their members. For Star Alliance however, the estimation results were not clear cut for 2003. However, for 2008, after taking into account route specific effects, the overall effect of Star Alliance was positive.

However, this effect turned out to be at the expense of non-members for the results show that members' market share was gained by diverting passenger traffic from non-members.

In chapter 4, I pursued further the creation versus diversion effects of alliances. This was done by estimating the effects of alliance membership on net income. Unfortunately, only the domestic market was considered since net income data is publicly available for US carriers only. Over the period considered, 1999 to 2007, US carriers reported losses for most years in the domestic and the international markets due to several external factors such as the terrorists attack of 9/11, rising fuel prices and natural disasters like Hurricane Katrina and Rita. These losses reported in the sample made it difficult to estimate a profit model. Instead, a profitability model was estimated with a 9-year sample (1999-2007) obtained from the T-100 Segment and the Financial Schedule (P-12) datasets.

Data analysis on the performance on six US carriers—departure, passengers, capacity and net income—which are alliance members was not encouraging however. Growth rates on departures were in the negative territory for most of the years for the period considered. Growth rates on passenger traffic reinforce the negative findings from the departure data as the six airlines reported several years of negative growth rates. In terms of capacity, US carriers found a way to fill their planes by increasing utilization of their seats capacity.

Net income figures for these six airlines were negative, for most years, in the domestic market. However, the picture did improve when the net income arising from the international market was considered. US Airways, a member of Star Alliance, Continental in Sky Team and American in One World seem to be the winners among the major carriers in the international market. Of note is the fact that US Airways and Continental's performance in the international market improved significantly as they became members of their respective alliances. This suggests that the positive effect of airline alliances is much more pronounced in the international market than in the domestic market.

The profitability model estimation shows that the coefficients for Star Alliance and Sky Team to be not statistically significant in spite of the good performance of US Airways and Continental. This suggests that the poor performance of United Airlines, Delta and Northwest was "pulling" down the alliance performance. Only the coefficient of One World was found to be positive and significant. Thus, being a member of this alliance seem to have increased profitability in the domestic market by 10 percent.

In short, alliances bestow benefits on their members in both the domestic and the international market. Alliances were found to have a positive effect on the traffic of their members. In terms of net income, it seems that alliances membership has a positive effect on its members but this effect becomes clearer on a case-by-case analysis (in only US carriers are considered). It is worth noting that the alliance effect is higher in the international market than in the domestic market. This is due to the fact that the international market allows for a wider network and hence more routes, passengers and profits.

Finally, there seems to be a hierarchy among alliances. One World, in spite of being the smallest of the three major alliances in terms of memberships, outperformed Star Alliance and Sky Team in both the domestic and international markets. The findings on income data lend support to this claim since One World was the only alliance that reported a positive and significant gain in the domestic market.

Future research:

As stated earlier, the "alliance" effect can be seen clearly in the international market. Unfortunately, international data is scarce or are not easily accessible. For this research, only two years (2003 and 2008) of the Origin and Destination Survey were provided by the US Department of Transportation and no data on net income could be procured for international carriers. If more international data became available, a more thorough analysis could be made as there were some time effects in the international sample that could not be accounted for. These variables are expected to affect the alliance members' performance.

Given the losses incurred by the six US carriers in the domestic market and the better performance reported in the international market, a look at US carriers' affiliates operating in the domestic market may bear fruit. To do so a compilation of data on their departures, passenger traffic and income statements can be carried out to see if affiliates performed better than the alliance members in the domestic market.

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APPENDIX

Table A.1: Alliance Members and Affiliates

Star Alliance		
Carrier	***Period of Membership***	***Affiliate***
Adria Airways *(Slovenia)*	2004 - Present	
Air Canada *(Canada)*	1997 - Present	Air Canada Jazz Air Canada Jetz Air Georgian
Air China *(China)*	2007 - Present	
Air New Zealand *(New Zealand)*	1999 - Present	Air Nelson Eagle Airways Mount Cook Airline
All Nippon Airways *(Japan)*	1999 - Present	Air Central Air Japan Air Next Air Nippon
Ansett Australia *(Australia)*	1999 - 2001	
Asiana Airlines *(South Korea)*	2003 - Present	
Austrian Airlines *(Austria)*	2000 - Present	Tyrolean Airways Lauda Air
Blue1 *(Finland)*	2004 - Present	
BMI *(United Kingdom*	2000 - Present	BMI Regional
Brussels Airlines *(Belgium)*	2009 - Present	
Continental Airlines *(United States)*	2009- Present	Cape Air Colgan Air CommutAir Gulfstream International Airlines Chautauqua Airlines ExpressJet Airlines Continental Micronesia
Croatia Airlines *(Croatia)*	2004- Present	
Egypt Air *(Egypt)*	2008- Present	Egypt Air Express
LOT *(Poland)*	2003 - Present	EuroLOT
Lufthansa *(Germany)*	1997	Lufthansa Italia Air Dolomiti Augsburg Airways Contact Air Eurowings Lufthansa CityLine

Table A.1: *Continued*

Mexicana *(Mexico)*	2000-2004	
SAS Scandinavian Airlines *(Sweden-Denmark-Norway)*	1997 – Present	
Shanghai Airlines *(China)*	2007 – Present	
Singapore Airlines *(Singapore)*	2000 – Present	
South African Airways *(South Africa)*	2006 – Present	Airlink South African Express
Spanair *(Spain)*	2003 - Present	
Swiss International Air Lines *(Switzerland)*	2006 – Present	Swiss European Air Lines
TAP Portugal *(Portugal)*	2005 – Present	Portugalia PGA Express
Thai Airways International *(Thailand)*	1997 – Present	
Turkish Airlines *(Turkey)*	2008 – Present	
United Airlines *(United States)*	1997 – Present	Chautauqua Airlines Colgan Air GoJet Airlines Mesa Airlines Shuttle America SkyWest Trans States Airlines
US Airways *(United States)*	2004 – Present	Air Wisconsin Chautauqua Airlines Colgan Air Mesa Airlines Piedmont Airlines PSA Airlines Republic Airlines Trans States Airlines US Airways Shuttle
Varig *(Brazil)*	1997-2007	

Table A.1: *Continued*

Sky Team		
Carrier	***Period of Membership***	***Affiliate***
Aeroflot Russian Airlines (Russia)	2006 – Present	Donavia Nordavia
Aeromexico (Mexico)	2000 – Present	Aeromexico Connect Aeromexico Travel
Air France (France)	2000 – Present	Brit Air CityJet Regional
Alitalia (Italy)	2008 – Present	Alitalia Express
Alitalia-Linee Aeree Italiane (Italy)	2001-2008	
China Southern Airlines (China)	2007 – Present	
Continental (United States)	2004-2009	
Czech Airlines (Czech Republic)	2001 – Present	
Delta Airlines (United States)	2000 – Present	Delta Connection Delta Shuttle
KLM (Netherlands)	2004 – Present	KLM Cityhopper
Korean Air (South Korea)	2000 – Present	
Norwest Airlines (United States)	2004-2009	

One World		
Carrier	***Period of Membership***	***Affiliate***
American Airlines (United States)	1999 – Present	American Eagle Executive Airlines Chautauqua Airlines
Aer Lingus (Ireland)	2000 - 2007	
British Airways (United Kingdom)	1999 – Present	BA CityFlyer Comair Sun-Air
Canadian Airlines (Canada)	1999-2000	
Cathay Pacific (Hong Kong)	1999 – Present	Dragonair
Finnair (Finland)	1999 – Present	
Iberia (Spain)	1999 - Present	Air Nostrum
Japan Airlines (Japan)	2007 - Present	J-Air JAL Express JALways Japan Transoceanic Air

Table A.1: ***Continued***

Lan *(Chile)*	2000 – Present	LAN Argentina LAN Ecuador LAN Express LAN Peru
Malev *(Hungary)*	2007- Present	
Mexicana *(Mexico)*	2009 – Present	MexicanaClick MexicanaLink
Qantas *(Australia)*	1999 – Present	Jetconnect Airlink Eastern Australia Airlines Sunstate Airlines
Royal Jordanian *(Jordan)*	2007 - Present	
Sources: *http://www.staralliance.com/en/about/airlines/* http://www.staralliance.com/en/about/airlines/ http://www.staralliance.com/assets/doc/en/about/member-airlines/pdf/star_backgrounder_history_chronological.pdf www.skyteam.com/news/facts/2010.html http://www.oneworld.com/ow/news-and-information/fact-sheets		

Table A.2: Description and findings of selected studies

Study	Brief Description and Results	Data
Oum et al. (1996)	Investigates the effects of **complementary code-sharing** between non-markets leaders on the market leader's fares and passenger volume in a context of oligopoly. Complementary code-sharing between non-leaders makes the market leader behave more competitively. Code-sharing **increases** annual **output** of passengers for the market leader and **reduces** its **fares.**	Panel data of 57 transpacific air routes over the period of 1982-1992. Sources: International Civil Aviation Organization, Official Airline Guide, US Department of Transportation, among others.
Brueckner (2001)	Explores the effect of airline cooperation on the level of interline fare paid by international passengers. The analysis focuses on two measures of cooperation—code-sharing and antitrust immunity. **Code-sharing reduces fares by 8-17%** on an international interline itinerary and that **antitrust immunity reduces fares by 13 – 21%.** The combined effect ranges between 17-30%.	Passenger Origen and Destination Survey (Data Bank 1A). The year covered is 1999.
Bamberger et al. (2004)	This study focuses on the effects of domestic alliances (code-share) on fares and traffic. It particularly studies two domestic alliances: Continental/ America West and Northwest/ Alaska Airlines. The former makes **fares fall by 7%** and **increases traffic by 6 %** on city pairs served by the alliance partners. The latter appears **reduces fares by 6%** but estimates on traffic are not statistically significant.	Data Bank 1A and 298C from DOT are used. Different periods are covered for each of the alliances. The period 1994-95 for Continental/America West and the 1994-96 period for Northwest/Alaska alliance.
Whalen (2007)	Determines the effects of code-sharing, antitrust immunity and Open Skies treaties on fares, output (passengers for a carrier) and capacity (number of departures and also by total available seats). **Code-sharing** and **antitrust immunity decrease fares** by **5-9%** and **13- 20%,** respectively when compared to non-alliance interline service. **Antitrust immunity** and **code-sharing increase output** by **51-77%** and **29-41%,** respectively. Open Skies Treaties **increase** fares by **3 -5%.** In terms of **Capacity,** departures on hub to hub routes **increased** by **20.1%** and the number of seats rose by **29.8%** when a pair of countries has an Open Skies treaty and there is antitrust immunity between the pair of airlines from the member countries. **Code-sharing without Open Skies treaties** has a positive effect on capacity from **4 to 10 %.**	Panel data of international traffic between the US and Europe over the period of 1990- 2000. The data come from Data Bank 1A, 1B and T-100 (used to determine the categories of the different markets) from the DOT.

