The Evolution of Network Competition in Transatlantic Aviation and the Effects of Regulatory Liberalization

by

Alexander Cosmas

B.S. Applied Physics
Columbia University, 2004

Submitted to the Department of Aeronautics and Astronautics and the Engineering Systems Division
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Aeronautics and Astronautics

and

Master of Science in Technology and Policy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2009

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ABSTRACT

Since the domestic deregulation of the U.S. airline industry in 1978, impacts to domestic stakeholders, including airlines, airports, labor and consumers, have been well-studied. International air transportation, however, has remained principally regulated by bilateral agreements between governments. Recent global movement towards international deregulation, including the U.S.-EU Open Skies agreement which took effect March 30th 2008, has revived the debate over the effects of regulatory liberalization in aviation. Our research contributes to the debate over regulatory liberalization with an analysis of its impacts in the broader transatlantic market.

In this thesis we evaluate how competition in transatlantic aviation markets has evolved over the last decade and how regulatory liberalization has impacted service levels and competition in specific U.S. and European markets. In addition, we explore the extent to which various market characteristics impact transatlantic service levels. This research is conducted in four parts: (1) a stakeholder analysis, (2) a competition and market analysis of transatlantic aviation, (3) a review of the policy impacts since 1990, and (4) an econometric market analysis.

In our stakeholder analysis, we find that increased competition is brought about by loosened restrictions on airline networks and by strengthening carriers financially through the availability of foreign capital and opportunities for cross-border mergers. Our market analysis reveals that, in aggregate since 2000, transatlantic markets have seen an increase in number of competitors. In addition, U.S. carriers have gained a disproportionate share of new transatlantic service, leveraging the network effects of flying from their hubs. Further, we discover that although European gateways are highly concentrated to the largest four hubs, overall U.S. gateways are more concentrated than those of Europe, where a greater proportion of traffic is fed through smaller gateways.

In our analysis of Open Skies between European countries and the U.S., we find that the agreements have resulted in both increases and decreases in service levels in recent decades. Of the 22 European countries with U.S. Open Skies agreements in place by 2007, only seven demonstrated overall increases in service levels while six demonstrated overall reductions. Five countries saw no significant change and the remaining four have yet to receive direct transatlantic service, supporting our hypothesis that liberalization alone does not oblige service level increases. We discuss the extent to which antitrust immunized alliances in deregulated markets have led to the benefits often credited to liberalization. Our econometric analysis confirms the hypothesis that Open Skies demonstrates no statistically significant correlation to transatlantic service levels. Instead, total economic activity of a city or country and its status as a major carrier hub is the dominant explanatory factor of service levels.

Thesis Supervisor: Dr.Peter Belobaba
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You can't be a real country unless you have a beer and an airline.

-Frank Zappa

Acknowledgments

I started graduate school intending to work towards a solution to one of the most complex technical challenges of our time – the development of "highways in the sky" through which the everyday person could safely travel with speed, flexibility and efficiency. It would be a critical step in achieving the promise of flying cars for which most in my generation have waited over a quarter century. During my first semester at MIT, I enrolled in Dr. Peter Belobaba's 16.71 Airline Industry course to satisfy my curiosity and immediately realized that the more pressing air transportation challenges of our generation lie in the weakened state of commercial aviation. Martin Shugrue, former Vice Chairman and COO of Pan Am said it best of airlines: "If we went into the funeral business, people would stop dying." Since that first semester, I have focused my research on commercial aviation as a driver of the global economy.

First, I would like to thank my advisors, Peter Belobaba and Bill Swelbar, for their guidance, their support, and their never-ending ability to push me beyond my limits. Dr. Belobaba's Airline Industry course reinforced my passion for an industry I grew up marveling yet had no idea how to become a part of. His enthusiasm for the industry and talent as a teacher solidified my understanding of the analytic methods I will employ long after leaving MIT. Bill Swelbar has an uncanny ability to add value to numbers, to turn data points into history lessons (and undoubtedly controversies). I learned more from my conversations with Bill than from the hundreds of pages I read while a graduate student.

I would also like to thank John Byerly, Deputy Assistant Secretary of State for Transportation Affairs, Pieter Bootsma at KLM, John Heimlich and Cecilia Bethke at the Air Transport Association, Don Fields and Mark Treadaway at the Metropolitan Washington Airports Authority, Pat Murphy at Gerchick & Murphy, Will Ris at American Airlines, Michael Francesconi at UPS, Diane Peterson at Airports Council International, Russ Bailey at the Air Line Pilots Association, Steven Taylor and Nancy Sparks at FedEx, Conor McAuliffe at United Airlines, Bill Brunger at Continental Airlines, and the many others who made contributions to this study.

I would also like to thank the U.S. Department of Defense, the Air Force Office of Scientific Research, and the American Society for Engineering Education for sponsoring my graduate work by awarding me the National Defense Science and Engineering Graduate Fellowship.

My friends at MIT have made my graduate experience rich and enjoyable. I want to thank my lab mates Nick, Gerry, Matt and Ioannis for the great times and for adding fun to the daily routine. I want to thank my good friends the "Frenchies" – Bastien and Julien – for challenging every word out of my mouth, for confirming my stereotypes, and for being such terrific teammates. A special thank you to my TPP contingent, Rob and Dai, for keeping me sane and making MIT home to memorable friendships.

Finally, my biggest thank you goes to my adoring wife, Ana, and to my loving parents, Steve and Stella. Mom and dad, your unconditional support since childhood gave me the courage and the confidence I needed to succeed at MIT. I would never have had such a wealth of opportunities if not for your hard work and dedication to giving our family the best life possible. Ana, I cannot thank you enough for your love, your energy, and your patience during my three years in graduate school. Your encouragement and affection carried me through my toughest challenges, and I would not have made it through MIT in one piece without you.

I dedicate this thesis to my loving grandparents, Athena and Kyriakos, Eleni and Constantinos.

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Chapter 1

Introduction

Since its domestic deregulation in 1978, the U.S. airline industry has seen many changes. Several carriers have come and gone, while others have been acquired by or merged with competitors. Some hubs have grown while others have been downsized or closed altogether. A number of large and small cities have received new domestic and international service, while some others have lost service. In this age of globalization, the once heavily regulated international aviation market is increasingly being liberalized. This represents a movement from the status quo that has proven contentious among air transportation stakeholders. Our research contributes to the debate over regulatory liberalization with an analysis of its effects in the transatlantic market.[1]

Historically, air service agreements between nations have been negotiated by governments. A nation's air transportation rights have often been granted or restricted as a foreign policy tool and an economic vehicle seeking to protect national interests. International routes, city pairs, frequencies, fares and operating carriers have been determined by the governments negotiating a given bilateral agreement. Significant research of deregulation's impact on airfares and service has been conducted. Studies have consistently found that since deregulation, fares have declined overall, most communities have more commercial air service than they did under regulation, and the rate of accidents has continued its historic decline (GAO, 1996). As U.S. airlines focus increasingly on expanding their international networks in response to the globalizing marketplace, many have sought the same operational freedoms internationally that they now enjoy domestically.

As strong trading partners and historic allies, the United States and European nations have led efforts to liberalize their transatlantic aviation market. Since 1992, 34 European nations have signed "Open Skies" agreements with the U.S. which allow any number of airlines unlimited rights to serve any city pairs between the two countries without any restrictions on capacity, code sharing or fares.[2] However, as discussed in this thesis, even Open Skies bilaterals contain operational and financial restrictions. This thesis explores the specific impacts of Open Skies agreements between European

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[1] In our research, we use the term "transatlantic" to refer to the air transportation market between the United States and Europe. The latter includes both European Union member states and those not covered by EU aviation agreements.
[2] Fares proposed by a flag carrier of either country remain unregulated unless both nations explicitly oppose them.

countries and the U.S. We explore how much of the change in transatlantic air service levels has historically been driven by liberalization itself, versus other natural phenomena like population increases, GDP growth, globalization or tourism.

1.1 Thesis Objective and Structure

The main objective of this thesis is to provide a framework for the ongoing debate over regulatory liberalization and to explore the specific impact that liberalization has had on transatlantic air transportation. In particular, the goal is to evaluate changes in service levels following the signing of Open Skies agreements and to develop a model that identifies any correlation between the existence of an Open Skies agreement and transatlantic service levels to a particular market. Furthermore, the evolution of transatlantic competition and the utilization of hubs as gateways are investigated in order to shed light on the future of transatlantic aviation under continued regulatory liberalization.

The thesis is divided into six chapters. This chapter summarizes the current regulatory environment and the debate surrounding the U.S.-EU agreement. It is separated into four sections. The first contains a summary of objectives and approach to our research. The second lays out the history which gave the U.S. its current air transportation policies. The third outlines the EU-U.S. Open Skies agreement and frames the debate over further liberalization. Lastly, a few important definitions are reviewed.

Chapter 2 provides a detailed stakeholder analysis in conjunction with a summary of the issues most often cited in the debate over liberalized foreign ownership, a condition for a permanent Open Skies agreement between the U.S. and EU. We discuss the merits of each issue from the lens of individual stakeholders and conclude by presenting vehicles for legislative change.

Chapter 3 evaluates the transatlantic aviation market in terms of competition and market service levels over the last decade. U.S. carrier performance in the transatlantic market is evaluated relative to their non-U.S. counterparts. Transatlantic service levels of several U.S. and European markets are described to highlight significant changes in the previous decade and the role that transatlantic gateways have played.

Chapter 4 explores service levels following specific policy events. An emphasis is given to individual Open Skies agreements, but the impacts of alliances and antitrust immunity are also discussed. We discuss transatlantic service levels country by country and draw conclusions about the overall effects of Open Skies.

In Chapter 5 we present an econometric analysis that seeks to explain transatlantic service levels for U.S. and European cities. After reviewing the literature in the field of air transportation econometric analysis, we describe a number of market characteristics and perform a series of regressions to explore the explanatory power of each factor.

Chapter 6 presents a summary of our research findings and contrasts our results with other studies. We then discuss the limitations of the analysis and suggest topics for future research.

1.2 The U.S. Air Transportation Regulatory Environment

Air transportation is critical to a nation's economy, providing an incentive for governments to safeguard their industry players and keep them thriving. In the U.S., the commercial aviation sector drives, directly and indirectly, approximately 5.8% of total domestic output and 5.0% of Americans' personal earnings (Campbell-Hill, 2006). Additionally, air transportation generates nearly 9% of domestic jobs, over one million direct and another ten million indirect and induced. As a result of its economic dependence upon air transportation, the U.S. government continues to regulate the industry – even more so than other industries regarded as essential to the national interest including power, telecommunications, automotive, aerospace/defense and banking. Table 1 summarizes the major events that have defined the regulatory environment in which U.S. airlines operate.

What specifically is regulated? The foundation of airline regulation is the premise that unfettered access to a nation's markets and infrastructure should be limited to airlines of that nation. An airline only qualifies as a "national carrier" if it fulfills citizenship requirements established by legislation. The primary requirement is a restriction on foreign ownership. Any carrier that is not a national carrier but may operate within another country is commonly referred to as a "foreign carrier." National carriers have full access to domestic markets whereas foreign carriers are restricted to operating within the bilateral agreements established between its home country and that in which it flies.

In the U.S., only airlines granted a fitness certificate by the Department of Transportation (DOT) and operating certificate by the Federal Aviation Administration (FAA) are allowed to operate domestic flights (8^{th} and 9^{th} freedom), described in further detail in Section 1.4. To be granted an FAA operating certificate, an airline must be a U.S. citizen corporation, which is defined as:

A corporation organized under the laws of the United States of which the president and at least two-thirds of the board of directors and other managing officers are citizens of the United States, which is under the actual control of citizens of the United States, and in which at least 75 percent of the voting interest (read corporate stock with voting rights) is owned or controlled by persons that are citizens of the United States.

Source: 49 USC § 40102(a)(15)

Table 1: Timeline of Significant Events in the U.S. Air Transportation Regulatory Environment

Year	Event and Impact on Air Transportation Regulations
1919	**Paris Convention** establishes exclusive sovereignty of a state over its airspace. Nations are given the right to favor their airlines in connection with the carriage of persons and goods for hire.
1926	**Air Commerce Act** acknowledges the potential for air commerce. U.S. citizens must own >50% of any individual aircraft for it to be registered in the U.S.
1938	The **Civil Aeronautics Act** centralizes safety and commercial regulation of air transportation. It requires that U.S. citizens own or control at least 75% of the voting interests of U.S. airlines, a regulation which remains 70 years later.
1944	The U.S. convenes the **Chicago Convention**, where five "freedoms of the air" are established. The Convention prohibits scheduled international air service over or into territory without the permission of its sovereign State. This effectively begins the use of bilateral agreements.
1946, 1977	The **Bermuda/Bermuda II Treaties** establish bilateral rights for air travel between the U.S. and UK. The restrictive bilateral becomes the blueprint for most subsequent air service agreements.
1977	The **Air Cargo Deregulation Act** is passed, clearing the way for the deregulation throughout the air transportation industry over the next few years. FedEx credits its existence to its rapid expansion made possible by deregulation.
1978	The **Airline Deregulation Act** is signed by President Carter. This begins the domestic liberalization of market entry/exit, pricing and competition, and is phased in over several years until the Civil Aeronautics Board is dissolved in the mid-1980's.
1979	President Carter signs the **International Air Transportation Competition Act** which aims at reducing barriers to entry into new international markets. As a protection, the Act authorizes the President to take quick action against a foreign government that engages in discriminatory or anticompetitive practices against American carriers.
1970s-2000s	Various attempts at foreign buyouts of (or mergers with) U.S. airlines. Many result in divestiture after U.S. failure to approve (Nanda, 2002). The DOT establishes the practice of evaluating proposals on a case-by-case basis.
1991	The Secretary of Transportation proposes allowing an increase of foreign ownership of U.S. airlines to 49% voting stock. The proposal was made in response to heavy losses suffered by U.S. airlines in 1990-1991.
2003-2006	The Bush Administration proposes raising the 25% cap to 49%. After the proposal fails to gain Congressional support, a Notice of Proposed Rulemaking seeks to redefine "actual control" but meets strong opposition in Congress. In May 2006, DOT issues a Supplemental NPRM addressing Congressional concerns, but it is later withdrawn under continued opposition.
March, 2008	Stage 1 of U.S.-EU Open Skies begins; Stage 2 negotiations begin in May 2008. EU officials make relaxed foreign ownership a prerequisite for continuing with a permanent agreement. This comes at a time when a weak U.S. aviation industry is prompting bankruptcies and consolidation among its major players.

Therefore, only U.S. citizen-controlled airlines are allowed full, unrestricted access to U.S. air transportation markets. Foreign carriers, on the other hand, have traditionally been limited by bilateral agreements that specify which city pairs they can serve, often with restrictions on capacity, frequency and fares. Foreign ownership restrictions are meant to ensure that airlines which serve the domestic market consider the national interest. However some, such as former U.S. Labor Secretary Robert Reich, suggest that the implicit assumption behind foreign ownership restrictions is the "questionable belief" that local owners are more likely than foreign owners to consider the national interest or to serve local stakeholder interests (Carney and Dostaler, 2006). Chapter 2 presents a stakeholder analysis in the debate over the relaxation of foreign ownership caps.

Traditional bilateral agreements are increasingly being replaced by Open Skies agreements in which airlines are granted virtually unrestricted access to another nation's international air transportation markets. A study by InterVISTAS (2006) estimated that countries that have liberalized their air transportation markets experienced growth in air service of 12% to 50% or more. They estimated that the full liberalization (as opposed to simply Open Skies) of the U.S.-UK market alone would produce a 29% increase in traffic and generate 117,000 new jobs. The incremental GDP impact, according to the report, would be roughly $7.8 billion.

The largest Open Skies agreement to date, signed by EU and U.S. officials in April 2007, is expected to bring about tremendous change to the industry. As a prerequisite to a permanent agreement, the Europeans have made liberalized foreign ownership a focal issue in the upcoming 2nd Stage agreement. As a result, the debate over further liberalization of the U.S. airline industry has extended beyond regulation of frequency, capacity and fares to the actual ownership and control of U.S. airlines. The two issues can no longer be de-coupled.

Proponents of further liberalization between the U.S. and EU often cite the benefits that earlier Open Skies agreements between the two have afforded. In our research we attempt to demonstrate two points:

1) **Liberalization takes many forms, and it is not clear that the demonstrated benefits of one form of deregulation can be used to predict the effects of other forms.** For example, even if it were accepted that U.S. domestic regulation since 1978 and individual Open Skies agreements were beneficial in aggregate, it cannot necessarily be concluded that changing foreign ownership laws would provide additional benefit. Nor can the opposite argument be made.
2) **While some Open Skies agreements have led to increases in service levels and/or competition, there are others that have been followed by decreases in service or competition.** The impacts of liberalization depend on many factors not inherently common to all cases, and are therefore best evaluated on a case-by-case basis. Additionally, the costs of regulation (operating inefficiencies, opportunity costs, etc.) should be weighed against any service gains in determining net utility to individual stakeholders.

1.3 Framing the Issue: EU-U.S. Open Skies

On April 30, 2007, EU and U.S. officials signed a 1st Stage Open Skies accord which allows EU airlines to operate direct flights between the U.S. and any EU country (and some others) and grants U.S. airlines the reciprocal right, plus the ability to fly between city-pairs in different EU countries. The new opportunities resulting from the 1st Stage U.S.-EU Open Skies agreement are summarized as follows:

- Grants full "5th freedom" rights to all U.S. and EU carriers (both cargo and passenger). For example, United Airlines may fly from Washington Dulles to Paris and onward to Athens carrying Paris-Athens local traffic.

- U.S. and EU carriers are able to codeshare on flights to previously-restricted nations (e.g. Greece, Spain), allowing airlines to offer new routings and service to new markets.
- Elimination of the nationality clause allows EU airlines to restructure or consolidate into cross-border entities without jeopardizing their right to fly to the U.S. For example, Air France and KLM could merge their dual-hub operations to achieve economies of scale without losing their rights into the U.S. (although their traffic rights to other countries may be jeopardized).
- EU airlines are able to offer transatlantic services from any location in the EU as a result of elimination of the nationality clause. This allows any U.S. or EU carrier to compete in any U.S.-EU market. For example, AF-KLM began (and subsequently discontinued) nonstop service between Los Angeles and London Heathrow, which previously was limited to four carriers – two British and two American. Similarly, Lufthansa could choose to offer nonstop service between Miami and Barcelona with no connection to Germany.
- U.S. regulators will consider foreign requests to hold larger shares of non-voting equity, including combinations in which the total of voting and non-voting equity exceeds 50% (U.S. DOC, 2007).

Many studies predict enormous economic growth impacts resulting from full deregulation under a so-called "Open Aviation Area" (OAA). One of the most referenced reports, The Brattle Group's (2002) assessment of "The Economic Impact of an EU–U.S. Open Aviation Area" was commissioned by the EC's Directorate-General Energy and Transport. Brattle was asked to "analyze the effects of complete U.S.-EU aviation liberalization," specifically the economic effects on airline costs and output and the resulting effects on consumer welfare and aviation employment. In the report, Brattle estimates that the potential cost savings to the airline industry from greater productive efficiency are about €2.9 billion ($3.8b) annually, or 4.2% of total costs. A majority of those savings would come from intra-EU operations. Furthermore, Brattle estimates that fare decreases associated with these cost savings would result in up to €370 million ($481m) in added consumer welfare due to the increase in passenger traffic.

The Brattle Group also identified annual passenger traffic increases of 9% to 24%, or 4.1 to 11 million passengers, on transatlantic routes resulting from the complete elimination of commercial regulations (Brattle, 2002). In aggregate, they suggest that liberalization would result in an annual increase of over €5 billion ($6.5b) in consumer surplus. The report then concludes that a U.S.-EU OAA would not jeopardize national security, labor or aviation safety but that the issues that arise as a result of it "would challenge regulators."

Booz Allen Hamilton's (2007) follow-up report maintained the Brattle Group approach but used updated (and reduced) forecasts for transatlantic traffic and applied a more conservative approach to calculating consumer surplus. The report identifies opportunity for 26 million additional passengers over five years, translating to a consumer surplus of €6.4 to €12 billion ($8.3 to $15.6b). Additionally, Booz Allen Hamilton (BAH) estimates that 72,000 jobs will be created in the EU and U.S. and that cargo tonnage would grow 1-2% in the same period. In terms of traffic and consumer surplus, BAH forecasts lower, albeit still significant, impacts from movement to a U.S.-EU OAA.

Proponents of the Open Skies agreement (and further liberalization) often cite the benefits identified by Brattle and BAH, despite differences between the Open Skies agreement and an OAA, as identified in Table 2. The benefits that result from the Stage 1 U.S.-EU Open Skies agreement will be less than those calculated by Brattle or BAH in an OAA, where foreign ownership/control and full cabotage rights are allowed.

Table 2: Summary of Restrictions in Traditional Bilaterals, Open Skies Agreements and OAAs

Type of agreement	Open service capacity and frequency ?	Freedom in setting fares ?	Extended traffic rights (e.g. onward 5ths)? (see Note 1)	Foreign ownership and control allowed ?	"Cabotage" (see Note 2)
Traditional Bilaterals	x	x	x	x	x
"Open Skies"	✓	✓	✓	x	x
Open Aviation Area (OAA)	✓	✓	✓	✓	✓

Note 1: 5ths are the right to pick up passengers from a foreign country (B) and fly them to another foreign country (C).
Note 2: "Cabotage" is the right of a foreign carrier to operate purely domestic services in another country.

Source: Civil Aviation Authority (2006)

Because the foreign ownership issue had not been resolved when U.S. and EU officials signed the 1st Stage agreement, EU officials made it clear that liberalized foreign ownership remains a primary objective for a permanent agreement. By agreement within the European Council, individual EU countries could demand suspension of certain rights granted by the Open Skies agreement should U.S. officials not agree by 2012 to allow increased foreign investment in U.S. airlines.

The premise for their demand is reciprocity of the EU's 49% ownership cap. However, it is clear that access to the U.S. domestic market, which comprises one third of global traffic, is valuable as both a standalone market and international hub-feeder. Since cabotage rights are only granted to U.S. citizen-controlled airlines, the U.S. market provides little benefit to foreign airlines that lack effective control of operational decisions (including network planning). In other words, the EU's rationale reflects that of increased control rather than equity.

In the next section we define terms used throughout this thesis and distinguish between equity ownership and control. In Chapter 2 we return to the stakeholder analysis of EU-U.S. Open Skies.

1.4 Definitions

Service Levels

The term "service level" can be used to describe a number of measures in air transportation, from service quality (seat pitch, delays, concessions, etc.) to the number of itinerary options a passenger can choose from. In this thesis, transatlantic service levels for a particular city refer to the:

1) number of transatlantic destinations offered
2) number of transatlantic departures performed
3) number of carriers providing transatlantic service
4) number of transatlantic passengers flown to or from a given city

The term is therefore not a quantitative indicator of any above metric but is instead used to describe aggregate change over time or differences between cities.

Origin-Destination (O-D) Market

An O-D market includes all potential travelers per period wishing to travel from all points served by origin airport A to all points served by destination airport B. Although sometimes used to describe one-way demand, we generally refer to an O-D market as round-trip. Example: BOS (Boston Logan) to LHR (London Heathrow).

City Pair

An O-D market in which the origin and destination are cities rather than airport catchment areas. Example: New York City to London (where both are served by multiple airports).

Stage Length

Stage length is the distance flown by an aircraft between two points. For a nonstop market, the stage length is equal to the total distance between the origin and destination.

Available Seat Miles (ASMs)

Available seat miles are a measure of airline capacity, weighted by distance. For a given flight, the number of ASMs is equal to the number of aircraft seats multiplied by the number of miles flown, regardless of how many seats are occupied. It is commonly used to compare the allocation of capacity across different airlines and markets.

Seat-Departures

Seat-departures are an alternative measure of airline capacity, not weighted by distance. It is equal to the total number of seats departed over a given time period. For a 250-seat aircraft performing one round-trip, the carrier performed 500 seat-departures. This metric is commonly used to compare capacity across airlines when one wishes to avoid assigning value to the distance of flight segments.

Revenue Passenger Miles (RPMs)

Revenue passenger miles are a measure of the output sold by an airline. One RPM is equal to one revenue-generating passenger transported one mile. Total RPMs can be calculated as the total number of enplanements multiplied by the average stage length. RPMs are used to compare traffic share across different airlines and over time.

Average Load Factor (ALF)

Average Load Factor is the percentage of an airline's capacity that is sold. For a given flight, the load factor is equal to the total number of passengers divided by the total number of seats. Across a system, the average load factor is equal to total RPMs divided by total ASMs. ALF is not an indicator of profitability, but rather of an airline's ability to fill seats with passengers, irrespective of revenue quality.

Yield

Yield is a common measure of the revenue quality of a particular flight leg, market or network. It is defined as the revenue generated by an airline divided by its RPMs. Yield measures the revenue generated by a passenger flown by one mile, or the revenue per unit of output sold.

Freedoms of the Sky

In 1944, delegates from 52 nations met in Chicago to develop a multilateral treaty securing each nation's rights over its airspace. These "freedoms of the sky" are the fundamental building blocks of air transportation regulation and each subject to specific conditions, such as establishing the frequency of flights or airport usage. There are five basic freedoms that are recognized (although not necessarily granted) by virtually all countries. Freedoms 6 and 7 are less common, and typically only negotiated between stalwart trading partners. Freedoms 8 and 9 are only now entering into Air Service Agreements (ASAs), but they are still rare.

Table 3: Freedoms of the Sky

1st freedom	The right to fly over another nation's territory without landing (overflight)
2nd freedom	The right to land in a foreign country for non-traffic reasons, such as maintenance or refueling, without picking up or setting down revenue traffic
3rd freedom	The right to carry traffic (people or cargo) from own State A to treaty partner State B
4th freedom	The right to carry traffic (people or cargo) from treaty partner State B to own State A
5th freedom	The right to carry traffic between two foreign countries with services starting or ending in own State A (i.e. "beyond rights")
6th freedom	The right to carry traffic between two foreign countries via State A. Combines two sets of 3rd and 4th freedom rights as so it is rarely specified explicitly in Air Service Agreements
7th freedom	The right to operate stand-alone services between two foreign states which lie entirely outside A
8th freedom	The right to carry traffic between two points within a foreign state on a service originating or terminating in State A (i.e. consecutive or fill-up cabotage). Example: Alitalia picks up passengers in Atlanta and drops them off in Boston en route to Milan (currently not allowed)
9th freedom	The right to carry traffic between two points within a foreign state with no requirement to originate or terminate in State A (i.e. pure or full cabotage). Example: German-based Air Berlin flies nonstop between London and Manchester without any connection to Germany

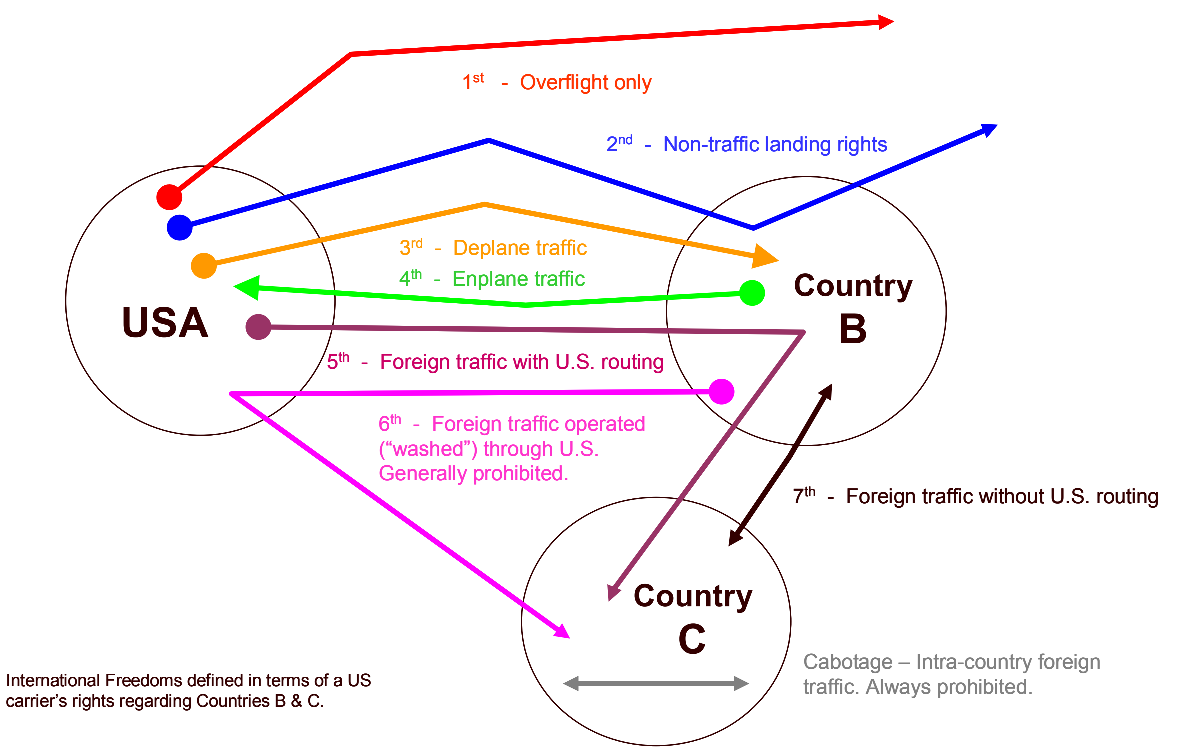

Figure 1: Freedoms of International Air Transportation (Source: Michael Francesconi, UPS)

Equity Ownership versus Control

Foreign equity and control of U.S. airlines are differentiated under U.S. law. Although foreign investment in U.S. airlines is capped at 25% of voting stock, foreign investors are currently allowed to own up to 49% of equity stake in airlines provided that the airline is under the "actual control" of U.S. citizens and that the CEO is a U.S. citizen. The DOT uses several methods to test for "actual control" (U.S. DOT 2003), including:

- Supermajority or disproportionate voting rights
- Negative control/power to veto
- Buyout clauses
- Significant Contracts
- Credit agreements/debt
- Family ties between foreigners and U.S. officers

Other nations have experimented with variable voting rights in which no equity cap is placed on the sale of shares but where the total fraction of controlling (i.e. voting) stake remains fixed. Canada, for example, has capped the foreign controlling stake of its airlines at 25% but places no limit on the number of shares foreign investors can own. Foreign investors currently own 75% of Air Canada's holding company, ACE, but they have been issued Class A pro-rated shares which, by design, total no more than 25% of the voting stake in Air Canada. Foreigners can buy as many airline shares as they'd like without ever controlling more than 25% of the voting rights of a Canadian airline.