Table A.3a: Alliance Membership Evolution: Star Alliance

1997 (N=6)	1998 (N=6)	1999 (N=9)	2000 (N=13)	2001 (N=12)	2002 (N=12)	2003 (N=15)	2004 (N=18)	2005 (N=19)	2006 (N=21)	2007 (N=22)	2008 (N=24)
Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada	Air Canada
Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa	Lufthansa
SAS	SAS	SAS	SAS	SAS	SAS	SAS	SAS	SAS	SAS	SAS	SAS
Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways	Thai Airways
United	United	United	United	United	United	United	United	United	United	United	United
Varig	Varig	Varig	Varig	Varig	Varig	Varig	Varig	Varig	Varig[d]	-	-
		Ansett	Ansett[b]	-	-	-	-	-	-	-	-
		ANA[a]	ANA	ANA	ANA	ANA	ANA	ANA	ANA	ANA	ANA
		Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand	Air New Zealand
			Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines	Singapore Airlines
			Mexicana	Mexicana	Mexicana	Mexicana	-	-	-	-	-
			British Midland	British Midland	British Midland	British Midland	British Midland	British Midland	British Midland	British Midland	British Midland
			Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines	Australian Airlines
						Asiana Airlines	Asiana Airlines	Asiana Airlines	Asiana Airlines	Asiana Airlines	Asiana Airlines
						Spanair	Spanair	Spanair	Spanair	Spanair	Spanair
						LOT	LOT	LOT	LOT	LOT	LOT
							US Airways	US Airways[c]	US Airways	US Airways	US Airways
							Blue1	Blue1	Blue1	Blue1	Blue1
							Adria Airways	Adria Airways	Adria Airways	Adria Airways	Adria Airways
							Croatia Airlines	Croatia Airlines	Croatia Airlines	Croatia Airlines	Croatia Airlines
								TAP Portugal	TAP Portugal	TAP Portugal	TAP Portugal

Table A.3a: *Continued*

									South African Airways	South African Airways	South African Airways
									Swiss Airlines	Swiss Airlines	Swiss Airlines
										Air China	Air China
										Shanghai Airlines	Shanghai Airlines
											Turkish Airlines
											Egypt Air

Notes:

[a] ANA stands for All Nippon Airlines.

[b] Ansett Australia had to leave Star Alliance due to bankruptcy.

[c] In 2005 America West joins the Star Alliance after merging with US Airways.

[d] Varig leaves the Star Alliance.

Source:

http://www.staralliance.com/en/about/airlines/

http://www.staralliance.com/assets/doc/en/about/member-airlines/pdf/star_backgrounder_history_chronological.pdf

Table A.3b: Alliance Membership Evolution: Sky Team

2000* (N=4)	2001 (N=6)	2002 (N=6)	2003 (N=6)	2004 (N=9)	2005 (N=9)	2006 (N=10)	2007 (N=14)	2008 (N=14)
Aeromexico	Aeromexico	Aeromexico	Aeromexico	Aeromexico	Aeromexico	Aeromexico	Aeromexico	Aeromexico
Air France	Air France	Air France	Air France	Air France	Air France	Air France	Air France	Air France
Delta	Delta	Delta	Delta	Delta	Delta	Delta	Delta	Delta
Korean Air	Korean Air	Korean Air	Korean Air	Korean Air	Korean Air	Korean Air	Korean Air	Korean Air
	CSA Czech	CSA Czech	CSA Czech	CSA Czech	CSA Czech	CSA Czech	CSA Czech	CSA Czech
	Alitalia	Alitalia	Alitalia	Alitalia	Alitalia	Alitalia	Alitalia	Alitalia
				Continental	Continental	Continental	Continental	Continental
				KLM	KLM	KLM	KLM	KLM
				Northwest	Northwest	Northwest	Northwest	Northwest
						Aeroflot	Aeroflot	Aeroflot
							Air Europa	Air Europa
							Copa Airlines	Copa Airlines
							Kenya Airways	Kenya Airways
							China Southern Airlines	China Southern Airlines

Notes:
*Sky Team alliance was launched in 2000.
Source: www.skyteam.com/news/facts/2010.html

Table A.3c: Alliance Membership Evolution: One World

1999[a] (N=7)	2000 (N=8)	2001 (N=8)	2002 (N=8)	2003 (N=8)	2004 (N=8)	2005 (N=8)	2006 (N=8)	2007 (N=11)	2008 (N=11)
American	American	American	American	American	American	American	American	American	American
British Airways	British Airways	British Airways	British Airways	British Airways	British Airways	British Airways	British Airways	British Airways	British Airways
Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific	Cathay Pacific
Canadian Airlines[b]	-	-	-	-	-	-	-	-	-
Qantas	Qantas	Qantas	Qantas	Qantas	Qantas	Qantas	Qantas	Qantas	Qantas
Finnair	Finnair	Finnair	Finnair	Finnair	Finnair	Finnair	Finnair	Finnair	Finnair
Iberia	Iberia	Iberia	Iberia	Iberia	Iberia	Iberia	Iberia	Iberia	Iberia
	LAN	LAN	LAN	LAN	LAN	LAN	LAN	LAN	LAN
	Aer Lingus	Aer Lingus	Aer Lingus	Aer Lingus	Aer Lingus	Aer Lingus	Aer Lingus	-	-
								Dragonair	Dragonair
								Malev	Malev
								Japan Airlines	Japan Airlines
								Royal Jordanian	Royal Jordanian

Notes:
[a] The One World alliance was launched in 1999.
[b] Canadian withdraws from One World after being purchased by Air Canada.
Source: http://www.oneworld.com/ow/news-and-information/fact-sheets

Table A.4a: Domestic passengers in the sample (1999 – 2007)

Star Alliance	1999	2000	2001	2002	2003	2004	2005	2006	2007	Av. Growth Rate
United (UA)	24,728,524	23,878,480	17,687,104	14,665,386	11,634,107	12,893,022	12,351,067	10,912,805	10,516,305	-0.10
US Airways (US)	2,488,362	1,996,803	1,255,307	789,861	581,993	565,159	721,563	493,093	748,818	-0.13
Sky Team	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Av. Growth Rate**
Delta (DL)	16,209,083	15,280,290	11,133,730	10,312,472	9,268,599	11,611,857	10,106,615	6,876,089	5,746,287	-0.12
Northwest (NW)	2,169,043	2,205,083	2,031,290	2,019,338	2,070,506	2,478,724	2,790,670	2,625,785	2,196,812	0.00
Continental (CO)	1,167,431	1,058,090	857,978	602,259	588,051	721,725	660,777	689,975	658,139	-0.06
One World	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Av. Growth Rate**
American (AA)	9,259,064	11,648,362	9,340,967	11,035,671	10,316,202	12,398,337	14,793,689	14,473,717	15,416,280	0.06
Pass alliance member	33,987,588	50,807,132	38,161,800	36,013,548	31,218,908	40,820,664	41,658,272	36,426,392	35,645,580	0.01
Pass non-member	24,251,888	7,782,866	6,328,372	5,449,558	5,484,365	2,506,421	2,134,429	2,207,224	1,868,022	-0.28
Total	58,239,476	58,589,998	44,490,172	41,463,106	36,703,273	43,327,085	43,792,701	38,633,616	37,513,602	-0.05

Table A.4b:International passengers in samples (2003 and 2008)

Carrier Code	Carrier Name	Passengers 2003	Passengers 2008	Growth Rate
Star Alliance				
Carrier Code	**Carrier Name**	**Passengers 2003**	**Passengers 2008**	**Growth Rate**
AC	Air Canada	7,616	13,487	9.52
CA	*Air China**	*773*	*1456*	*10.55*
LH	Lufthansa	7,199	11,066	7.17
SK	SAS	312	518	8.45
TG	Thai Airways	211	92	-13.83
UA	United	198,813	182,131	-1.46
NH	ANA	2,963	4,665	7.56
NZ	Air New Zealand	620	708	2.21
SQ	Singapore Airlines	740	881	2.91
BD	British Midland	3,339	4,093	3.39
OZ	Asiana Airlines	1,605	1,100	-6.30
JK	Spanair	1	29	56.12
LO	LOT	28	170	30.06
US	US Airways	15,304	18,954	3.57
TP	TAP Portugal	307	248	-3.56
Sky Team				
Carrier Code	**Carrier Name**	**Passengers 2003**	**Passengers 2008**	**Growth Rate**
AM	Aeromexico	4,450	2,776	-7.86
AF	Air France	4,945	6,943	5.66
DL	Delta	72,678	124,506	8.97
CO	*Continental*	81,543	122,593	6.80
NW	*Norwest*	88,666	110,079	3.61
KE	Korean Air	10754	3,931	-16.77
OK	CSA Czech	137	111	-3.51
AZ	Alitalia	8	5	-7.83

Table A.4b: *Continued*

One World				
Carrier Code	**Carrier Name**	**Passengers 2003**	**Passengers 2008**	**Growth Rate**
AA	American	230085	312692	5.11
BA	British Airways	8020	10838	5.02
CX	Cathay Pacific	1045	2935	17.21
QF	Qantas	4260	5163	3.20
AY	Finnair	2	1	-11.55
IB	Iberia	535	1590	18.15
LA	LAN	870	2104	14.72
Note: *Airlines in italics were not alliance members in 2003.				