According to Clive Beddoe, Chief Executive at WestJet, the structure "doesn't make any difference to the value of the stock. It's very rare that shareholders need to vote on any contentious issue" (Knibb, 2007). Therefore the average shareholder places little value on the voting rights of stock, and since Class A and Class B shares trade at the same price, the market has not established a price premium for voting rights.

However, other studies have found price premiums emerge as an impact of barriers to foreign investment. Bailey, Chung and Kang (1999), for example, find that when foreign ownership limits have been reached, "foreigners begin to trade local equities among themselves at a premium." They find that foreigners "often pay premiums of 20, 50 or even 100% above otherwise identical security available only to locals."

In January 2008, German carrier Lufthansa purchased a 19% stake in JFK-based carrier JetBlue. While executives from both carriers have indicated that collaboration is likely, Lufthansa has yet to exercise control over JetBlue's operations. This investment provides evidence that EU airlines do not need complete liberalization to invest in U.S. airlines.

But as we stated earlier, without control of operational decisions, route networks cannot be shaped, and there is no benefit to international carriers that could not otherwise be afforded through alliances or equity ownership. We therefore assume for this analysis that a controlling, as opposed to equity, stake is ultimately desired by foreign investors.

Chapter 2

Stakeholder Analysis and Literature Review

This chapter is separated into two sections. The first contains a summary of the stakeholders and issues that are considered in this research. Stakeholders with the most direct impacts resulting from regulatory liberalization and those most vocal in the debate are highlighted. Stakeholders without mention are by no means unaffected by regulations in air transportation, but restrictions of time and space require a limit in scope.

The second section is a literature review of academic, industry and journalistic works as well as a summary of takeaways from the various stakeholder surveys conducted for this research. The works cited range from the theory of regulation to analyses of specific impacts to today's stakeholders. Similarly, the stakeholder reviews range from opinion editorials and anonymous executive opinions to formal positions of industry players.

2.1 Overview of the Regulatory Liberalization Debate

Although the easing of operational restrictions associated with Open Skies has been widely supported, the frameworks by which freedoms are granted have proven more contentious. Most recently, the debate over U.S.-EU Open Skies intensified when the European Commission requested that, in addition to negotiating operational freedoms, the U.S. ease its foreign ownership requirement. The U.S. began restricting ownership of airlines in the 1930's for four primary reasons. First, Congress wanted to protect the then-fledgling U.S. airline industry. Second, U.S. officials were concerned about allowing foreign aircraft access to U.S. airspace. Third, international air service was regulated under bilateral agreements as a tool for foreign policy. Finally, the military relied (and continues to rely) on civilian airlines to supplement its airlift capacity, much like it does with sea-going vessels.

While protectionism increased following the Civil Aeronautics Act of 1938, attempts to deregulate the industry began immediately after the restrictive Bermuda II treaty was signed in 1977. By 1978, President Carter had signed the Airline Deregulation Act to reduce the role of government in air transportation and allow for new entrants and increased competition to provide price and service benefits to consumers in U.S. domestic markets.

While the momentum domestically has clearly been towards liberalization, the U.S. remains among the most ownership-restricted aviation markets in the world (see Table 4). Chang and Williams (2001) summarize nationality clauses and the current regulations around the world and assess "the prospects for change in ownership rules under multilateral and plurilateral proposals." They explain that governments have traditionally designated, set up, and regulated their own airlines as a means of safeguarding their sovereignties and controlling foreign relations with trade partners.

Table 4: Status of Foreign Ownership Restrictions in Select Countries

Country	Status of Foreign Ownership Restriction
Australia	49% for international (25% single); 100% for domestic[3]
Brazil	20% of voting equity
Canada	25% of voting equity (15% single)[4]
Chile	Principal place of business only
China	35%
Colombia	40%
European Union	49%
India	26% for Air India, 49% for privately owned domestic carriers, 74% for charter and cargo
Indonesia	Substantial ownership and effective control
Israel	34%
Japan	33.33%
Kenya	49%
Korea	50%
Malaysia	45% for Malaysia Airlines (20% single), 30% other
Mauritius	40%
New Zealand	49% for international; 100% for domestic
Peru	49%
Philippines	40%
Singapore	None
Taiwan	33.33%
Thailand	30%
United States	25% of voting equity; one-third of board at maximum; cannot be Chairman of Board

Adapted from Hsu and Chang (2005)

Easing of ownership rules, according to Chang and Williams, is often accompanied by a loosening of other market restrictions. The authors point out that the recent increase in foreign investment in airlines reflects the growing globalization of the industry. They hold that "restrictive foreign ownership rules clearly no longer satisfy the demands of today's marketplace" and that "removing

[3] The Australian government released a policy paper on December 1st, 2008 that proposes lifting the foreign ownership limit for single entities to 49%.
[4] As of February 2009, the Canadian government was debating a proposal to increase ownership limits to 49%. The proposal, which is supported by Air Canada, is backed by both the Conservative Party and the Liberal Party.

the nationality clauses in bilateral air service agreements (ASA's) is a vital step towards achieving a truly competitive global airline industry."

Some argue that current regulations are required to maintain the strong safety record of U.S. carriers and that removing barriers of ownership would hinder the U.S.' competitive position, hurt labor, and jeopardize national security. Our stakeholder analysis attempts to characterize the economic and security implications of the issues that are most often cited by stakeholders in the debate over regulatory liberalization.

2.2 Issues in Regulatory Liberalization

It is commonly acknowledged by industry experts that increased foreign ownership and reduced operational regulations will increase competition, but they disagree on whether the resulting impacts are positive or negative. Costs and benefits are often proportioned unevenly across stakeholders in the market, and government officials feel it is their obligation to ensure that their constituency does not face a disproportionate burden. Many arguments against changes to the status quo are economically motivated. Others are more intangible in nature, attributed to impacts that are not quantifiable. For example, some fear that weaknesses in a nation's civil aviation industry, often associated with the "rapid progress of technology and continuous changes and innovations, has become a mirror reflecting the general standard of [national] society" (Gertler, 1994).

Opponents of regulatory liberalization, particularly an increased foreign ownership cap, argue that it will pose a risk to national security, reduce aviation safety, and hurt aviation labor. In order to frame our stakeholder analysis, these issues are discussed in further detail below and a summary is provided in Table 5. We then present a detailed stakeholder analysis, incorporating takeaways from our stakeholder interviews.

Table 5: Issues in the Debate Over Foreign Ownership Liberalization

Issue	Point of Contention
Domestic Competition	Will liberalized foreign ownership change the competitive landscape? Would any such change benefit or hurt U.S. consumers?
National Security	Does foreign stake mean foreign control? Will the Civil Reserve Air Fleet become ineffective under increased foreign ownership?
Employment	Will increased foreign ownership put U.S. jobs at risk or affect the labor-management balance of power?
Safety	Does either foreign stake or foreign control imply lower safety standards? Would oversight of additional regulatory standards burden the FAA?
International Competition	Will relaxing ownership laws increase international competition? Will U.S. airlines be able to compete without changes to the domestic industry structure?
National Prestige & Political Intangibles	Will increased foreign presence hurt the U.S. position as a world leader? Will it present a risk of aviation system disruption?

Domestic Competition

Some U.S. government officials have recently raised the concern that consolidation prompted by increased competition will hurt, rather than help, consumers by reducing choice and increasing fares (Oberstar, 2008). However by definition, restricting the natural evolution of airlines, including consolidation, is itself a form of regulation. While consolidation has the potential for reductions in service, recent bankruptcy filings by U.S. carriers underscore the effects of high commodity prices and fragile capital markets. Consolidation can occur in many ways: consolidation through liquidation of airlines; consolidation through continued capacity reductions; or consolidation through merger and acquisition activity. Based on current proposals, capacity cuts may be minimized under a scenario of consolidation through merger and acquisition activity. Maximizing access to U.S. air transportation markets is most important for consumers and the U.S. market has proven time and time again that if prices are perceived to be too high, then a competitor will exploit that opportunity.

One clear benefit of reduced ownership regulations is that airlines will gain access to additional capital,[5] and economic theory tells us that the average cost of capital will decrease as its supply increases. Access to foreign capital, paired with strong leadership and responsible business plans, would strengthen U.S. airlines financially while enhancing their competitive position by retiring debt, consolidating, improving services and avoiding bankruptcy. In addition, diversifying investor risk profiles allows U.S. airlines with weaker credit ratings to seek capital. However, it may also be true that limiting the pool of capital encourages stronger, less risky business plans. If we assume the quality and number of business plans remain constant, additional capital may favor weaker plans.

A secondary benefit is that foreign airline investors impact the culture of acquired airlines, encouraging them to adopt best practices. If the infusion of capital and management best practices strengthens U.S. carriers financially and operationally, regulatory liberalization will increase competition domestically.

International Competition

Whether through elimination of the nationality clause or by expanding the number of airlines to which rights are granted, liberalization is likely to increase international competition. Under an OAA, the most liberalized regime, competition is increased by both allowing a greater number of foreign carriers to compete and strengthening domestic carriers through capital infusion.

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[5] While current airline ownership laws in the U.S. restrict foreign ownership of voting equity, the argument holds for debtors as well. Debtors seek a level of control in their investments that would raise concern with regulators. As Carney and Dostaler (2006) point out, “Banks typically demand ‘insider status’ to monitor executive decisionmaking.”

Some critics of liberalization point to the adverse effects of increased foreign presence on U.S. carriers and the flying public, namely that changes in the competitive landscape will hurt consumers. Some even suggest that an increased foreign carrier presence in the U.S. will reduce the number of carriers flying the U.S. flag around the world and would quickly hurt national prestige.

In response, others have highlighted the unlikelihood of a flood of new competition resulting from further liberalization. They point to the noticeably low levels of new service that resulted from the Stage 1 EU-U.S. Open Skies agreement. Airlines' hesitance to enter new markets following the agreement highlights the risk-aversion to strong competition that carriers face even domestically. For example, U.S. carriers are currently able to fly between virtually any city pair within the U.S., and EU carriers can do the same within EU boundaries. However, we have yet to see Continental schedule direct service between Delta's Atlanta hub and American's Dallas hub, or between US Airways' Charlotte hub and nearby Greenville. Similarly, Lufthansa has yet to operate direct service between BA's London Heathrow and AF-KLM's Paris CDG, or between Alitalia's Naples and Milan strongholds. The reason is generally not that these O-D pairs are unprofitable, but instead that airlines maintain domains of control where even the strongest competitors hesitate to enter. This control arises from the operational flexibility, larger local market share, and economies of scale that hubs provide.

Although U.S. carriers compete intensely, they are careful to focus their resources where least likely to become victims of overwhelming competitive response. The reality of competition is that players can price compete in every market until neither is profitable, but the social value of preserving many weak competitors is arguably lower than that of multiple competitive carriers.

Under a more liberalized regime, U.S. carriers are forced to compete internationally with strong network carriers on service while maintaining cost competitiveness with low-cost carriers. Their ability to further collaborate (and even merge) with foreign carriers might enable them to realize economies of scale and operational synergies for their increasingly global networks.

Impacts on Passengers

When discussing the impact of regulatory liberalization on the U.S. consumer, it is important to recognize that benefits to consumers as measured by fares, service levels (schedules, frequencies, destinations, quality of service) and safety, can be improved through increased competition, whether foreign or domestic.

Impacts on fares and safety are discussed in later sections, so here we address service levels. For the latter, Mazzeo (2003) demonstrates that increased competition is correlated with better on-time performance, which according to the author is the most common category of customer complaints regarding service quality. Other studies, including Douglas & Miller (1974), Rupp, Owens & Plumly

(2003) and Lee & Luengo-Prado (2003) support the hypothesis that increased competition is positively correlated with service quality.

Increased competition forces carriers to improve the efficiency of their operations and to improve services to capture greater market share of their largely commoditized product. A liberalized regulatory environment in which U.S. carriers face direct competition from international carriers with high service ratings would likely result in improved levels of service for U.S. travelers. A stronger domestic industry with access to cheaper capital allows U.S. airlines to invest in new services, products and aircraft while enabling competitive returns for shareholders.

Military Airlift

U.S. airlines volunteer to assist the Department of Defense (DoD) with supplemental airlift capacity in emergencies through the Civil Reserve Air Fleet (CRAF) program. In return, these carriers are granted preferred access to U.S. government peacetime airlift contracts worth over $2 billion per year in revenue (Bolkcom, 2006). In the past, DoD officials have raised concerns that foreign investors might discourage continued participation in CRAF or increase the likelihood of a carrier defaulting on its promise in times of need.

The concern is based on the fact that the U.S. government has more legal leverage over U.S. carriers than foreign carriers. It is true that the government could revoke the operating certificate of a non-compliant CRAF carrier, seize the needed aircraft and call up the carrier's reservist pilots to fly them. But truth be told, a U.S. airline with minority stake foreign ownership remains a U.S. airline and must operate according to U.S. law. While there is a viable concern that an airline could re-flag its international operations overseas to substitute lower-wage pilots (thus disqualifying those pilots from CRAF), there are legal means to prevent this. And if all else fails, the President has the authority under the Exon-Florio amendment to the Defense Production Act to block any transaction that poses a threat to national security.

Although the DoD concurs with the DOT's protections of CRAF, supporting the NPRM (U.S. DOT, 2006), Congressional officials still cite national security as a major concern. They often allude to the prohibitively expensive alternative to CRAF, having the DoD maintain the airlift capacity organically. A RAND study found that replacing CRAF's major theater capability of CRAF would cost about $3 billion annually (Gebman, 1994).

But some believe that "the government would save money if it paid U.S. carriers to participate in CRAF and then opened the government travel market to all qualified carriers" (Robyn et al., 2005). They are referring to the Fly America program, which provides incentive to U.S. carriers to participate in CRAF. Enacted in 1974 as part of the International Air Transportation Fair Competitive Practices Act, Fly America requires federal employees and their dependents, consultants, contractors, grantees, and others performing U.S. Government-financed foreign air travel to travel by U.S. flag carriers except where travel by foreign carrier is a matter of necessity (i.e. U.S. carrier service or codeshare is not available).

It is not clear that the government would even need to go that far. Not a single airline executive we interviewed indicated that they would withdraw from CRAF if Fly America were abolished. As one legacy airline executive put it, "CRAF is lucrative for us, and it would remain that way even without Fly America revenue." While provisions must certainly be put in place to ensure national security needs are met, the obstacle can be overcome.

Labor

Labor groups often cite the concern that increased foreign investment could put jobs at risk. The risk is particularly high for those U.S. pilots and crew on international routes who could easily be replaced by foreign, lower-wage crews. Labor unions fear that regulatory liberalization "would tend to eliminate international flying by U.S. carriers" which is the "most remunerative, and therefore the most desired, flying performed by pilots" (Woerth, 2006). The concern here is rooted in the fact that pilots in the EU15 earn about 15% less than their American counterparts, and that the disparity in wages with the 12 states that have since joined the EU is even greater (Robyn et. al, 2005). However, U.S. carriers are not able to replace U.S. flight crews for their domestic operations, which account for over 70% of total U.S. airline revenue (MIT ADP, 2008). Therefore pilots and crews maintain significant bargaining leverage to prevent carriers from shipping the most senior (i.e. desired) jobs overseas. That, of course, assumes that domestic job losses are not significant enough to depreciate labor's bargaining power.

Others believe that additional investment in U.S. airlines would strengthen the industry and stimulate domestic aviation employment. An airline's ability to acquire capital during times of financial difficulty would allow them to retire debt, consolidate services, and to enhance their competitive position rather than resorting to drastic cost-cutting measures. Labor concessions are less likely in the environment where cash shortages can be met, in the short term, by infusion of additional capital. A sustainable, financially viable U.S. aviation industry can moderate the impact of the historical cyclicality of the U.S. industry, providing greater stability for employees.

Still others take the view that changes in foreign ownership laws would not affect labor at all. The U.S. DOT, for example, has indicated that "due to existing collective bargaining agreements and other regulatory requirements governing U.S. airlines and their employees, the administration's proposal would not affect the rights of labor or the obligation of airlines with respect to labor" (Hecker, 2003). Either way it is important to cushion labor against possible losses resulting from regulatory liberalization.

Such protections should be built with cooperation from airlines and their labor unions. A stronger industry would benefit labor, but we have yet to see labor support for foreign ownership relaxation. Opposition to change in the status quo has been a consequence of uncertainty in the effects of policy change.

Safety

Some labor groups and Congressional officials have warned that regulatory liberalization could hurt aviation safety by (1) increasing competition that prompts spending cuts including those related to safety and by (2) increasing the FAA's oversight burden of carriers subject to different regulatory regimes (in the case of cabotage). In response to the first concern, we are reminded that U.S. airline deregulation prompted similar concerns in the late 1970s, however numerous studies have shown that deregulation had little or no adverse impact on safety (Bier, 2003 and GAO, 1996). In fact, airline safety as measured by death risk improved from 1 in 2.6 million to 1 in over 10 million following deregulation in 1978 (Barnett and Higgins, 1989).

The second concern would require an adjustment of regulations to ensure that the inevitable globalization of aviation improves, rather than hurts, aviation safety. Currently, EU carriers operating inside of the U.S. remain the regulatory responsibility of EU authorities. Under an OAA, Congress may impose direct FAA oversight for all aircraft operating in the U.S. Some officials are concerned that oversight of multiple regulatory standards would burden the FAA. However, this could be avoided if the FAA were to maintain its Bilateral Aviation Safety Agreements with any OAA partner and require that the FAA's safety standards be applied to foreign carriers. And if all else fails, the U.S. government has the authority to revoke the certificates of those foreign carriers and crews operating in the U.S. that fall short of safety requirements. As with concerns over national security, provisions can be put in place to ensure safety standards are met in a fully liberalized environment.

2.3 Stakeholder Analysis

Changes in legislation are generally contentious because it is difficult to build consensus for movement away from the status quo. In the United States, legislation is a product of elected officials that are accountable to constituents who seldom comprise a single viewpoint on a given issue. Legislation governing air transportation is no different, and in many respects more complex because it reflects a unique constituent makeup. Millions of Americans travel by air, and they are spread throughout every congressional district.

Travelers' interests are relatively simple to model – they are interested in low fares, safe and high-quality service, and an expansive network. Contention over legislation arises because the various air transportation stakeholders disagree on what action will generate the best balance of fares, safety, service quality and offerings. Table 6 summarizes the stakeholders that are considered in this research. Note that our analysis highlights those stakeholders with the most direct impacts resulting from regulatory liberalization or those most vocal in the debate. The following subsections present various stakeholder perspectives ranging from opinion editorials and anonymous executive opinions to formal positions of industry players.

Table 6: Major Stakeholders in the Debate Over Regulatory Liberalization

Stakeholder	Interests
U.S. Airlines	Have traditionally welcomed access to new markets & capital, although relaxed foreign ownership has not been unanimously supported
Foreign Airlines	Generally welcome exchange of market access and the ability to consolidate with U.S. counterparts to build stronger global networks, although there are notable exceptions
U.S. and International Airports	Welcome greater access to a wider array of destinations, including a larger volume of international flights
Dept. of Transportation/ Federal Aviation Administration	Have led increasing efforts to relax restrictions
Department of Defense	Has historically been concerned about reduced airlift capacity under CRAF, but has supported DOT's liberalization attempts since 2003
Labor Unions	Concerned about the impact of liberalization on U.S. airline jobs
Foreign Investors	Welcome opportunity to new investment opportunities
International Civil Aviation Organization	Has led increasing support for the relaxation of restrictive bilateral agreements
Organization for Economic Cooperation and Development	Supports economic cooperation and development between nations as well as regulatory liberalization, but has played a reduced role in the debate since the late 1990's
International Air Transport Association	International trade organization supports the economic growth (and strength) of its members, officially supports regulatory liberalization
European Commission	Has made liberalized foreign ownership a prerequisite for a 2nd stage Open Skies agreement
U.S. Congress	Serves multiple constituencies but has traditionally opposed increased foreign control of U.S. airlines
U.S. Travelers	Will bear most of the consequences and benefits from increased foreign ownership, including changes to fares, levels of service, safety, and quality of service

Airlines

From an operational standpoint, airlines in aggregate stand to benefit from regulatory liberalization, although some will certainly fare better than others. One impact of increased competition paired with reduced regulations may be the reduction of government handouts or bankruptcy protections to weaker players in a strong industry.[6] Handouts are a barrier to entry, an anticompetitive practice of making weak players stronger and limiting new entrants' ability to take their place. The opportunity for stronger players to buy out weaker ones (including their labor and capital assets) saves the taxpayer dollars (Dempsey, 2003) and fortifies U.S. carriers in an increasingly competitive global industry.

As we made the argument that foreign ownership and operational liberalization (i.e. Open Skies) cannot be decoupled, we must also address the effects of the latter. As Continental, Delta, Northwest, and US Airways begin new transatlantic service into London Heathrow, British Airways stands to lose some of its high-yield traffic. For a 10-20% fall in premium fares and 2-5% for leisure fares, BA could lose £120-260 million in profit, as estimated by ABN Amro in a July 2005 report. Yet BA, which ABN-Amro estimates makes 70% of its profits from the restricted transatlantic markets, has responded by identifying new profit opportunities afforded by the U.S.-EU deal. BA's OpenSkies subsidiary began operating nonstop service in June 2008 between New York and both Paris and Amsterdam.

In the rapidly changing airline industry, carriers must be quick to adapt to new regulatory and competitive landscapes in order to maintain profitability. The U.S.-EU Open Skies agreement has already prompted transformations from the industry's leaders, including attempts at consolidation, service improvements to attract high-yield traffic, and changes to route networks. Some executives we interviewed indicated that dollars previously spent petitioning the DOT for frequency allocations and lobbying foreign governments for liberalized access will instead be spent on maintaining competitiveness.

Apart from a few airlines concerned that recent liberalization events grant competitive advantages to a few players, the industry has collectively welcomed access to new markets and capital. In June, 2003, the Air Transport Association's (ATA) Board of Directors voted unanimously to support the DOT proposal for increased foreign ownership of U.S. airlines to 49%. A majority of the executives interviewed stated that while airlines do not necessarily have a need for access to global capital, bringing U.S. foreign investment regulations in line with those elsewhere would remain a prerequisite for international deregulation, of great importance to U.S. carriers faced with limited growth prospects in the domestic market.

In recent years, U.S. carriers have increasingly focused on international service. In aggregate, U.S. legacy carriers increased their international available seat miles (ASMs) relative to total capacity from 29.6% in 2002 to 37.7% in 2007 (MIT ADP, 2008). As a percentage of total ASMs, all six U.S. legacy carriers have moved or added a larger portion of capacity to international service relative to

[6] Note that economic recessions or the demand downturn following 9/11 are industry-wide and therefore government assistance is defensible to prevent systematic collapse of service.

domestic service since 2002, as seen in Figure 2.[7] Given fleet limitations, the LCC sector will likely continue to seek out codeshare agreements to leverage international revenue opportunities in the short-term. As the trend towards international service continues, airlines recognize that liberalization is essential to maintaining growth in the transatlantic and transpacific markets.

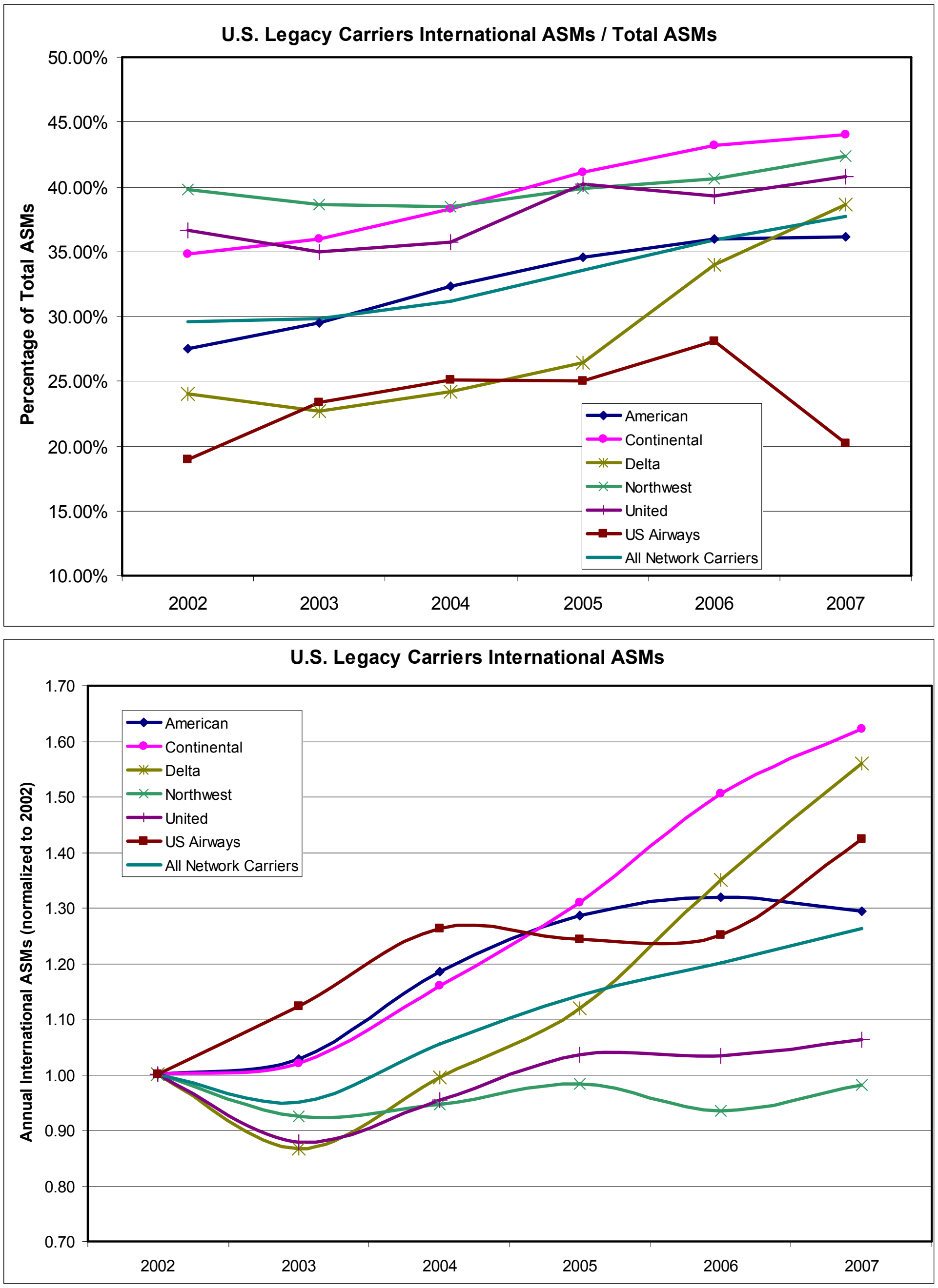

Figure 2: Growth in U.S. Legacy Carrier International Service Since 2002
(Source: MIT Airline Data Project and U.S. DOT Form 41, Schedule T2 via Bureau of Transportation Statistics)

[7] ASMs summed over all flights operated each year.

Alliances, Partnership and Mergers

Although arguably an extension of airlines, alliances represent important stakeholders certain to be impacted by regulatory liberalization. Many experts forecast that some of the biggest long-term changes resulting from the U.S.-EU Open Skies will be to alliances. Alliances have been used as a market-derived solution to foreign ownership restrictions and have proven that increasing integration among international carriers can lead to benefits for the consumer (GAO, 1995). The U.S. DOT is responsible for granting global partners antitrust immunity, which enables its members to cooperate in fare setting, capacity planning, and direct revenue or profit sharing. A U.S. DOT (2000) report found that strong traffic growth was coincident with receipt of antitrust immunity, even for those alliance partners already code-sharing.

However, the U.S. DOT only grants antitrust immunity to carriers in nations which have an Open Skies agreement in place with the U.S. Under the new U.S.-EU Open Skies agreement, many new airline partnerships will be eligible for immunity, further strengthening these global alliances. Yet consolidation of airlines may result in airlines switching alliances, such as Continental's recent decision to switch from SkyTeam to Star Alliance in October 2009. Furthermore, the Delta-Northwest merger is a testament to the role that existing alliances and immunized partnerships will play in the future makeup of the industry.

Because of the ability to grant antitrust immunities that were previously infeasible without Open Skies agreements, the DOT will be in a position to authorize new global strategic partnerships. A study by a U.S. Department of Justice (DOJ) economist suggests that capacity expansions associated with Open Skies are primarily due to expansion by immunized carriers on routes between their hubs (Whalen, 2005). The study predicts an increase in output for immunized alliances of 51-88% and of code-sharing by 22-45% as compared to traditional interline services. Whalen also predicts a 14-22% fare reduction for interline itineraries under immunized alliances and a 5-10% reduction for codeshare itineraries.

Airports

One airport executive asserted to us that "airlines serve the public to make money, whereas airports make money to serve the public." In other words, although airports are rational actors who seek profitability, the role of airport managers is to develop the greatest number of service options for the public. Airlines are responsible for maintaining the profitability of that service through operational decisionmaking, yield management, and promotion. Since most airports (particularly non-hubs) pursue international carriers, there are few airports that would not welcome additional carriers that are granted access as a result of Open Skies. As another airport manager said, "the number of service options is the most important factor for airports."

In November 2003, ACI-Europe published a position paper in support of the "full liberalization of the air transport industry." The paper highlighted twenty points in support of market determination of prices, code-sharing agreements, ground handling rights and eight other contentious issues. Most notably, however, ACI held that issues related to the granting of cabotage rights to EU carriers within the U.S. "should not in itself hold up a final agreement" for an OAA.