Table A.5a: Routes in Domestic Sample (1999-2007)

Route number	Origin City, State	Destination City, State	Origin Region	Destination Region
1	Albany, NY	Boston, MA	Northeast	Northeast
2	Albany, NY	Chicago, IL	Northeast	Midwest
3	Albany, NY	Detroit, MI	Northeast	Midwest
4	Albany, NY	New York, NY	Northeast	Northeast
5	Albuquerque, NM	Denver, CO	Southwest	West
6	Albuquerque, NM	Las Vegas, NV	Southwest	West
7	Albuquerque, NM	Los Angeles, CA	Southwest	West
8	Albuquerque, NM	New York, NY	Southwest	Northeast
9	Atlanta, GA	Austin, TX	Southeast	Southwest
10	Atlanta, GA	Chicago, IL	Southeast	Midwest
11	Atlanta, GA	Dallas/Ft.Worth, TX	Southeast	Southwest
12	Atlanta, GA	Denver, CO	Southeast	West
13	Atlanta, GA	Detroit, MI	Southeast	Midwest
14	Atlanta, GA	Indianapolis, IN	Southeast	Midwest
15	Atlanta, GA	Las Vegas, NV	Southeast	West
16	Atlanta, GA	New York, NY	Southeast	Northeast
17	Atlanta, GA	Washington, DC	Southeast	Southeast
18	Austin, TX	Chicago, IL	Southwest	Midwest
19	Austin, TX	Denver, CO	Southwest	West
20	Austin, TX	Los Angeles, CA	Southwest	West
21	Austin, TX	New York, NY	Southwest	Northeast
22	Austin, TX	Washington, DC	Southwest	Southeast
23	Birmingham, AL	Chicago, IL	Southeast	Midwest
24	Birmingham, AL	Detroit, MI	Southeast	Midwest
25	Birmingham, AL	New York, NY	Southeast	Northeast
26	Boston, MA	Albany, NY	Northeast	Northeast
27	Boston, MA	Chicago, IL	Northeast	Midwest
28	Boston, MA	Cleveland, OH	Northeast	Midwest
29	Boston, MA	Detroit, MI	Northeast	Midwest
30	Boston, MA	Indianapolis, IN	Northeast	Midwest
31	Boston, MA	Las Vegas, NV	Northeast	West
32	Boston, MA	Los Angeles, CA	Northeast	West

Table A.5a: *Continued*

33	Boston, MA	Austin, TX	Northeast	Southwest
34	Boston, MA	Nashville, TN	Northeast	Southeast
35	Boston, MA	New York, NY	Northeast	Northeast
36	Boston, MA	Portland, ME	Northeast	Northeast
37	Boston, MA	Tulsa, OK	Northeast	Southwest
38	Boston, MA	Washington, DC	Northeast	Southeast
39	Buffalo, NY	New York, NY	Northeast	Northeast
40	Buffalo, NY	Washington, DC	Northeast	Southeast
41	Chicago, IL	Albany, NY	Midwest	Northeast
42	Chicago, IL	Albuquerque, NM	Midwest	Southwest
43	Chicago, IL	Atlanta, GA	Midwest	Southeast
44	Chicago, IL	Austin, TX	Midwest	Southwest
45	Chicago, IL	Birmingham, AL	Midwest	Southeast
46	Chicago, IL	Boston, MA	Midwest	Northeast
47	Chicago, IL	Buffalo, NY	Midwest	Northeast
48	Chicago, IL	Cleveland, OH	Midwest	Midwest
49	Chicago, IL	Dallas/Ft.Worth, TX	Midwest	Southwest
50	Chicago, IL	Denver, CO	Midwest	West
51	Chicago, IL	Detroit, MI	Midwest	Midwest
52	Chicago, IL	Indianapolis, IN	Midwest	Midwest
53	Chicago, IL	Kansas City, MO	Midwest	Midwest
54	Chicago, IL	Las Vegas, NV	Midwest	West
55	Chicago, IL	Los Angeles, CA	Midwest	West
56	Chicago, IL	New York, NY	Midwest	Northeast
57	Chicago, IL	Portland, ME	Midwest	Northeast
58	Chicago, IL	Salt Lake City, UT	Midwest	West
59	Chicago, IL	Seattle, WA	Midwest	West
60	Chicago, IL	Tucson, AZ	Midwest	Southwest
61	Chicago, IL	Washington, DC	Midwest	Southeast
62	Cleveland, OH	Boston, MA	Midwest	Northeast
63	Cleveland, OH	Chicago, IL	Midwest	Midwest
64	Cleveland, OH	Detroit, MI	Midwest	Midwest
65	Cleveland, OH	Indianapolis, IN	Midwest	Midwest
66	Cleveland, OH	Las Vegas, NV	Midwest	West

Table A.5a: *Continued*

67	Cleveland, OH	Los Angeles, CA	Midwest	West
68	Cleveland, OH	New York, NY	Midwest	Northeast
69	Cleveland, OH	Washington, DC	Midwest	Southeast
70	Dallas/Ft.Worth, TX	Atlanta, GA	Southwest	Southeast
71	Dallas/Ft.Worth, TX	Chicago, IL	Southwest	Midwest
72	Dallas/Ft.Worth, TX	Cleveland, OH	Southwest	Midwest
73	Dallas/Ft.Worth, TX	Denver, CO	Southwest	West
74	Dallas/Ft.Worth, TX	Las Vegas, NV	Southwest	West
75	Dallas/Ft.Worth, TX	Los Angeles, CA	Southwest	West
76	Dallas/Ft.Worth, TX	Salt Lake City, UT	Southwest	West
77	Dallas/Ft.Worth, TX	Washington, DC	Southwest	Southeast
78	Denver, CO	Albuquerque, NM	West	Southwest
79	Denver, CO	Atlanta, GA	West	Southeast
80	Denver, CO	Austin, TX	West	Southwest
81	Denver, CO	Chicago, IL	West	Midwest
82	Denver, CO	Cleveland, OH	West	Midwest
83	Denver, CO	Dallas/Ft.Worth, TX	West	Southwest
84	Denver, CO	Detroit, MI	West	Midwest
85	Denver, CO	Indianapolis, IN	West	Midwest
86	Denver, CO	Kansas City, MO	West	Midwest
87	Denver, CO	Las Vegas, NV	West	West
88	Denver, CO	Los Angeles, CA	West	West
89	Denver, CO	New York, NY	West	Northeast
90	Denver, CO	Portland, OR	West	West
91	Detroit, MI	Albany, NY	Midwest	Northeast
92	Detroit, MI	Austin, TX	Midwest	Southwest
93	Detroit, MI	Las Vegas, NV	Midwest	West
94	Detroit, MI	Los Angeles, CA	Midwest	West
95	Detroit, MI	Nashville, TN	Midwest	Southeast
96	Detroit, MI	New York, NY	Midwest	Northeast
97	Detroit, MI	Portland, ME	Midwest	Northeast
98	Detroit, MI	Washington, DC	Midwest	Southeast
99	Kansas City, MO	Austin, TX	Midwest	Southwest
100	Kansas City, MO	Chicago, IL	Midwest	Midwest

Table A.5a: *Continued*

101	Kansas City, MO	Detroit, MI	Midwest	Midwest
102	Kansas City, MO	Indianapolis, IN	Midwest	Midwest
103	Kansas City, MO	Las Vegas, NV	Midwest	West
104	Kansas City, MO	Los Angeles, CA	Midwest	West
105	Kansas City, MO	New York, NY	Midwest	Northeast
106	Kansas City, MO	Washington, DC	Midwest	Southeast
107	Las Vegas, NV	Atlanta, GA	West	Southeast
108	Las Vegas, NV	Austin, TX	West	Southwest
109	Las Vegas, NV	Boston, MA	West	Northeast
110	Las Vegas, NV	Chicago, IL	West	Midwest
111	Las Vegas, NV	Cleveland, OH	West	Midwest
112	Las Vegas, NV	Dallas/Ft.Worth, TX	West	Southwest
113	Las Vegas, NV	Denver, CO	West	West
114	Las Vegas, NV	Detroit, MI	West	Midwest
115	Las Vegas, NV	Indianapolis, IN	West	Midwest
116	Las Vegas, NV	Kansas City, MO	West	Midwest
117	Las Vegas, NV	Los Angeles, CA	West	West
118	Las Vegas, NV	New York, NY	West	Northeast
119	Las Vegas, NV	Salt Lake City, UT	West	West
120	Las Vegas, NV	Washington, DC	West	Southeast
121	Los Angeles, CA	Austin, TX	West	Southwest
122	Los Angeles, CA	Boston, MA	West	Northeast
123	Los Angeles, CA	Chicago, IL	West	Midwest
124	Los Angeles, CA	Cleveland, OH	West	Midwest
125	Los Angeles, CA	Denver, CO	West	West
126	Los Angeles, CA	Detroit, MI	West	Midwest
127	Los Angeles, CA	Indianapolis, IN	West	Midwest
128	Los Angeles, CA	Kansas City, MO	West	Midwest
129	Los Angeles, CA	Las Vegas, NV	West	West
130	Los Angeles, CA	Nashville, TN	West	Southeast
131	Los Angeles, CA	New York, NY	West	Northeast
132	Los Angeles, CA	Tucson, AZ	West	Southwest
133	Los Angeles, CA	Washington, DC	West	Southeast
134	Nashville, TN	Chicago, IL	Southeast	Midwest