Some airports stand to gain more than others as a result of liberalization. Airports with high volumes of Fly America traffic, such as Washington Dulles (IAD), see these restrictions on government personnel travel as a major barrier to international carriers scheduling service to IAD. Currently, foreign airlines can only carry U.S. government traffic through a codeshare with a U.S. partner or under a few exceptional circumstances. Since Fly America limits the number of options government personnel and contractors can shop for, some project that the program raises the cost of travel to U.S. government personnel (Robyn et. al, 2005). Some airports have joined others who question the necessity of Fly America.

Other airports, such as those who serve as hubs for weaker carriers, are less excited about the long-term prospects of liberalization. European flag carrier hubs such as Athens or Vienna are the most likely target for new competition after the skies are open – they have strong O-D traffic and their hub carriers may be less capable of a strong competitive response. Such airports may see a loss in number of operations if their primary operator is absorbed by other carriers with little incentive to maintain the hub's original size.

U.S. Department of Defense

Modifying its 1992 position, the DoD supported the DOT in its 2003 attempt to liberalize foreign ownership. A report from the Institute for Defense Analyses (Graham, 2003) supported the DoD position that it could "effectively manage the CRAF program to meet national security requirements, even if the U.S. government were to raise the current ceiling on foreign ownership and control." The group suggested that the DoD build a risk-management framework to assess proposed changes in international regulatory regimes, with the two key risk management provisions being:

1. Eligibility criteria that ensure participating airlines can reliably meet their CRAF commitments, independent of their ownership.
2. Criteria for national security reviews of individual airline applications to increase foreign ownership shares beyond the current 25% ceiling. Such reviews could be done under the authority of current airline fitness reviews, or under the authority of the Committee on Foreign Investment in the United States.

Yet some in Congress still cite national security as their biggest concern with raising the foreign ownership cap. According to Rep. Peter DeFazio (D-OR), "during the Gulf War an EU member didn't supply [the U.S.] with a type of carrier we needed when we ran out because they didn't support the war" (Grassi, 2006). The DOT's Supplemental Notice of Proposed Rulemaking (SNPRM) addressed the issue by ensuring that all decisions that could impact national security would remain under the control of U.S. citizens. The DoD is satisfied with increasing the foreign ownership cap provided that the proper provisions are in place. And this should be of no surprise, since the DoD allows the maritime equivalent of CRAF, the Voluntary Intermodal Sealift Agreement (VISA), to include foreign-owned carriers.

European Commission

The EC has historically been the strongest proponent for liberalization of regulations governing transatlantic flights. In response to the House Transportation and Infrastructure Committee's move to tighten the 'actual control' provisions of the foreign ownership statutes, Jacques Barrot, the European transport commissioner, stressed that Congress' actions could "dangerously impair" the ability to enter into "a meaningful dialogue" during second stage negotiations between the U.S. and EU (Done and Cameron, 2007).

The EC sponsored both the Brattle Group and Booz Allen Hamilton studies that forecast optimistic growth in the transatlantic markets over the five years following the start of a liberalized regulatory regime. These, as well as other often-cited reports, were initiated to garner support for a full OAA between the EU and U.S. However, in light of the opposition that the DOT faced in increasing the ownership cap to 49%, EU officials agreed to a 1st Stage agreement, but have insisted that the 2nd Stage address liberalized foreign control. By agreement within the European Council, individual EU countries could demand suspension of certain rights granted by the Open Skies agreement if U.S. officials do not agree by 2012 to allow increased foreign investment in U.S. airlines.

Again, since cabotage rights are only granted to U.S.-incorporated airlines, the U.S. market provides little benefit to foreign airlines without effective control of operational decisions (including network planning). In other words, the EU's rationale reflects that of increased control rather than equity.

Organization for Economic Cooperation and Development (OECD)

Kenneth J Button, former head of aviation policy at OECD, published a 1998 study for CATO's Center for Trade Policy Studies in which he suggests that opening U.S. skies would inject capital and competition into the U.S. aviation market, providing the ultimate "free-market check on predatory pricing and domestic price collusion" and would therefore "negate any arguments for imposing federal price regulations and antitrust sanctions." Research sponsored by OECD holds that Congress should repeal all laws that restrict foreign participation in the U.S. air transportation market and that keeping the markets closed weakens the U.S. negotiating position abroad. Button points to the continued growth of alliances as proof that airlines have a desire to collaborate to achieve cost efficiencies and capture greater market share, which alliances only enable them to do to a degree (Button, 1998).

In a 2001 study, OECD concluded that air transport reforms aimed at liberalizing entry and prices result in "significant benefits for all categories of travelers" and that the simultaneous liberalization of domestic and international markets "encourages network optimization and cost-efficiency while reducing price-cost margins" (Gönenç and Nicoletti, 2001).

Labor Unions

Some believe that liberalized regulations would allow foreign carriers to direct U.S. carriers in ways that maximize their own economic objectives no matter what the cost to U.S. labor. Edward Wytkind, President of the Transportation Trades Department of the AFL-CIO, paints the picture of a European airline that has its newly acquired U.S. carrier feed traffic to its international flights rather than competing more broadly in the U.S. market or developing international services itself. Furthermore, Wytkind contents that foreign airlines with control over the maintenance decisions of a U.S. partner may ship work overseas to repair stations that fail to meet the high safety and security standards of the U.S. and EU (Wytkind, 2007).

In a letter dated September 20, 2006, six labor union leaders confronted Secretary-Designate Mary Peters on the DOT's NPRM, which they claimed gives companies "yet another tool to seek out and utilize the lowest cost labor available." They highlight that "airlines…could transfer pilot and flight attendant work to foreign partners" and that "air carriers have already pursued aggressive plans to outsource as much aircraft maintenance work as possible to overseas contractors" (Woerth et. al, 2006).

One concern of the Air Line Pilots Association (ALPA) is that the EU has yet to resolve its labor law issue, namely that all 27 member states have their own labor laws whereas the U.S. has one. Increasing foreign ownership would allow investors to move pilot and flight attendant domiciles to the most cost-effective labor zone (Bailey, 2003). The concern is that carriers would re-flag their transatlantic operations to lower cost EU countries, much like the "flags of convenience" prevalent in the maritime industry.

The counterargument is that we have yet to see a relevant airline case in the U.S. involving labor substitution or any indication that a U.S. carrier would have the desire or ability to re-flag its operations. And as discussed in Section 2.2, labor unions exercise significant leverage over management decisions and since U.S. carriers cannot replace U.S. flight crews for their domestic operations, labor maintains significant bargaining power to prevent carriers from shipping jobs overseas.

The EU itself can be used as a case study demonstrating the ability of any nation to protect its own labor against direct or indirect wage substitution. While the EU as a whole has moved towards an OAA in recent years, member states are increasingly building protections into their operating laws. France, for example, requires that any carrier maintaining a hub in France or operating full cabotage flights within French borders must obey French labor laws.[8] U.S. pilots have often been able to negotiate similar protections, without the aid of government regulation, against the risks that alliances and cross-border mergers have created.

Labor unions are best equipped to negotiate protections specific to their circumstances. Lawmakers must work to incorporate protections that address labor's concerns and be careful not to interpret their concerns as a blanket justification for protectionism.

U.S. Travelers

As the end-user of the air transportation system, U.S. travelers bear most of the consequences and benefits from regulatory liberalization. Despite varying levels of enthusiasm for domestic deregulation in 1978, "nearly all economists agree…that deregulation [improves] consumer welfare" (Borenstein, 1992). However, the debate continues over what these consequences and benefits of international deregulation will be – the most frequently cited changes are to fares, service levels and safety. The latter was covered in previous sections, so here we discuss fares and service levels.

American travelers might typically view the U.S.-EU Open Skies agreement as an opportunity for their cities to receive nonstop service to Europe. However, it has yet to be determined what the specific impact on networks and service levels will be. One certainty is that reduced regulation allows for increased competition with the removal of barriers to entry into (or expansion of) particular markets.

One concern is that secondary and tertiary domestic market coverage may be reduced as airlines are forced to focus on their most profitable segments. This, however, is based on the assumption that capital resources are increasingly limited. According to the executives we interviewed, if a market is profitable enough to meet an airline's cost of capital, the capital is available to serve it. Carriers that have the ability to seek cheap capital and leverage cost-cutting synergies are better equipped to serve smaller markets, provided that they produce positive returns.

According to Boeing, as of 2004 there remained an additional 114 city pairs between the U.S. and EU that could support non-stop services with a 250-seat aircraft (GAO, 2004). However, an increase in

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[8] French Décret No. 2006-1425, November 21, 2006

new entrants and services may be damped by the effects of consolidation, competitor domains and slot restrictions. All three phenomena limit a carrier's ability or willingness to add capacity to new city-pairs, especially where it requires cannibalization of other profitable service.

Fares have the potential to be lower as competition increases. GAO (1996) found that fifteen years after deregulation, the average fare per passenger mile, adjusted for inflation, declined 9% for small-community airports, 11% for medium-sized community airports and 8% for large community airports. According to Alfred Kahn, who chaired the CAB during the transition to deregulation, deregulated fares have been 10-18% lower, on average, than they would have been under the previous regulatory environment (Kahn, 1988). Both sources note that safety and service levels increased over the same period.

However, some U.S. officials fear that fares would rise if the number of network carriers in the U.S. decreases, and that the goal of preserving competition can be met by preserving competitors. This fear is based on the assumption that a larger number of competitors is always better for the consumer. But well-known cases such as UPS and FedEx, Coke and Pepsi, or Boeing and Airbus demonstrate that as few as two players can meet the service needs of the entire market and compete even more fiercely than a palette of six or more.

Since 2000, all six major U.S. carriers have engaged in consolidation talks with other domestic carriers. Airline executives have made clear their intentions to expand their networks and find cost synergies that would strengthen their competitive positions in the global marketplace. In April 2008, the first of the legacy mergers, between Delta and Northwest, was signed. The two airlines have since cleared all major regulatory hurdles and have begun integrating their operations. For months however, it was unclear whether regulators, backed by vocal opposition from Congress, would ultimately approve the merger. Those in Congress who oppose consolidation are also those who oppose changes in foreign ownership. They often cite lost service to secondary markets as a major concern of consolidation. However, their argument presupposes that leisure and business travelers prefer increased frequency choices to lower fares brought about by increased competition. It assumes that those in secondary or tertiary markets are unwilling to drive 100 miles to avoid a natural price premium of hundreds of dollars. American and European low-cost carriers (LCCs) are proving otherwise.

Overall, the question is whether regulatory behavior that limits consolidation, international collaboration and the natural life-cycle of the industry actually preserves competition.

2.4 Stakeholders and the Policy Debate

In debates over which policies equitably distribute the benefits and costs of change, stakeholders seldom agree and are therefore forced to compromise on issues. In the case where stakeholders do not even agree what the impacts of a given policy change will be, resolution over the debate becomes exceedingly difficult. In this debate over regulatory liberalization in air transportation, many studies have produced evidence suggesting that national security, employment and safety will not be harmed if the appropriate policy safeguards are used. In addition, there is consensus that competition will increase both at home and abroad. Why then, is there still debate over the appropriate policy?

The issue here is that movement away from the status quo into uncharted territory requires overwhelming evidence in support of change. In this particular case, historical precedent plays an important role in garnering support for the issue. In addition, the increasing attention paid to the issue by government, industry and academia brings the issue into the public domain, which then provides additional pressure to change legislation. At no time since deregulation have so many called for change in the industry, including lawmakers. Congressional officials are responsible to their constituencies, so over the long-term policies will change in favor of the electorate.

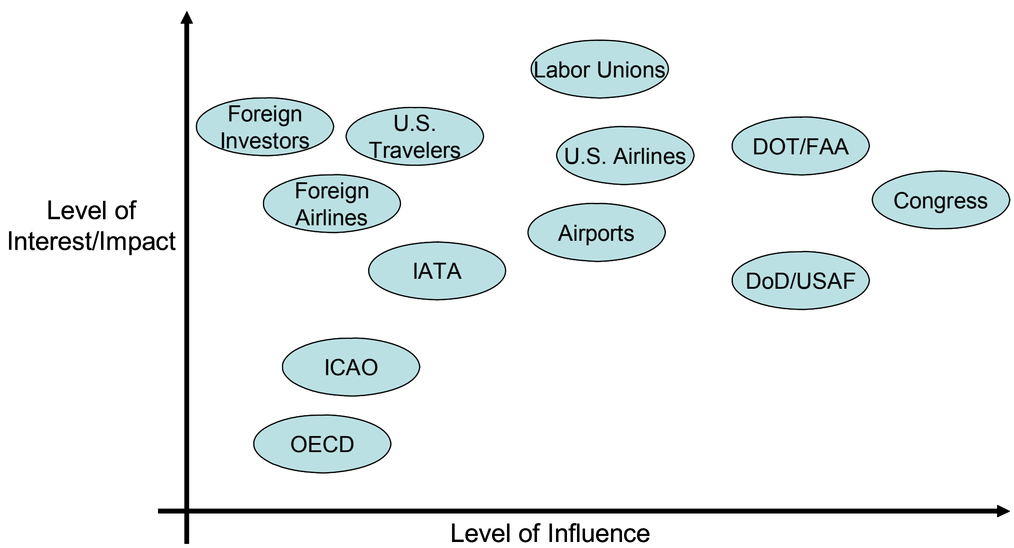

Figure 3: Levels of Stakeholder Interest and Influence in the Debate Over Regulatory Liberalization

Figure 3 plots the stakeholders with the most direct impact and/or influence in the debate. The vertical axis represents the level of interest that a given stakeholder has in the issue, which is correlated to the level of impact regulatory liberalization will have on that stakeholder. The horizontal axis describes the level of influence that a stakeholder has over regulatory change, either through lobbying or direct legislation.

Since regulations are products of government, we can expect U.S. government agencies to bear the greatest influence in change, although the lobbying power of airlines and labor unions certainly plays an influential role in the debate. International organizations tend to have a lower aggregated interest (and influence over U.S. regulations) because it is often difficult to reach consensus across national borders.

2.4.1 Vehicles for Legislative Change

As Nanda (2002) concludes, foreign investment laws are governed by statute and hence any change to the rule could only be made through legislative action. While the U.S. DOT has attempted to revise the interpretation of existing statues to meet the demands of globalization, Congress has blocked its attempts on numerous occasions.

In a 2003 whitepaper, Havel (2003) suggests that airline citizenship tests be replaced by a new "corporate affinity test" which separates commercial control by a foreign investor from regulatory control by the U.S. government. He develops a framework for deregulation which keeps safety and security issues in public hands. While a novel approach to addressing issues of safety and security, this policy alternative still requires movement from the status quo for the entire commercial aviation industry.

Some have suggested that regulatory liberalization be tested on a subset of the industry. The International Air Cargo Association (TIACA) and ACI support the rapid liberalization of cargo traffic (TIACA, 2003). Furlan (2005) forecasts some expected benefits should the industry liberalize ownership regulations. He recommends that air cargo be used as the "natural starting point for the process and should lead liberalization efforts," as should agreements between the U.S. and EU as comparable economic powers. Zhang and Zhang (2002) contend, however, that liberalizing the air cargo sector separately may be difficult because of the "distinctive inter-linkage of passenger and air cargo business" in some parts of the world.

As part of the U.S.-EU Open Skies Stage 2 negotiations, the DOT could attempt to focus its liberalization efforts on cargo carriers to generate additional evidence that liberalization is not harmful to national security, safety or employment. Alternatively, the DOT could push for piecewise liberalization that grants ownership freedoms to carriers with primarily domestic operations, such as some American LCCs. The Australian government has led the movement towards liberalization with its understated realization that benefits to the people of Australia can come from any shade of currency.

If not from the lessons of other nations, U.S. policymakers can reflect on other American industries with similar labor and security concerns as well as issues of national pride. The movement towards deregulation in auto manufacturing, banking, passenger and freight rail and utilities reflects the changing needs of the global marketplace. Rod Eddington, former Chief Executive of British Airways, once pointed out the irony that airlines, which are enablers of globalization in virtually every industry, themselves remain "stuck in a time warp of bilateral agreements" (Eddington, 2003).

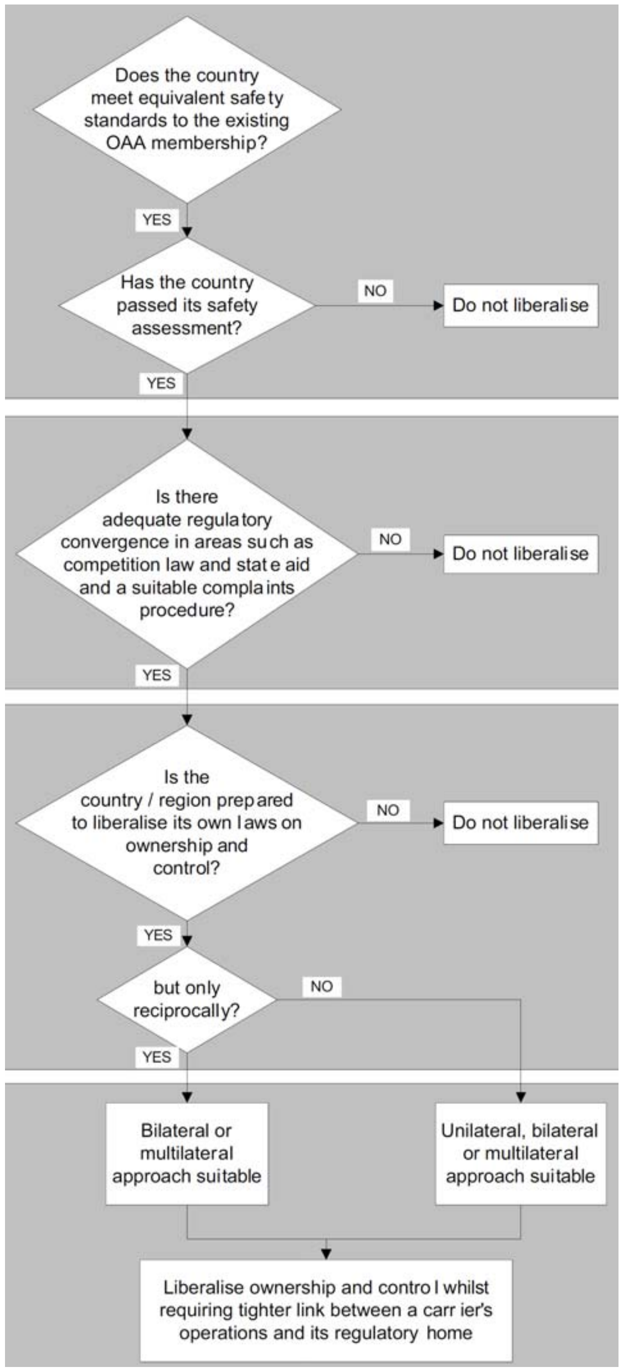

Figure 4: Pathway to Liberalization
(Source: Civil Aviation Authority, 2006)

No matter what the legislative vehicle, it is possible to incorporate protections against threats to national security, safety, overburdens of regulatory oversight, and disproportionate impacts to labor. The Civil Aviation Authority (CAA) included a "Pathway to Liberalization" (Figure 4) in its 2006 report on Ownership and Control Liberalization. The pathway includes checks to ensure that compliance with domestic regulations is met and that liberalization is limited to those nations willing to grant reciprocity. This is required to ensure that U.S. carriers are granted the same rights as their international competitors. The CAA's methodology fails to address issues of labor and national security, but it provides a framework within which policy can be shaped.

2.5 Policy Conclusions

On March 30th 2008, the U.S.-EU markets opened up to increased competition. As a result, U.S. carriers are preparing to face stronger competition from the EU. As globalization continues, the air transportation industry becomes less of a domestic business. The networks are global and regulations are beginning to adapt to reflect that. As we will see in Chapter 4, service level changes immediately following the removal of restrictions represent inefficiencies and lost opportunities that result from regulation. Markets are better equipped than any regulatory regime in dictating how service industries should adapt to change. And the evolution of an industry dictated by market forces, by definition, includes elements of popular interests, those which provide the greatest economic benefit and social welfare with the least deadweight loss.

In this chapter we have seen that, apart from uncovering operational inefficiencies, regulatory liberalization could grant U.S. carriers access to cheap capital to retire debt, consolidate, and invest in their product, enhancing their competitive position globally. Further immunization, joint ventures and cross-border consolidation allow carriers to develop their global networks to better serve the traveling public. Expanded global networks from financially stronger carriers will better connect U.S. businesses to the world while delivering economic synergies for investors.

Numerous studies have shown that, with the appropriate legislative safeguards, removing regulations generates a social benefit that far outweighs its cost. In the next Chapter, we will explore recent trends in competition between U.S. carriers and their European counterparts. We will see that U.S. carriers have gained a disproportionate share of transatlantic service, based primarily around their hub operations. In Chapter 4, we analyze the specific impacts that liberalization events have had upon transatlantic service levels. Both of these chapters support the conclusion that liberalization is necessary to uncover operating inefficiencies and leverage growth opportunities. We will also see, however, that liberalization alone is not sufficient in guaranteeing increased service levels.

Chapter 3

Analysis of Transatlantic Markets and Competition

In this chapter we evaluate transatlantic competition since 2000 and highlight market changes that have occurred over the same period. The goal is to identify trends in competition and market service levels to then evaluate in the context of policy changes over the same period. We first explore American and European cities and their respective levels of service. Next, we investigate aggregate competition between U.S. and non-U.S. carriers. We then discuss the increasing reliance on hubs as a focal point of transatlantic route networks.

The primary data source for the analyses presented in the next three chapters is the Air Carrier Statistics database, also known as the T-100 data bank, of the U.S. Department of Transportation. The database contains all international nonstop segment data for certificated U.S. air carriers and foreign carriers having at least one point of service in the U.S. or one of its territories. Flights with both origin and destination in a foreign country are not included. Data is reported monthly and includes carrier, origin city and airport, destination city and airport, aircraft type and service class for transported passengers, freight and mail, available capacity, scheduled departures, departures performed, aircraft hours, and load factor. International flight data is released by the Bureau of Transportation Statistics' Office of Airline Information on a six month delay.

In July 2007, there were 30 U.S. cities and 52 European cities with transatlantic service.[9] Although a number of cities have gained or lost service since 2000, this ratio has remained virtually constant throughout. In our analysis we use three points in time to identify trends and evaluate changes: 2000, 2004 and 2007. For most metrics, we use data from July of each year since summer tends to experience peaks in traffic and number of seasonal destinations across the Atlantic. July 2000 reflects the period prior to the demand downturn following the terrorist attacks of September 11th, 2001. By July 2004 much of the demand downturn and subsequent capacity cuts had recovered to pre-9/11 levels. We use July 2007 as our third time point in order to avoid the sudden effects on capacity and traveler behavior as a result of skyrocketing oil prices in 2008. In July 2007, oil was still priced below $80 per barrel and airlines, although still affected, were able to maintain status quo service levels.

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[9] Here we consider only scheduled commercial passenger service (as opposed to cargo-only or charter service) that is offered a minimum of four times per month (i.e. weekly).

3.1 Cities and Destinations

In July 2000, 29 U.S. cities had nonstop service to at least one European city. By July 2007, that number grew to 30. These cities are listed in Table 7. Note here that multi-airport systems within a Combined Statistical Area (CSA) are listed as one city. For our analysis, Ft. Lauderdale is considered to be part of the Miami market, Sanford part of the Orlando market, Oakland part of the San Francisco market and Baltimore part of the Washington, DC market. In addition, Newark Liberty International (EWR) and John F. Kennedy International (JFK) together comprise the New York City market.

Table 7: U.S. Cities with Direct Transatlantic Service, 2000-2007

U.S. Metropolitan Area	CSA Population 2007[10]	2000 Destinations	2004	2007
Anchorage, AK	359,180	2	1	1
Atlanta, GA	5,626,400	15	15	23
Boston, MA	7,476,689	13	12	15
Charlotte, NC	2,277,074	3	3	3
Chicago, IL	9,745,165	22	20	20
Cincinnati, OH	2,176,749	4	5	5
Cleveland, OH	2,896,968	1	1	1
Dallas/Ft.Worth, TX	6,498,410	4	4	4
Denver, CO	2,998,878	1	2	3
Detroit, MI	5,405,918	7	5	6
Fairbanks, AK	51,926	**0**	1	1
Ft. Myers, FL	623,724	2	2	2
Hartford, CT	1,306,151	**0**	**0**	1
Houston, TX	5,729,027	4	5	4
Las Vegas, NV	1,880,449	2	2	4
Los Angeles, CA	17,755,322	10	9	9
Memphis, TN	1,280,533	1	1	1
Miami, FL	5,413,212	12	9	9
Minneapolis/St. Paul, MN	3,538,781	3	3	3
New York, NY	21,961,994	41	38	51
Orlando, FL	2,693,552	4	6	7
Philadelphia, PA	6,385,461	7	11	19
Phoenix, AZ	4,179,427	1	1	1
Pittsburgh, PA	2,446,703	3	2	**0**
Portland, OR	2,159,720	**0**	1	1
Raleigh/Durham, NC	1,635,974	1	1	1
San Francisco, CA	7,264,887	7	5	6
San Juan, PR[11]	2,509,007	3	1	1

[10] U.S. Census Bureau

Seattle, WA	4,038,741	4	4	4
St. Louis, MO	2,866,517	2	**0**	**0**
Tampa, FL	2,697,731	2	1	1
Washington, DC	8,241,912	12	14	13

By July 2004, Fairbanks AK and Portland OR had both gained transatlantic service to Frankfurt. Portland's daily FRA service was provided by Lufthansa and Fairbanks' weekly service was offered seasonally by German holiday carrier Condor Flugdienst. However, St. Louis MO had lost both its London and Paris daily service operated by Trans World Airlines (TWA). This loss happened shortly after 2001, when TWA was acquired by American Airlines, which subsequently downsized the hub operation at St. Louis. Over this period, seven cities saw an increase in transatlantic destinations whereas thirteen saw reductions.

By July 2007, Hartford CT had gained nonstop daily service to Amsterdam offered by Northwest Airlines.[12] However, Pittsburgh PA had lost its daily nonstop flights to Frankfurt, London and Paris, all previously operated by US Airways. These losses occurred after Pittsburgh lost its US Airways hub status in 2004 following an operating fee dispute between the airport authority and the carrier. Over this period, nine U.S. cities saw an increase in transatlantic destinations whereas only three saw reductions.

Since 2000, fifteen European cities have gained their first transatlantic service while seven have lost all transatlantic service. Of the fifteen that have seen new service, seven received service from U.S. carriers. Of the seven that have lost all transatlantic service, only one was a result of a U.S. carrier pulling out of that market (Delta in Lyon). Furthermore, since 1990 an additional six European cities have lost all transatlantic service. They are Nantes, Bordeaux and Lille (in France), Zagreb and Dubrovnik (in Croatia) and Luxembourg (in Luxembourg). None of these cities were served by U.S. carriers.

Table 8: European Cities with Direct Transatlantic Service, 2000-2007

European City[13]	Urban Area Population[14]	2000 Destinations	2004	2007
Amsterdam, Netherlands	6,579,720	15	16	17
Athens, Greece	3,829,018	3	1	3
Barcelona, Spain	4,959,864	2	2	3
European City	**Urban Area Population**	**2000 Destinations**	**2004**	**2007**

[11] Puerto Rico is included since U.S. territories are covered by U.S. aviation bilateral agreements.
[12] This service was cancelled by NWA in October 2008 citing high fuel costs and decreased demand. In December, NWA announced it would restore the transatlantic service beginning June 2009.
[13] Note here that multi-airport systems within an urban area are listed as one city. For our analysis, London is composed of Heathrow (LHR), Gatwick (LGW), Stansted (STN) and Luton (LTN) airports. Paris is composed of both Charles de Gaulle (CDG) and Orly (ORY) airports.
[14] 2008 World Gazetteer data from Eurostat. 2007 data not available.

Belfast, United Kingdom	645,536	**0**	**0**	2
Belgrade, Serbia and Montenegro	1,766,534	**0**	1	**0**
Berlin, Germany	4,040,690	**0**	**0**	1
Birmingham, United Kingdom	3,704,574	2	1	1
Bologna, Italy	385,813	**0**	**0**	1
Bristol, United Kingdom	551,066	**0**	**0**	1
Brussels, Belgium	2,175,008	6	4	6
Bucharest, Romania	2,192,372	1	**0**	1
Budapest, Hungary	2,578,731	1	1	1
Connaught, Ireland	503,083	**0**	**0**	2
Copenhagen, Denmark	2,387,192	3	4	5
Dublin, Ireland	1,058,265	5	6	6
Dusseldorf, Germany	11,817,132	7	6	8
Edinburgh, United Kingdom	1,250,000	**0**	1	2
Frankfurt, Germany	3,133,739	20	22	20
Geneva, Switzerland	470,000	1	1	1
Glasgow, United Kingdom	1,633,187	2	3	4
Hamburg, Germany	3,266,896	**0**	**0**	1
Helsinki, Finland	1,262,805	1	1	1
Istanbul, Turkey	13,179,865	3	2	2
Kiev, Ukraine	2,989,638	1	1	1
Koeln/Bonn (Cologne), Germany	11,817,132	**0**	**0**	1
Krakow, Poland	756,757	2	2	2
Lisbon, Portugal	2,634,878	2	1	2
Liverpool, United Kingdom	5,019,446	**0**	**0**	1
London, United Kingdom	13,063,441	25	24	23
Lyon, France	1,798,395	1	**0**	**0**
Madrid, Spain	6,270,551	7	6	8
Malaga, Spain	561,250	**0**	1	**0**
Manchester, United Kingdom	5,019,446	5	8	7
Milan, Italy	4,308,403	8	6	6
Moscow, Russia (European)	14,744,150	4	4	4
Munich, Germany	2,312,477	7	10	12
Naples, Italy	3,817,076	**0**	**0**	1
Nice, France	915,000	1	1	1
Oslo, Norway	568,809	1	1	1
Palermo, Italy	1,000,820	**0**	**0**	1
Paris, France	11,818,503	16	13	14
Pisa, Italy	90,482	**0**	**0**	1
Porto, Portugal	1,299,713	1	**0**	1
Prague, Czech Republic	1,406,142	1	1	2
Reykjavik, Iceland	201,000	4	5	5
Riga, Latvia	727,578	**0**	**0**	1
European City	**Urban Area Population**	**2000 Destinations**	**2004**	**2007**

Rome, Italy	3,858,111	6	7	7
Rzeszow, Poland	740,000	**0**	**0**	1
Santiago De Compostela, Spain	92,919	1	**0**	**0**
Satu Mare, Romania	130,059	1	**0**	**0**
Shannon, Ireland	9,222	6	6	5
Stockholm, Sweden	1,964,805	2	2	3
Stuttgart, Germany	2,334,683	1	1	1
Terceira, Portugal	54,996	1	**0**	**0**
Timisoara, Romania	359,132	1	**0**	**0**
Venice, Italy	297,743	1	1	3
Vienna, Austria	2,113,619	3	2	4
Warsaw, Poland	2,251,474	2	2	2
Zurich, Switzerland	1,025,499	10	8	10

So, in aggregate, U.S. carriers' presence in Europe has increased since 2000 despite service losses in thirteen European cities. Figure 5 and Figure 6 confirm that U.S. carriers have in fact gained a disproportionate share of new service between the U.S. and Europe.