Table A.5a: *Continued*

135	Nashville, TN	Detroit, MI	Southeast	Midwest
136	Nashville, TN	Indianapolis, IN	Southeast	Midwest
137	Nashville, TN	Los Angeles, CA	Southeast	West
138	Nashville, TN	New York, NY	Southeast	Northeast
139	Nashville, TN	Washington, DC	Southeast	Southeast
140	New York, NY	Albany, NY	Northeast	Northeast
141	New York, NY	Albuquerque, NM	Northeast	Southwest
142	New York, NY	Atlanta, GA	Northeast	Southeast
143	New York, NY	Austin, TX	Northeast	Southwest
144	New York, NY	Birmingham, AL	Northeast	Southeast
145	New York, NY	Boston, MA	Northeast	Northeast
146	New York, NY	Buffalo, NY	Northeast	Northeast
147	New York, NY	Chicago, IL	Northeast	Midwest
148	New York, NY	Denver, CO	Northeast	West
149	New York, NY	Detroit, MI	Northeast	Midwest
150	New York, NY	Indianapolis, IN	Northeast	Midwest
151	New York, NY	Kansas City, MO	Northeast	Midwest
152	New York, NY	Las Vegas, NV	Northeast	West
153	New York, NY	Los Angeles, CA	Northeast	West
154	New York, NY	Nashville, TN	Northeast	Southeast
155	New York, NY	Portland, ME	Northeast	Northeast
156	New York, NY	Seattle, WA	Northeast	West
157	New York, NY	Tucson, AZ	Northeast	Southwest
158	New York, NY	Washington, DC	Northeast	Southeast
159	Indianapolis, IN	Boston, MA	Midwest	Northeast
160	Indianapolis, IN	Chicago, IL	Midwest	Midwest
161	Indianapolis, IN	Cleveland, OH	Midwest	Midwest
162	Indianapolis, IN	Detroit, MI	Midwest	Midwest
163	Indianapolis, IN	Las Vegas, NV	Midwest	West
164	Indianapolis, IN	Los Angeles, CA	Midwest	West
165	Indianapolis, IN	New York, NY	Midwest	Northeast
166	Indianapolis, IN	Washington, DC	Midwest	Southeast
167	Portland, OR	Denver, CO	West	West
168	Portland, OR	Los Angeles, CA	West	West

Table A.5a: *Continued*

169	Salt Lake City, UT	Chicago, IL	West	Midwest
170	Salt Lake City, UT	Dallas/Ft.Worth, TX	West	Southwest
171	Seattle, WA	Dallas/Ft.Worth, TX	West	Southwest
172	Seattle, WA	New York, NY	West	Northeast
173	Tucson, AZ	Austin, TX	Southwest	Southwest
174	Tucson, AZ	Chicago, IL	Southwest	Midwest
175	Tucson, AZ	Las Vegas, NV	Southwest	West
176	Tucson, AZ	Los Angeles, CA	Southwest	West
177	Washington, DC	Albany, NY	Southeast	Northeast
178	Washington, DC	Atlanta, GA	Southeast	Southeast
179	Washington, DC	Austin, TX	Southeast	Southwest
180	Washington, DC	Birmingham, AL	Southeast	Southeast
181	Washington, DC	Boston, MA	Southeast	Northeast
182	Washington, DC	Buffalo, NY	Southeast	Northeast
183	Washington, DC	Chicago, IL	Southeast	Midwest
184	Washington, DC	Cleveland, OH	Southeast	Midwest
185	Washington, DC	Dallas/Ft.Worth, TX	Southeast	Southwest
186	Washington, DC	Detroit, MI	Southeast	Midwest
187	Washington, DC	Indianapolis, IN	Southeast	Midwest
188	Washington, DC	Kansas City, MO	Southeast	Midwest
189	Washington, DC	Las Vegas, NV	Southeast	West
190	Washington, DC	Los Angeles, CA	Southeast	West
191	Washington, DC	Nashville, TN	Southeast	Southeast
192	Washington, DC	New York, NY	Southeast	Northeast
193	Washington, DC	Portland, ME	Southeast	Northeast
194	San Francisco, CA	Albuquerque, NM	West	Southwest
195	San Francisco, CA	Atlanta, GA	West	Southeast
196	San Francisco, CA	Boston, MA	West	Northeast
197	San Francisco, CA	Chicago, IL	West	Midwest
198	San Francisco, CA	Cleveland, OH	West	Midwest
199	San Francisco, CA	Dallas/Ft.Worth, TX	West	Southwest
200	San Francisco, CA	Denver, CO	West	West
201	San Francisco, CA	Houston, TX	West	Southwest
202	San Francisco, CA	Las Vegas, NV	West	West

Table A.5a: ***Continued***

203	San Francisco, CA	Minneapolis, MN	West	Midwest
204	San Francisco, CA	New York, NY	West	Northeast
205	San Francisco, CA	Newark, NJ	West	Northeast
206	San Francisco, CA	Washington, DC	West	Southeast
207	Miami, FL	Atlanta, GA	Southeast	Southeast
208	Miami, FL	Boston, MA	Southeast	Northeast
209	Miami, FL	Denver, CO	Southeast	West

Table A.5b: Routes in International Sample (2003 and 2008)

Route number	Origin City, Country	Destination City, Country
1	Abu Dhabi, United Arab Emirates	London, United Kingdom
2	Amsterdam, Netherlands	Atlanta, GA
3	Amsterdam, Netherlands	Bombay, India
4	Amsterdam, Netherlands	Boston, MA
5	Amsterdam, Netherlands	Chicago, IL
6	Amsterdam, Netherlands	Detroit, MI
7	Amsterdam, Netherlands	Frankfurt, Germany
8	Amsterdam, Netherlands	Houston, TX
9	Amsterdam, Netherlands	London, United Kingdom
10	Amsterdam, Netherlands	Los Angeles, CA
11	Amsterdam, Netherlands	Miami, FL
12	Amsterdam, Netherlands	New York, NY
13	Amsterdam, Netherlands	Newark, NJ
14	Amsterdam, Netherlands	Seattle, WA
15	Amsterdam, Netherlands	Washington, DC
16	Aruba, Aruba	Miami, FL
17	Aruba, Aruba	New York, NY
18	Asuncion, Paraguay	Sao Paulo, Brazil
19	Athens, Greece	Amsterdam, Netherlands
20	Athens, Greece	New York, NY
21	Atlanta, GA	Amsterdam, Netherlands
22	Atlanta, GA	Aruba, Aruba
23	Atlanta, GA	Bogota, Colombia
24	Atlanta, GA	Brussels, Belgium
25	Atlanta, GA	Dublin, Ireland
26	Atlanta, GA	Frankfurt, Germany
27	Atlanta, GA	Freeport, Bahamas
28	Atlanta, GA	Lima, Peru
29	Atlanta, GA	London, United Kingdom
30	Atlanta, GA	Mexico City, Mexico
31	Atlanta, GA	Montreal, Canada
32	Atlanta, GA	Paris, France

Table A.5b: *Continued*

33	Atlanta, GA	Tokyo, Japan
34	Atlanta, GA	Toronto, Canada
35	Atlanta, GA	Zurich, Switzerland
36	Auckland, New Zealand	Los Angeles, CA
37	Bangkok, Thailand	Hong Kong, Hong Kong-China
38	Bangkok, Thailand	Los Angeles, CA
39	Bangkok, Thailand	Taipei, Taiwan
40	Bangkok, Thailand	Tokyo, Japan
41	Barbados/Bridgetown, Barbados	Miami, FL
42	Barcelona, Spain	London, United Kingdom
43	Barcelona, Spain	New York, NY
44	Barcelona, Spain	Paris, France
45	Beijing, China	Chicago, IL
46	Beijing, China	Los Angeles, CA
47	Beijing, China	New York, NY
48	Beijing, China	San Francisco, CA
49	Beijing, China	Tokyo, Japan
50	Beirut, Lebanon	Amsterdam, Netherlands
51	Beirut, Lebanon	Paris, France
52	Belize City, Belize	Houston, TX
53	Berlin, Germany	Amsterdam, Netherlands
54	Berlin, Germany	London, United Kingdom
55	Bogota, Colombia	Atlanta, GA
56	Bogota, Colombia	Houston, TX
57	Bogota, Colombia	Miami, FL
58	Bogota, Colombia	Newark, NJ
59	Bogota, Colombia	Quito, Ecuador
60	Bombay, India	Amsterdam, Netherlands
61	Bombay, India	New York, NY
62	Boston, MA	Amsterdam, Netherlands
63	Boston, MA	Aruba, Aruba
64	Boston, MA	Frankfurt, Germany
65	Boston, MA	London, United Kingdom
66	Boston, MA	Montego Bay, Jamaica

Table A.5b: ***Continued***

67	Boston, MA	Montreal, Canada
68	Boston, MA	Nassau, Bahamas
69	Boston, MA	Paris, France
70	Boston, MA	Santo Domingo, Dominican Republic
71	Boston, MA	Sao Paulo, Brazil
72	Boston, MA	Tokyo, Japan
73	Boston, MA	Toronto, Canada
74	Brussels, Belgium	Atlanta, GA
75	Brussels, Belgium	Chicago, IL
76	Brussels, Belgium	London, United Kingdom
77	Bucharest, Romania	Paris, France
78	Budapest, Hungary	Amsterdam, Netherlands
79	Budapest, Hungary	Frankfurt, Germany
80	Buenos Aires, Argentina	Dallas/Ft.Worth, TX
81	Buenos Aires, Argentina	Miami, FL
82	Buenos Aires, Argentina	Montevideo, Uruguay
83	Buenos Aires, Argentina	New York, NY
84	Buenos Aires, Argentina	Sao Paulo, Brazil
85	Cairo, Arab Republic Of Egypt	London, United Kingdom
86	Calgary, Canada	Chicago, IL
87	Calgary, Canada	Los Angeles, CA
88	Capetown, Republic Of South Africa	London, United Kingdom
89	Chicago, IL	Amsterdam, Netherlands
90	Chicago, IL	Aruba, Aruba
91	Chicago, IL	Beijing, China
92	Chicago, IL	Brussels, Belgium
93	Chicago, IL	Calgary, Canada
94	Chicago, IL	Frankfurt, Germany
95	Chicago, IL	London, United Kingdom
96	Chicago, IL	Mexico City, Mexico
97	Chicago, IL	Montreal, Canada
98	Chicago, IL	Paris, France
99	Chicago, IL	Seoul, South Korea
100	Chicago, IL	Tokyo, Japan

Table A.5b: *Continued*

101	Chicago, IL	Toronto, Canada
102	Chicago, IL	Vancouver, Canada
103	Cleveland, OH	Toronto, Canada
104	Copenhagen, Denmark	Amsterdam, Netherlands
105	Copenhagen, Denmark	Frankfurt, Germany
106	Copenhagen, Denmark	London, United Kingdom
107	Dallas/Ft.Worth, TX	Calgary, Canada
108	Dallas/Ft.Worth, TX	Frankfurt, Germany
109	Dallas/Ft.Worth, TX	London, United Kingdom
110	Dallas/Ft.Worth, TX	Mexico City, Mexico
111	Dallas/Ft.Worth, TX	Sao Paulo, Brazil
112	Dallas/Ft.Worth, TX	Toronto, Canada
113	Delhi, India	Amsterdam, Netherlands
114	Delhi, India	Frankfurt, Germany
115	Delhi, India	London, United Kingdom
116	Denver, CO	Calgary, Canada
117	Denver, CO	Frankfurt, Germany
118	Denver, CO	London, United Kingdom
119	Denver, CO	Vancouver, Canada
120	Detroit, MI	Amsterdam, Netherlands
121	Detroit, MI	Frankfurt, Germany
122	Detroit, MI	London, United Kingdom
123	Detroit, MI	Mexico City, Mexico
124	Detroit, MI	Toronto, Canada
125	Detroit, MI	Vancouver, Canada
126	Doha, Qatar	London, United Kingdom
127	Dubai, United Arab Emirates	Amsterdam, Netherlands
128	Dubai, United Arab Emirates	London, United Kingdom
129	Dubai, United Arab Emirates	Paris, France
130	Dublin, Ireland	Amsterdam, Netherlands
131	Dublin, Ireland	Atlanta, GA
132	Dublin, Ireland	Chicago, IL
133	Dublin, Ireland	London, United Kingdom
134	Dublin, Ireland	New York, NY

Table A.5b: ***Continued***

135	Frankfurt, Germany	Amsterdam, Netherlands
136	Frankfurt, Germany	Atlanta, GA
137	Frankfurt, Germany	Boston, MA
138	Frankfurt, Germany	Chicago, IL
139	Frankfurt, Germany	Dallas/Ft.Worth, TX
140	Frankfurt, Germany	Denver, CO
141	Frankfurt, Germany	Detroit, MI
142	Frankfurt, Germany	Houston, TX
143	Frankfurt, Germany	London, United Kingdom
144	Frankfurt, Germany	Los Angeles, CA
145	Frankfurt, Germany	Miami, FL
146	Frankfurt, Germany	Montreal, Canada
147	Frankfurt, Germany	New York, NY
148	Frankfurt, Germany	Newark, NJ
149	Frankfurt, Germany	Philadelphia, PA
150	Frankfurt, Germany	San Francisco, CA
151	Frankfurt, Germany	Washington, DC
152	Freeport, Bahamas	Miami, FL
153	Guatemala City, Guatemala	Houston, TX
154	Guatemala City, Guatemala	Los Angeles, CA
155	Guayaquil, Ecuador	Miami, FL
156	Guayaquil, Ecuador	Newark, NJ
157	Guayaquil, Ecuador	Panama City, Panama Republic
158	Hong Kong, Hong Kong-China	Chicago, IL
159	Hong Kong, Hong Kong-China	Los Angeles, CA
160	Hong Kong, Hong Kong-China	San Francisco, CA
161	Hong Kong, Hong Kong-China	Tokyo, Japan
162	Honolulu, HI	Tokyo, Japan
163	Houston, TX	Amsterdam, Netherlands
164	Houston, TX	Belize City, Belize
165	Houston, TX	Calgary, Canada
166	Houston, TX	Guatemala City, Guatemala
167	Houston, TX	Lima, Peru
168	Houston, TX	London, United Kingdom

Table A.5b: *Continued*

169	Houston, TX	Mexico City, Mexico
170	Houston, TX	Paris, France
171	Houston, TX	Sao Paulo, Brazil
172	Houston, TX	Tokyo, Japan
173	Houston, TX	Toronto, Canada
174	Houston, TX	Vancouver, Canada
175	Istanbul, Turkey	Frankfurt, Germany
176	Istanbul, Turkey	New York, NY
177	Johannesburg, Republic Of South Africa	Atlanta, GA
178	Johannesburg, Republic Of South Africa	London, United Kingdom
179	Johannesburg, Republic Of South Africa	New York, NY
180	Kiev, Ukraine	Amsterdam, Netherlands
181	Kiev, Ukraine	Frankfurt, Germany
182	Kingston, Jamaica	Miami, FL
183	Kingston, Jamaica	New York, NY
184	Kuwait, Kuwait	London, United Kingdom
185	La Paz, Bolivia	Miami, FL
186	Las Vegas, NV	Mexico City, Mexico
187	Las Vegas, NV	Vancouver, Canada
188	Lima, Peru	Mexico City, Mexico
189	Lima, Peru	Miami, FL
190	Lisbon, Portugal	Amsterdam, Netherlands
191	Lisbon, Portugal	London, United Kingdom
192	Lisbon, Portugal	New York, NY
193	Lisbon, Portugal	Newark, NJ
194	London, United Kingdom	Amsterdam, Netherlands
195	London, United Kingdom	Atlanta, GA
196	London, United Kingdom	Boston, MA
197	London, United Kingdom	Chicago, IL
198	London, United Kingdom	Dallas/Ft.Worth, TX
199	London, United Kingdom	Denver, CO
200	London, United Kingdom	Detroit, MI
201	London, United Kingdom	Frankfurt, Germany
202	London, United Kingdom	Houston, TX

Table A.5b: ***Continued***

203	London, United Kingdom	Las Vegas, NV
204	London, United Kingdom	Los Angeles, CA
205	London, United Kingdom	Miami, FL
206	London, United Kingdom	New York, NY
207	London, United Kingdom	Newark, NJ
208	London, United Kingdom	Paris, France
209	London, United Kingdom	Philadelphia, PA
210	London, United Kingdom	San Francisco, CA
211	London, United Kingdom	Washington, DC
212	Los Angeles, CA	Amsterdam, Netherlands
213	Los Angeles, CA	Auckland, New Zealand
214	Los Angeles, CA	Calgary, Canada
215	Los Angeles, CA	Can Cun, Mexico
216	Los Angeles, CA	Frankfurt, Germany
217	Los Angeles, CA	London, United Kingdom
218	Los Angeles, CA	Madrid, Spain
219	Los Angeles, CA	Melbourne, Australia
220	Los Angeles, CA	Mexico City, Mexico
221	Los Angeles, CA	Paris, France
222	Los Angeles, CA	San Salvador, El Salvador
223	Los Angeles, CA	Sydney, Australia
224	Los Angeles, CA	Tokyo, Japan
225	Los Angeles, CA	Toronto, Canada
226	Los Angeles, CA	Vancouver, Canada
227	Luxembourg, Luxembourg	Frankfurt, Germany
228	Madrid, Spain	Amsterdam, Netherlands
229	Madrid, Spain	Frankfurt, Germany
230	Madrid, Spain	London, United Kingdom
231	Madrid, Spain	Miami, FL
232	Madrid, Spain	New York, NY
233	Madrid, Spain	Newark, NJ
234	Madrid, Spain	Paris, France
235	Managua, Nicaragua	Miami, FL
236	Manchester, United Kingdom	Chicago, IL