In 2000, 43 European cities were connected nonstop to the U.S. Non-U.S. carriers served over 90% of those destinations, whereas U.S. carriers only served 60%. In 2007, the number of European destinations had grown by 20% to 52. However, both U.S. and non-U.S. carriers now serve 80% of those destinations.

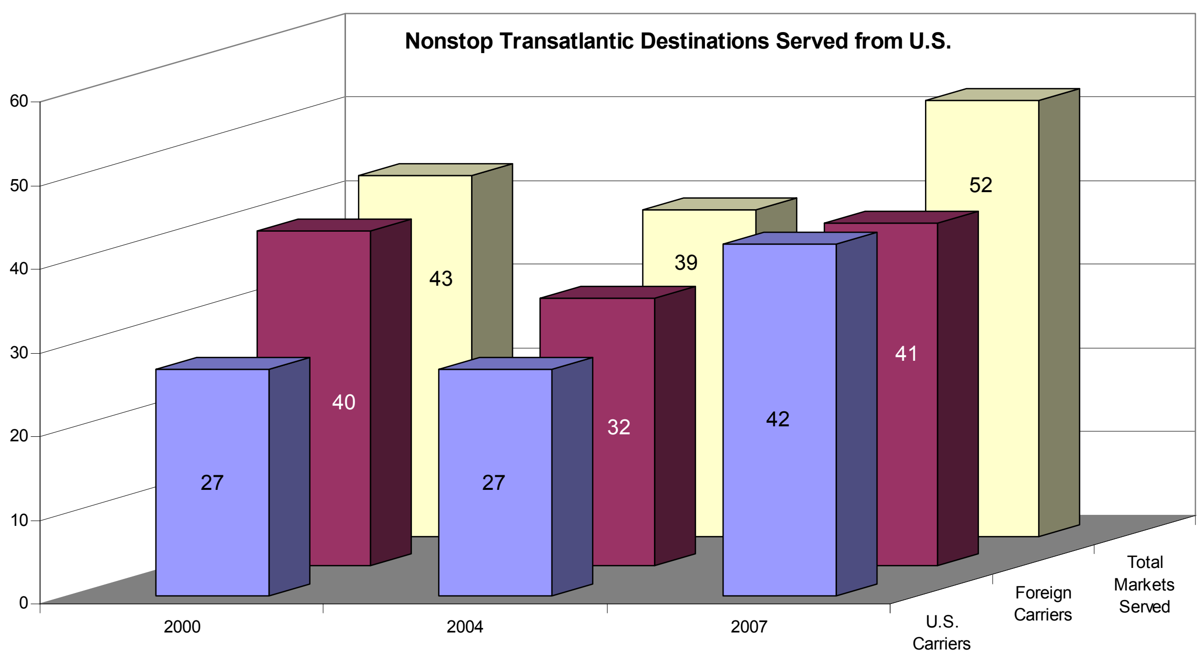

Figure 5: Number of Nonstop Transatlantic Destinations Served from U.S.

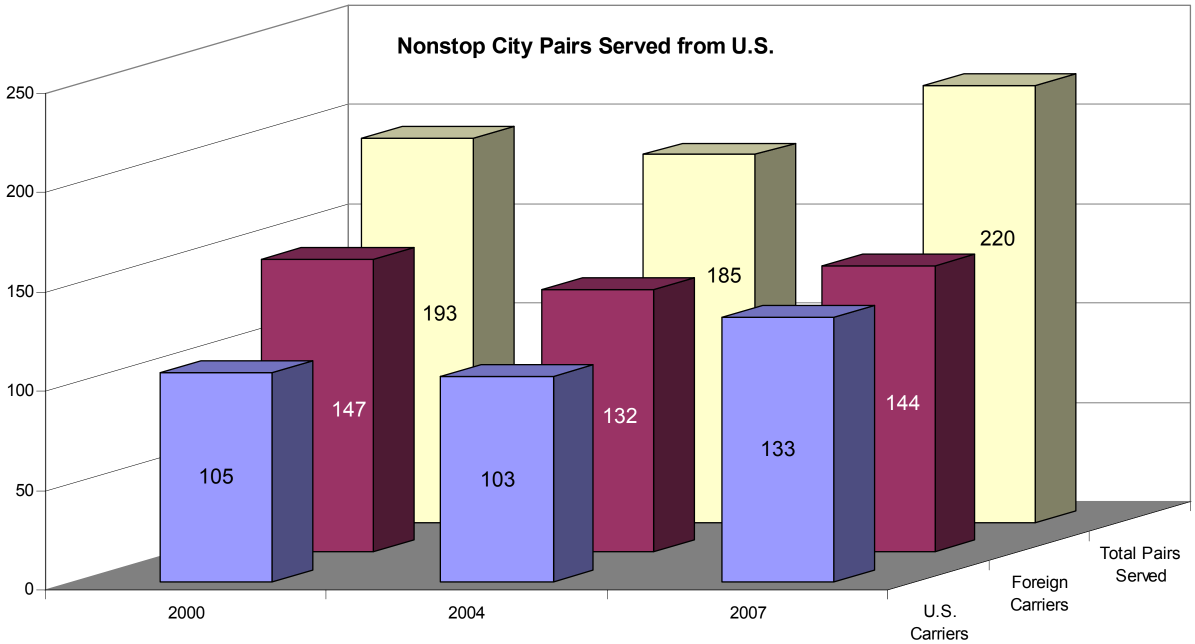

Figure 6: Number of Nonstop City Pairs Served from U.S.

The story is similar if we look at the number of nonstop city pairs served between the U.S. and Europe. In 2000, 193 city pairs had scheduled passenger transatlantic service at least once per week. Just over half were served by U.S. carriers whereas over three-quarters were served by non-U.S. carriers. In 2007, the number of city pairs had grown by 14% to 220. But by 2007 U.S. carriers served 60% of those city pairs and non-U.S. carriers served 65%.

U.S. carriers have therefore gained a disproportionate share of transatlantic service since 2000. In other words, much of the transatlantic service gains have come from U.S. carriers while service losses have generally occurred at the expense of European carriers.

3.2 Departures, Enplanements, Load Factors and Aircraft Size

We now turn our competitive analysis to traditional airline metrics that include the number of departures performed, total enplanements, average load factor and aircraft size. Although the performance of individual carriers may be interesting, here we focus on aggregate competitiveness of U.S. and non-U.S. carriers since bilateral agreements are established between nations rather than for specific carriers. The goal again is to understand the change in makeup of transatlantic services and to find trends that correlate (or fail to correlate) with policy events.

Figure 7 breaks out the number of transatlantic departures performed by U.S. and non-U.S. carriers in July of 2000, 2004 and 2007. The first thing to note is that the total number of monthly departures has increased by 13.5% from 11,258 to 12,779. This is in line with the 14% increase in city pairs over the same period, indicating that on average the number of departures per city pair has not changed drastically. Most importantly, perhaps, is that a 46%/54% departure share between U.S/non-U.S carriers in 2000 is now a 50%/50% split.

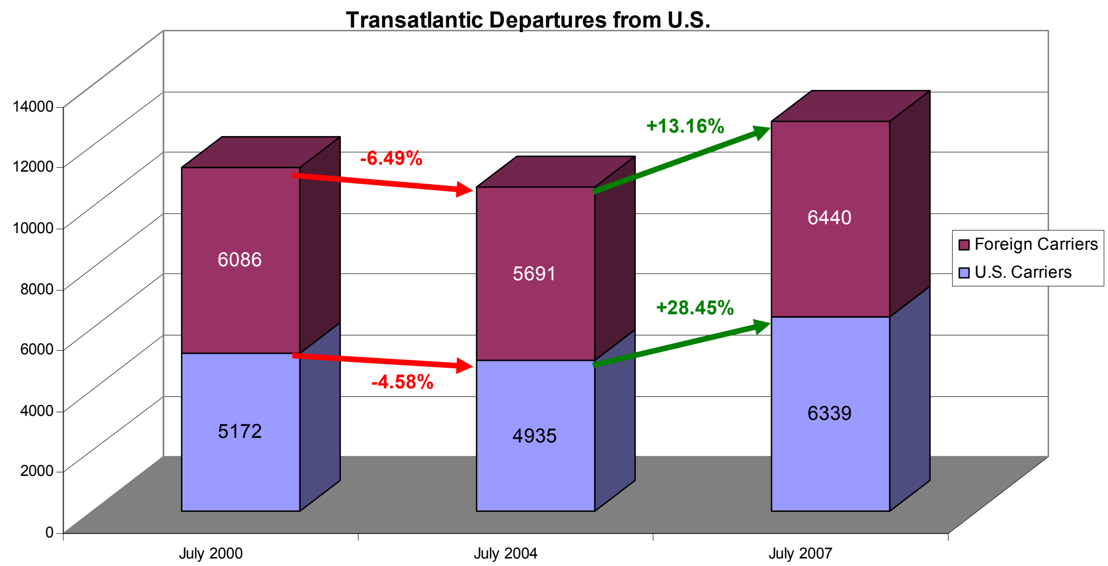

Figure 7: Number of Transatlantic Departures from U.S.

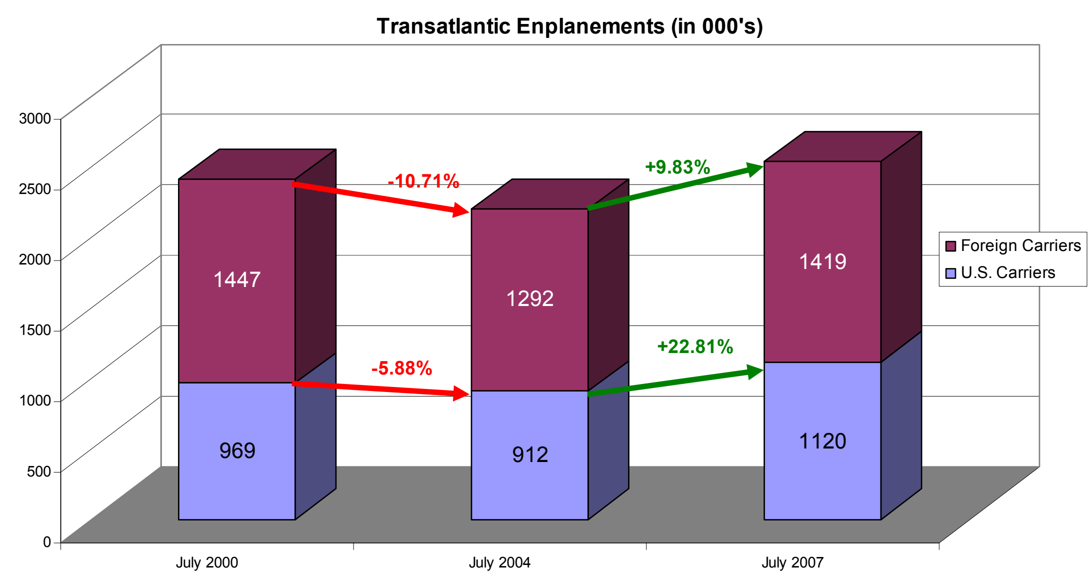

Figure 8: Number of Transatlantic Enplanements from U.S.

However, non-U.S. carriers continue to enplane nearly 27% more transatlantic passengers than U.S. carriers, as seen in Figure 8. In July 2007, non-U.S. carriers enplaned 56% of 2,539,000 passengers with U.S. carriers enplaning the remaining 44%. Although U.S. carriers have grown their total number of transatlantic departures and enplanements since 2004 at over twice the rate of their non-U.S. counterparts, the aggregate share of enplanements is still significantly lower.

Since the number of departures is identical, yet the number of passengers carried by non-U.S. carriers is 27% higher, U.S. carriers enplane fewer passengers per departure. This difference is either a result of lower average load factors (ALF) or smaller aircraft, or a combination of the two. Figure 9 clearly shows that ALFs are not the issue as U.S. and non-U.S. carriers had ALFs within one percentage point of each other. In fact, load factors have converged between the two groups since 2000.

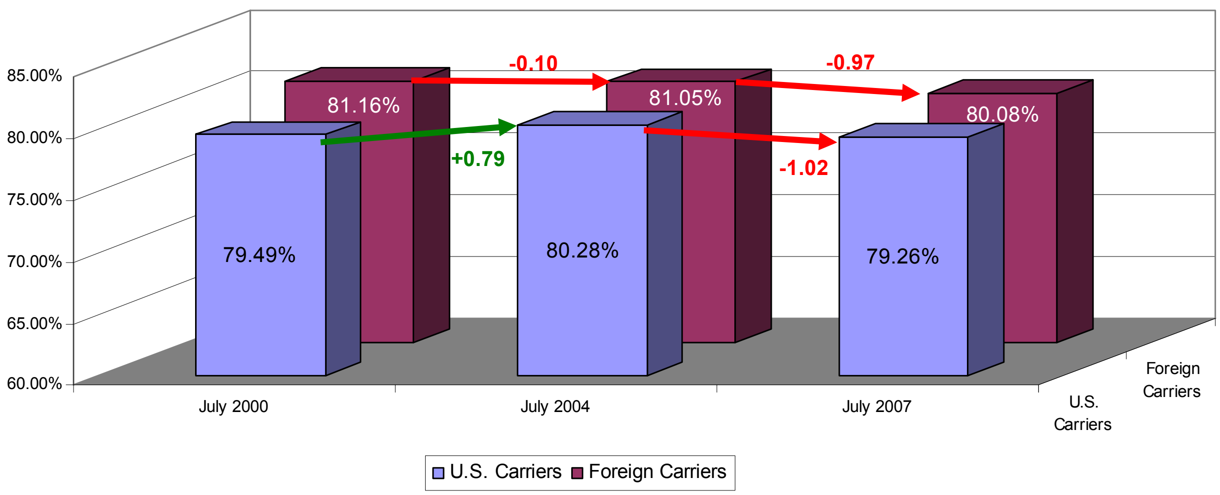

Figure 9: Transatlantic Average Load Factors, 2000-2007

The difference is therefore likely a function of the total capacity per departure (i.e. aircraft size). If we look first at total capacity as measured by seat-departures[15], Figure 10 shows that non-U.S. carriers perform 25% more seat-departures than their U.S. counterparts. U.S. carriers have only 44% of the total transatlantic capacity of 3,185,000 monthly seat-departures.