Table A.5b: *Continued*

237	Manila, Philippines	Hong Kong, Hong Kong-China
238	Manila, Philippines	Los Angeles, CA
239	Manila, Philippines	Seoul, South Korea
240	Melbourne, Australia	Los Angeles, CA
241	Mexico City, Mexico	Atlanta, GA
242	Mexico City, Mexico	Chicago, IL
243	Mexico City, Mexico	Dallas/Ft.Worth, TX
244	Mexico City, Mexico	Houston, TX
245	Mexico City, Mexico	Los Angeles, CA
246	Mexico City, Mexico	Miami, FL
247	Mexico City, Mexico	New York, NY
248	Miami, FL	Amsterdam, Netherlands
249	Miami, FL	Aruba, Aruba
250	Miami, FL	Bogota, Colombia
251	Miami, FL	Buenos Aires, Argentina
252	Miami, FL	Frankfurt, Germany
253	Miami, FL	Freeport, Bahamas
254	Miami, FL	Guatemala City, Guatemala
255	Miami, FL	London, United Kingdom
256	Miami, FL	Madrid, Spain
257	Miami, FL	Nassau, Bahamas
258	Miami, FL	Paris, France
259	Miami, FL	Quito, Ecuador
260	Miami, FL	Rio De Janeiro, Brazil
261	Miami, FL	Sao Paulo, Brazil
262	Minneapolis, MN	Toronto, Canada
263	Montevideo, Uruguay	Buenos Aires, Argentina
264	Montreal, Canada	Atlanta, GA
265	Montreal, Canada	Boston, MA
266	Montreal, Canada	Chicago, IL
267	Montreal, Canada	Miami, FL
268	Montreal, Canada	New York, NY
269	Montreal, Canada	Newark, NJ
270	Montreal, Canada	Philadelphia, PA

Table A.5b: ***Continued***

271	Moscow, Russia (European)	Frankfurt, Germany
272	Moscow, Russia (European)	London, United Kingdom
273	Moscow, Russia (European)	New York, NY
274	Moscow, Russia (European)	Zurich, Switzerland
275	Nassau, Bahamas	Miami, FL
276	New York, NY	Amsterdam, Netherlands
277	New York, NY	Aruba, Aruba
278	New York, NY	Frankfurt, Germany
279	New York, NY	Kingston, Jamaica
280	New York, NY	London, United Kingdom
281	New York, NY	Mexico City, Mexico
282	New York, NY	Montreal, Canada
283	New York, NY	Nassau, Bahamas
284	New York, NY	Paris, France
285	New York, NY	Tokyo, Japan
286	New York, NY	Toronto, Canada
287	New York, NY	Zurich, Switzerland
288	Newark, NJ	Amsterdam, Netherlands
289	Newark, NJ	Frankfurt, Germany
290	Newark, NJ	Lisbon, Portugal
291	Newark, NJ	London, United Kingdom
292	Newark, NJ	Mexico City, Mexico
293	Newark, NJ	Paris, France
294	Newark, NJ	Toronto, Canada
295	Paris, France	Amsterdam, Netherlands
296	Paris, France	Atlanta, GA
297	Paris, France	Boston, MA
298	Paris, France	Chicago, IL
299	Paris, France	Frankfurt, Germany
300	Paris, France	Houston, TX
301	Paris, France	London, United Kingdom
302	Paris, France	Madrid, Spain
303	Paris, France	Miami, FL
304	Paris, France	New York, NY

Table A.5b: *Continued*

305	Paris, France	San Francisco, CA
306	Paris, France	Washington, DC
307	Philadelphia, PA	Montreal, Canada
308	Prague, Czech Republic	Amsterdam, Netherlands
309	Quito, Ecuador	Miami, FL
310	Quito, Ecuador	Newark, NJ
311	Quito, Ecuador	Panama City, Panama Republic
312	San Francisco, CA	Amsterdam, Netherlands
313	San Francisco, CA	Beijing, China
314	San Francisco, CA	Calgary, Canada
315	San Francisco, CA	Frankfurt, Germany
316	San Francisco, CA	Hong Kong, Hong Kong-China
317	San Francisco, CA	London, United Kingdom
318	San Francisco, CA	Paris, France
319	San Francisco, CA	Seoul, South Korea
320	San Francisco, CA	Sydney, Australia
321	San Francisco, CA	Tokyo, Japan
322	San Jose, Costa Rica	Miami, FL
323	San Salvador, El Salvador	Miami, FL
324	Santiago, Chile	Dallas/Ft.Worth, TX
325	Santiago, Chile	Miami, FL
326	Santo Domingo, Dominican Republic	Newark, NJ
327	Sao Paulo, Brazil	Dallas/Ft.Worth, TX
328	Sao Paulo, Brazil	Los Angeles, CA
329	Sao Paulo, Brazil	Miami, FL
330	Sao Paulo, Brazil	New York, NY
331	Sao Paulo, Brazil	Newark, NJ
332	Sao Paulo, Brazil	Washington, DC
333	Seattle, WA	Amsterdam, Netherlands
334	Seattle, WA	Frankfurt, Germany
335	Seattle, WA	Vancouver, Canada
336	Seoul, South Korea	Chicago, IL
337	Seoul, South Korea	Los Angeles, CA
338	Seoul, South Korea	New York, NY

Table A.5b: *Continued*

339	Seoul, South Korea	San Francisco, CA
340	Seoul, South Korea	Tokyo, Japan
341	Shanghai, China	Los Angeles, CA
342	Shanghai, China	Tokyo, Japan
343	Singapore, Singapore	Hong Kong, Hong Kong-China
344	Singapore, Singapore	Tokyo, Japan
345	Stockholm, Sweden	London, United Kingdom
346	Sydney, Australia	Los Angeles, CA
347	Sydney, Australia	New York, NY
348	Sydney, Australia	San Francisco, CA
349	Sydney, Australia	Tokyo, Japan
350	Taipei, Taiwan	Los Angeles, CA
351	Taipei, Taiwan	New York, NY
352	Taipei, Taiwan	San Francisco, CA
353	Taipei, Taiwan	Tokyo, Japan
354	Tel Aviv, Israel	London, United Kingdom
355	Tel Aviv, Israel	Zurich, Switzerland
356	Tokyo, Japan	Atlanta, GA
357	Tokyo, Japan	Bangkok, Thailand
358	Tokyo, Japan	Beijing, China
359	Tokyo, Japan	Chicago, IL
360	Tokyo, Japan	Hong Kong, Hong Kong-China
361	Tokyo, Japan	Honolulu, HI
362	Tokyo, Japan	Los Angeles, CA
363	Tokyo, Japan	New York, NY
364	Tokyo, Japan	San Francisco, CA
365	Tokyo, Japan	Seoul, South Korea
366	Tokyo, Japan	Singapore, Singapore
367	Toronto, Canada	Boston, MA
368	Toronto, Canada	Chicago, IL
369	Toronto, Canada	Los Angeles, CA
370	Toronto, Canada	New York, NY
371	Toronto, Canada	Newark, NJ
372	Toronto, Canada	Philadelphia, PA

Table A.5b: *Continued*

373	Toronto, Canada	Washington, DC
374	Vancouver, Canada	Denver, CO
375	Vancouver, Canada	Honolulu, HI
376	Vancouver, Canada	Houston, TX
377	Vancouver, Canada	Los Angeles, CA
378	Vancouver, Canada	Phoenix, AZ
379	Vancouver, Canada	San Francisco, CA
380	Vancouver, Canada	Seattle, WA
381	Warsaw, Poland	Amsterdam, Netherlands
382	Warsaw, Poland	London, United Kingdom
383	Washington, DC	Buenos Aires, Argentina
384	Washington, DC	Frankfurt, Germany
385	Washington, DC	London, United Kingdom
386	Washington, DC	Mexico City, Mexico
387	Washington, DC	Tokyo, Japan
388	Washington, DC	Toronto, Canada
389	Zurich, Switzerland	Atlanta, GA
390	Zurich, Switzerland	Boston, MA
391	Zurich, Switzerland	Chicago, IL
392	Zurich, Switzerland	Frankfurt, Germany
393	Zurich, Switzerland	Los Angeles, CA
394	Zurich, Switzerland	New York, NY
395	Zurich, Switzerland	Newark, NJ

Table A.6: Net income and operating expenses (1999-2007)

Year	Overall (Domestic + International)		Domestic Service	Int. Service
	Net Income	Operating Expenses	Net Income	Net Income
1999	5,360,943.00	110,488,896.00	4,490,385.00	802,708.25
2000	2,532,700.00	123,234,216.00	1,991,496.25	461966
2001	-8,266,509.00	125,545,752.00	-7,234,855.00	-940,665.25
2002	-11,365,484.00	115,690,376.00	-9,329,102.00	-1,958,013.38
2003	-1,715,467.50	119,860,552.00	-1,469,580.38	-249,430.66
2004	-9,104,425.00	136,149,952.00	-9,906,155.00	649,832.38
2005	-27,219,896.00	151,096,784.00	-19,747,536.00	-7,663,275.50
2006	18,186,112.00	157,891,968.00	9,043,659.00	9,004,411.00
2007	7,691,404.50	165,352,672.00	2,995,875.25	4,505,131.50
Star Alliance (Major domestic members)				
United Airlines				
Year	Overall (Domestic + International)		Domestic Service	Int. Service
	Net Income	Operating Expenses	Net Income	Net Income
1999	1,203,761.00	16,608,774.00	840,537.00	363,224.00
2000	51,624.00	18,590,452.00	-10,052.00	61676
2001	-2,110,209.00	19,830,468.00	-1,278,776.00	-831,433.00
2002	-3,325,781.00	16,937,412.00	-2,168,052.00	-1,157,729.00
2003	-3,086,226.00	14,951,478.00	-1,976,545.00	-1,109,681.00
2004	-2,002,147.00	16,867,576.00	-1,699,062.00	-303,085.00
2005	-21,036,384.00	17,545,500.00	-12,832,612.00	-8,203,772.00
2006	22,658,184.00	18,883,336.00	-13,505,778.00	9,152,406.00
2007	348,502.00	19,096,724.00	-40,640.00	389,142.00
US Airways				
Year	Overall (Domestic + International)		Domestic Service	Int. Service
	Net Income	Operating Expenses	Net Income	Net Income
1999	273,469.00	8,258,020.00	264,417.00	9,052.00
2000	-254,804.00	9,225,611.00	-241,998.00	-12806
2001	-1,989,407.00	9,434,777.00	-1,969,996.00	-19,411.00
2002	-1,658,803.00	7,834,254.00	-1,591,172.00	-67,631.00
2003	1,452,056.00	7,182,984.00	1,442,943.00	9,113.00
2004	-577,855.00	7,421,065.00	-652,384.00	74,529.00

Table A.6: *Continued*

2005	159,886.00	7,425,433.00	50,425.00	109,461.00
2006	445,642.10	7,483,719.00	201,034.80	244,607.30
2007	334,437.90	8,774,306.00	222,567.40	111,870.50
Sky Team (Major domestic members)				
Delta				
Year	**Overall (Domestic + International)**		**Domestic Service**	**Int. Service**
	Net Income	**Operating Expenses**	**Net Income**	**Net Income**
1999	1,284,549.00	13,171,308.00	1,262,134.00	22,415.00
2000	686,463.00	13,861,493.00	694,842.00	-8379
2001	-1,107,053.00	14,183,170.00	-847,429.00	-259,624.00
2002	-1,294,977.00	13,445,770.00	-858,976.00	-436,001.00
2003	-895,595.00	15,360,197.00	-771,147.00	-124,448.00
2004	-3,362,180.00	16,767,217.00	-2,883,687.00	-478,493.00
2005	-3,797,551.00	17,308,864.00	-3,109,370.00	-688,181.00
2006	-5,996,683.00	17,308,296.00	-4,224,355.00	-1,772,328.00
2007	1,794,320.00	18,233,956.00	1,614,621.00	179,699.00
Continental				
Year	**Overall (Domestic + International)**		**Domestic Service**	**Int. Service**
	Net Income	**Operating Expenses**	**Net Income**	**Net Income**
1999	498,470.00	7,546,106.00	303,335.00	195,135.00
2000	340,906.00	8,542,461.00	68,611.00	272295
2001	-95,142.00	8,313,431.00	-411,195.00	316,053.00
2002	-451,002.00	7,833,538.00	-853,141.00	402,139.00
2003	38,156.00	7,303,747.00	-321,782.00	359,938.00
2004	-409,855.00	10,140,888.00	-1,091,057.00	681,202.00
2005	-67,467.00	11,201,729.00	-880,014.00	812,547.00
2006	343,327.00	12,599,970.00	-657,249.00	1,000,576.00
2007	459,507.00	13,484,442.00	-908,055.00	1,367,562.00
Northwest				
Year	**Overall (Domestic + International)**		**Domestic Service**	**Int. Service**
	Net Income	**Operating Expenses**	**Net Income**	**Net Income**
1999	287,839.00	9,099,249.00	319,287.00	-31,448.00
2000	269,943.00	10,293,107.00	320,062.00	-50119

Table A.6: *Continued*

2001	-418,101.00	10,388,396.00	-91,541.00	-326,560.00
2002	-766,429.00	9,935,075.00	-436,253.00	-330,176.00
2003	478,109.00	9,460,358.00	623,292.00	-145,183.00
2004	-757,299.00	11,699,605.00	-359,945.00	-397,354.00
2005	-2,309,740.00	13,210,759.00	-1,871,691.00	-438,049.00
2006	-2,798,531.00	11,773,257.00	-1,527,540.00	-1,270,991.00
2007	2,387,470.00	11,610,968.00	1,349,213.00	1,038,257.00
One World (Major domestic members)				
American				
	Overall (Domestic + International)		**Domestic Service**	**Int. Service**
Year	**Net Income**	**Operating Expenses**	**Net Income**	**Net Income**
1999	626,340.00	15,086,486.00	466,784.00	159,556.00
2000	778,003.00	16,874,132.00	511,809.00	266194
2001	-1,317,176.00	18,196,600.00	-1,354,712.00	37,536.00
2002	-3,495,660.00	19,183,530.00	-2,904,708.00	-590,952.00
2003	-1,318,491.00	18,847,340.00	-1,819,691.00	501,200.00
2004	-820,981.00	19,028,564.00	-1,314,864.00	493,883.00
2005	-891,719.00	21,007,890.00	-974,997.00	83,278.00
2006	163,876.00	21,677,784.00	-290,077.00	453,953.00
2007	355,781.00	22,130,660.00	-290,510.00	646,291.00

Notes: The figures in this table belong to domestic airlines with revenues of 20 million or more.
Figures are in thousands.

Figure A.1: Net Income for US Carriers (1999-2007)
(in millions)

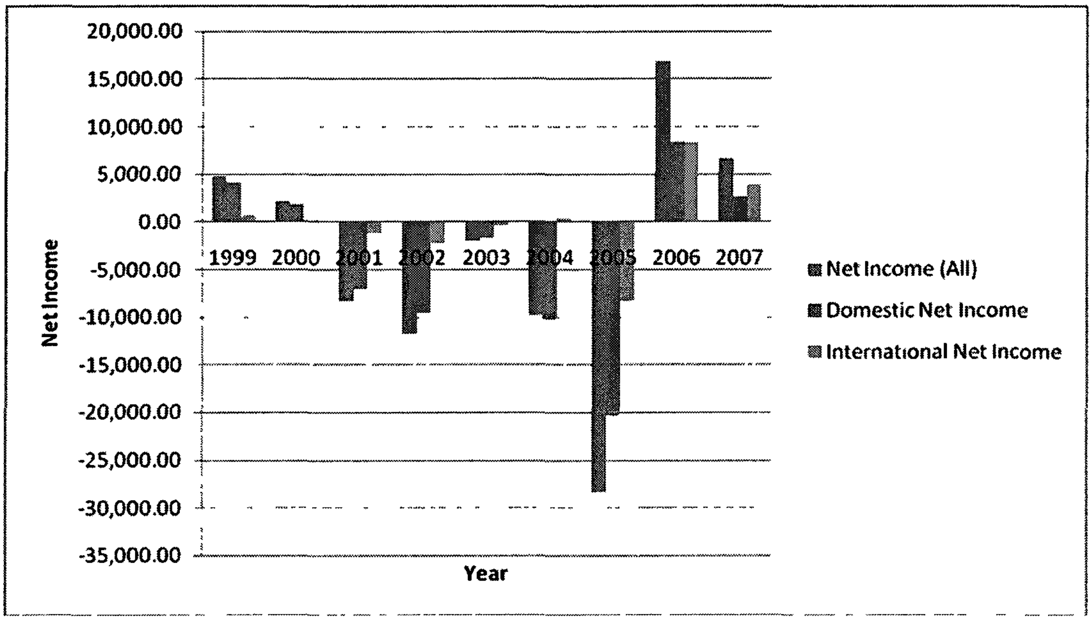

Figure A.2: United Airlines' Net Income (1999-2007)
(in millions)

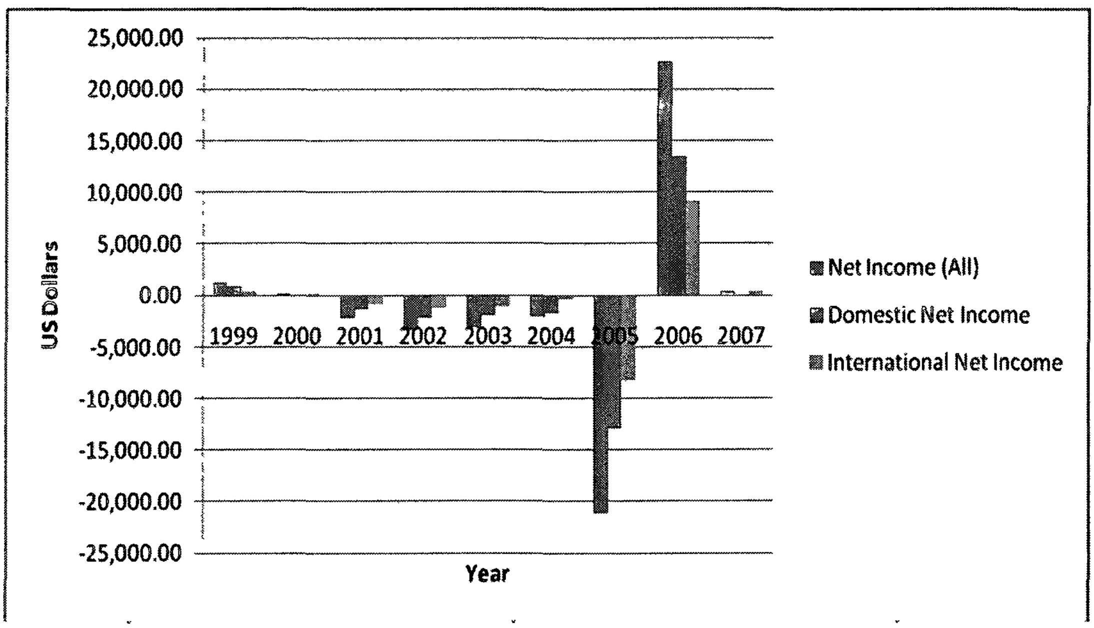

Figure A.3: US Airways' Net Income (1999-2007)
(in millions)

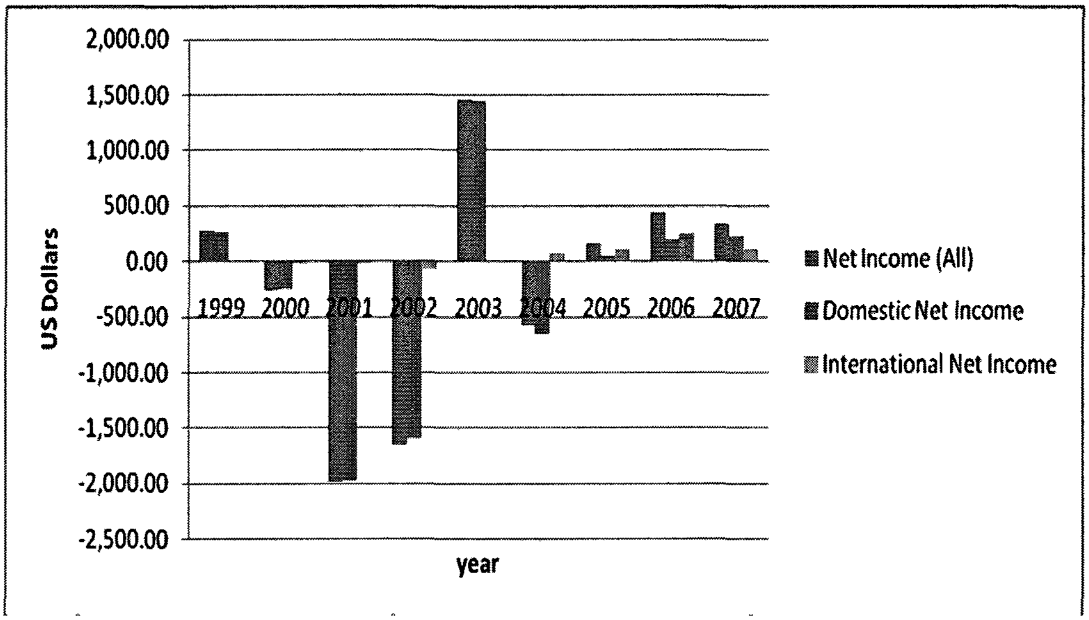

Figure A.4: Delta's Net Income (1999-2007)
(in millions)

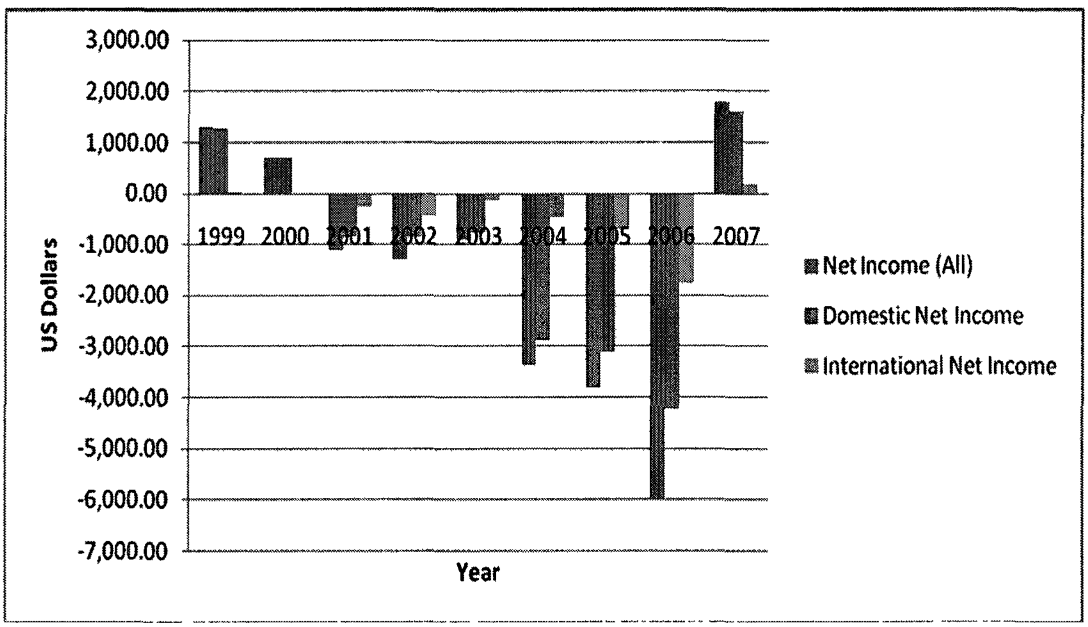

Figure A.5: Continental's Net Income (1999-2007)
(in millions)

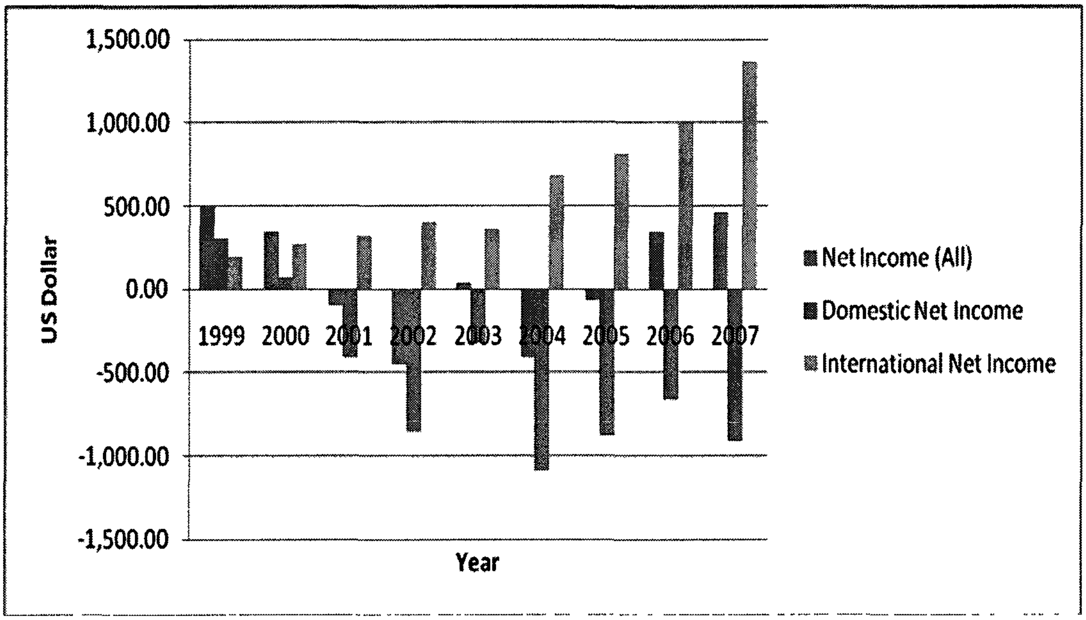

Figure A.6: Northwest's Net Income (1999-2007)
(in millions)

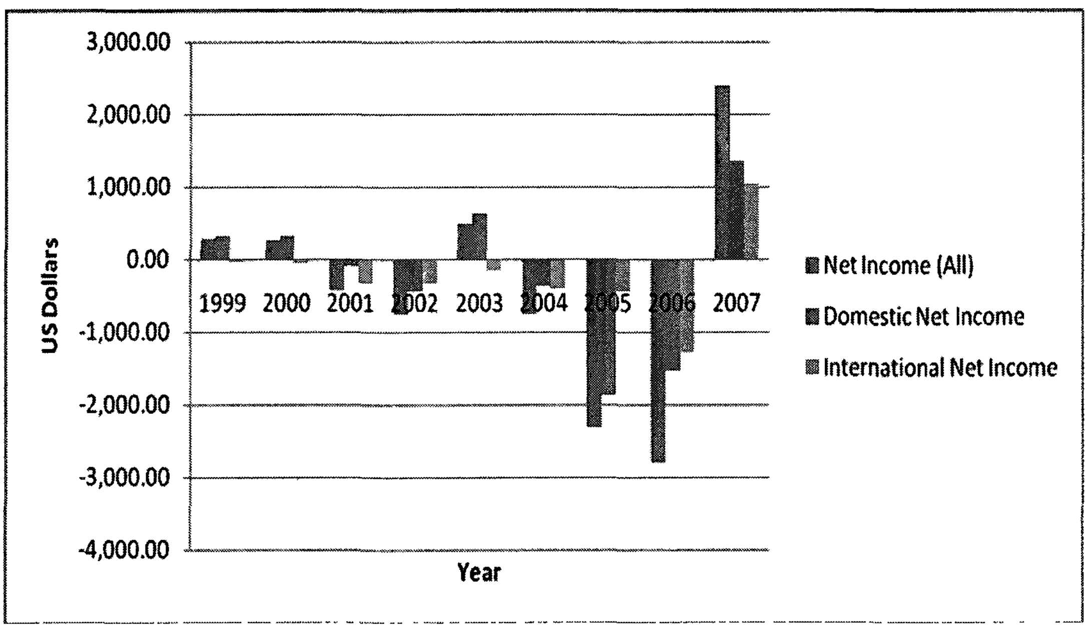

Figure A.7: American Airlines' Net Income (1999-2007)
(in millions)