[15] Note that here we use seat-departures rather than available seat miles (ASM) in order to avoid weighting by the stage length of individual flights.

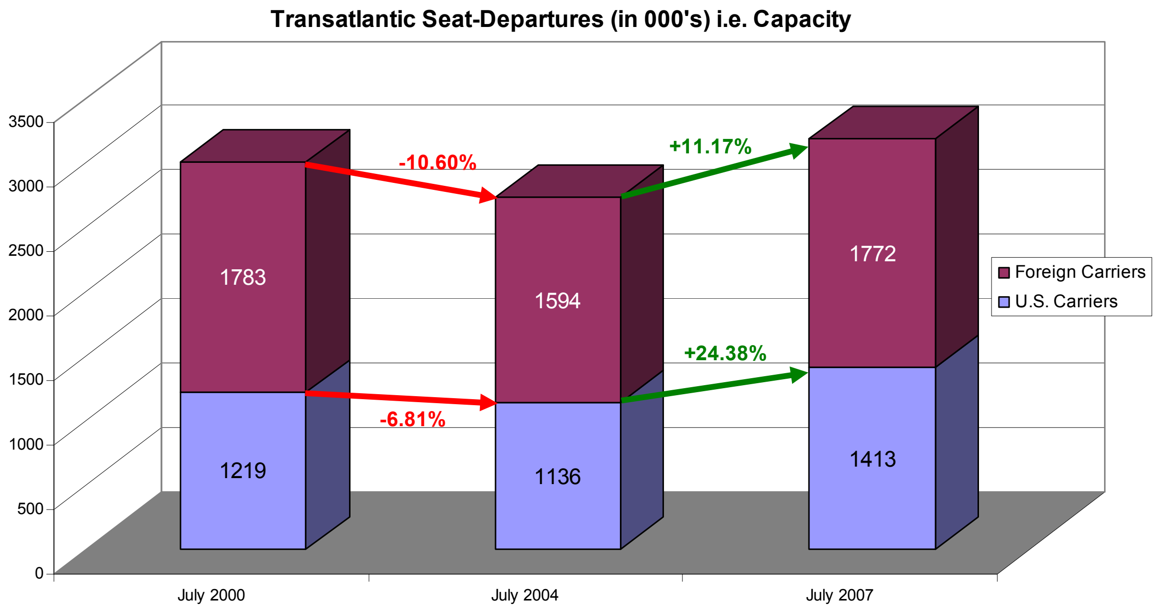

Figure 10: Number of Transatlantic Seat-Departures from U.S.

Figure 11 confirms our theory and shows that, on average, U.S. carriers carry 52 fewer seats per aircraft than their non-U.S. counterparts for transatlantic service. This reflects a 6% reduction in average aircraft size for both U.S. and non-U.S. carriers since 2000. It is worth noting that the overall trend has been towards smaller aircraft as larger markets become saturated and carriers compete on frequency share. One interesting phenomenon to watch is whether carriers with long-range fleets composed of smaller aircraft find it more feasible to add service as thinner transatlantic markets seek nonstop service.

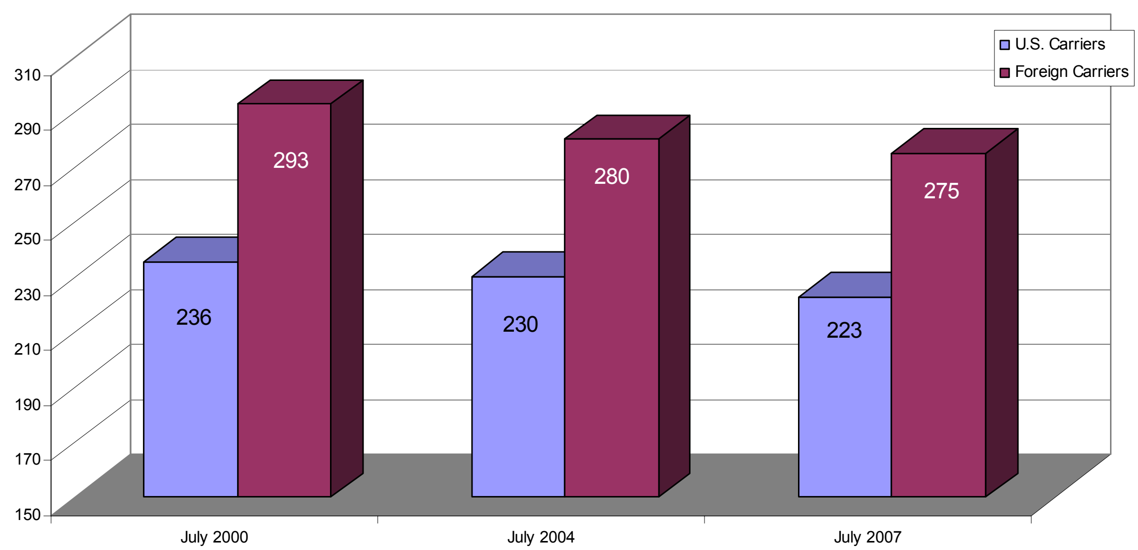

Figure 11: Average Aircraft Size for Transatlantic Service, 2000-2007

We have seen that, although U.S. carriers have gained a disproportionate share of transatlantic destinations and departures, they continue to enplane fewer passengers than non-U.S. carriers. This is a result of lower capacity per departure, or smaller average aircraft size. As our analysis does not consider fares, yields or operating costs, we will not explore the profitability of U.S. carriers relative to non-U.S. carriers. However, we can assume that in an unregulated environment, carriers will fly routes that are profitable to them. We can therefore proceed with the assumption that any gains in transatlantic service following deregulation policy events are to the benefit of the operating carriers.

3.3 Competition Across Transatlantic Markets

Before we turn our attention to the role that regulatory liberalization has had on transatlantic service levels, we first analyze levels of competition in individual nonstop markets. Although in aggregate transatlantic service levels have increased since 1990, not all communities have gained equally. We therefore explore market competition across city pairs, summarized in Figure 12.

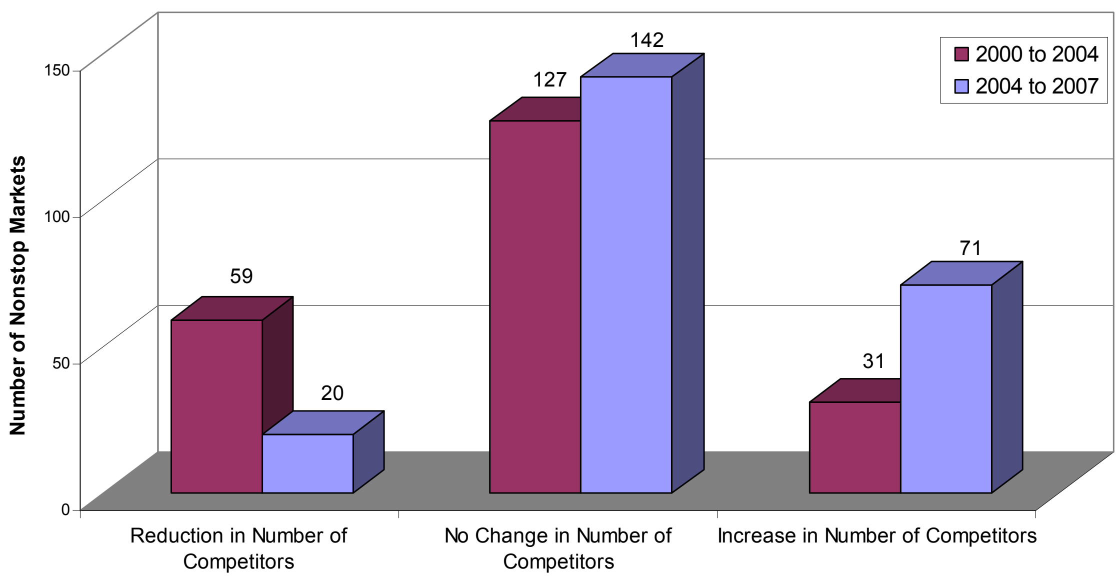

Figure 12: Aggregate Change in Transatlantic Market Competition, 2000-2007

From Figure 12, we see that in aggregate since 2004 market competition, as measured by number of competitors providing direct service, has been increasing. Between 2000 and 2004, 27% of city pairs saw a reduction in the number of carriers providing service. Between 2004 and 2007, that number dropped to 9%. Similarly, between 2000 and 2004, 14% of city pairs saw an increase in the number of competitors. Between 2004 and 2007, that number increased to 30%.

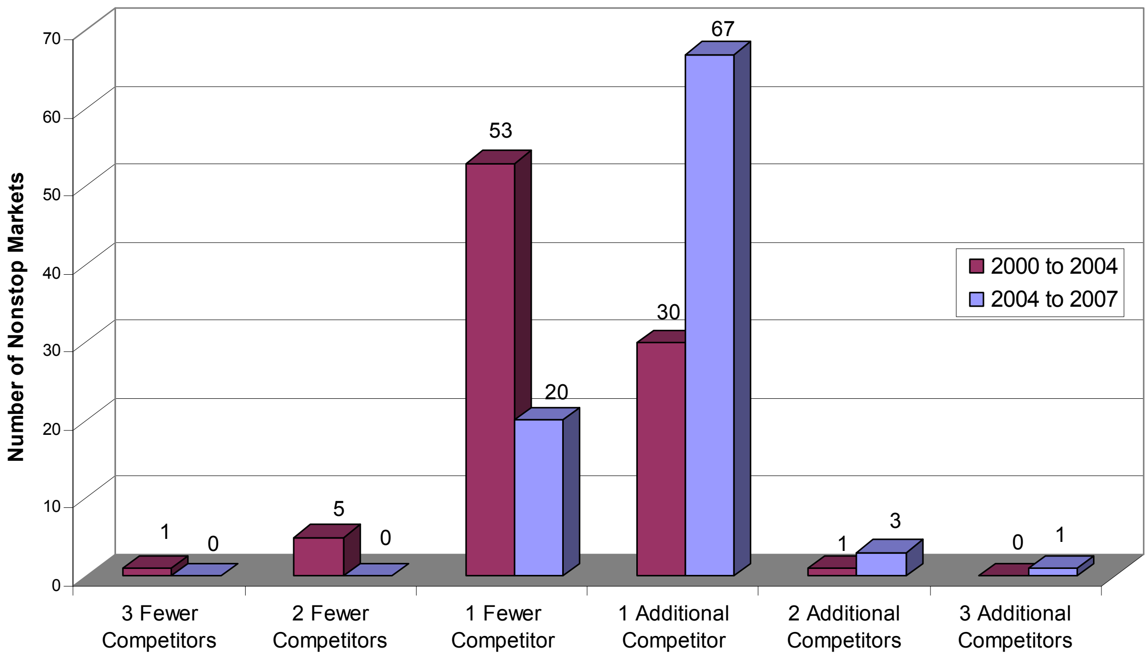

Figure 13: Detailed Change in Transatlantic Market Competition, 2000-2007

Figure 13 further breaks down the number of competitors gained or lost. As we might expect, the vast majority of changes in competition came from the addition or loss of one carrier. Also interesting to note is that of the 24 city pairs that were connected in 2004 but not in 2000, five returned to no service in 2007. Of the 48 city pairs that were connected in 2007 but not in 2004, six already had that service in 2000 (but lost it temporarily). These routes reflect the restoration of service that followed the capacity reductions post-9/11.

Table 9 lists the city pairs that saw an addition or reduction of more than one competitor between either 2000-2004 or 2004-2007.[16] These are the city pairs for which one would have guessed that nonstop capacity either clearly outpaced or failed to meet demand. One indicator we would use to reflect a mismatch of capacity and demand is load factor. Although by itself not an indicator of yields or profitability of a route, high load factors provide an indication that a market's demand was sufficient for a given capacity. It is interesting to note that none of the listed city pairs that lost two or three competitors had average load factors below 74%.

Of the 59 city pairs that saw a reduction in service between 2000 and 2004, 57 had ALFs over 65% and 31 had ALFs over 80%. Similarly, of the 20 city pairs that saw a reduction in service between 2004 and 2007, 17 had ALFs over 65% and 10 had ALFs over 80%. Domestically, these would be

[16] Again, here we consider only those carriers providing scheduled commercial passenger service at least once weekly.

considered desirable load factors. Although they don't tell us everything about the profitability of the route, flights with high load factors are often discontinued because (1) high competition drives yields down and that (2) there are alternative routes where a carrier's scarce resources are more profitable. This perhaps provides one additional indicator that transatlantic competition has been increasing in aggregate since 2000.

Table 9: City Pairs with Gain or Loss of Multiple Competitors Between 2000-2004 or 2004-2007

U.S. City	European City	2000 # Carriers	2004 # Carriers	2007 # Carriers	Change 00-04	Change 04-07	2000 ALF	2004 ALF	2007 ALF
Chicago, IL	Manchester, UK	1	3	3	**2**	0	86.28%	77.05%	73.28%
Chicago, IL	Shannon, Ireland	3	1	2	**-2**	1	78.64%	86.44%	70.95%
Los Angeles, CA	Paris, France	4	2	2	**-2**	0	75.69%	86.05%	89.05%
New York, NY	Amsterdam, Netherlands	6	3	3	**-3**	0	75.60%	83.09%	78.34%
New York, NY	Frankfurt, Germany	6	4	4	**-2**	0	74.93%	75.93%	76.03%
New York, NY	Shannon, Ireland	4	2	3	**-2**	1	90.46%	91.96%	83.68%
San Juan, PR	Frankfurt, Germany	2	0	0	**-2**	0	82.26%	0.00%	0.00%
New York, NY	Berlin, Germany	0	0	2	0	**2**	0.00%	0.00%	71.21%
New York, NY	London, UK	8	7	10	-1	**3**	74.56%	76.32%	70.40%
New York, NY	Stockholm, Sweden	2	1	3	-1	**2**	87.58%	78.54%	85.70%
Orlando, FL	Glasgow, UK	0	0	2	0	**2**	0.00%	0.00%	86.10%

3.4 Transatlantic Gateways

As discussed earlier, in 2007 there were 30 U.S. cities and 52 European cities with transatlantic service. Nineteen of these cities (three in the U.S., sixteen in Europe) have received their first transatlantic service since 2000. However, fifteen cities (two in the U.S., thirteen in Europe) have lost all transatlantic service over the same period. Figure 14 maps those cities which have gained transatlantic service and Figure 15 those which have lost it.

Looking quickly at these maps would suggest that the U.S. has fared better than Europe, having lost only two transatlantic gateways to Europe's thirteen. But in reality, this means that when traveling to the U.S., the 10 million people surrounding these thirteen gateways have no choice but to purchase a ticket through a European carrier and connect within Europe. Similarly, the only way for an American to get to Lyon or Luxembourg is to connect in Europe. Although the reverse holds true for Europeans wishing to fly to St. Louis or Pittsburgh, the fact remains that a lost transatlantic gateway in Europe means that U.S. passengers have no choice but to connect in Europe. And because more gateways have been lost in Europe, it is the airlines that operate the major European hubs that have gained more than others.

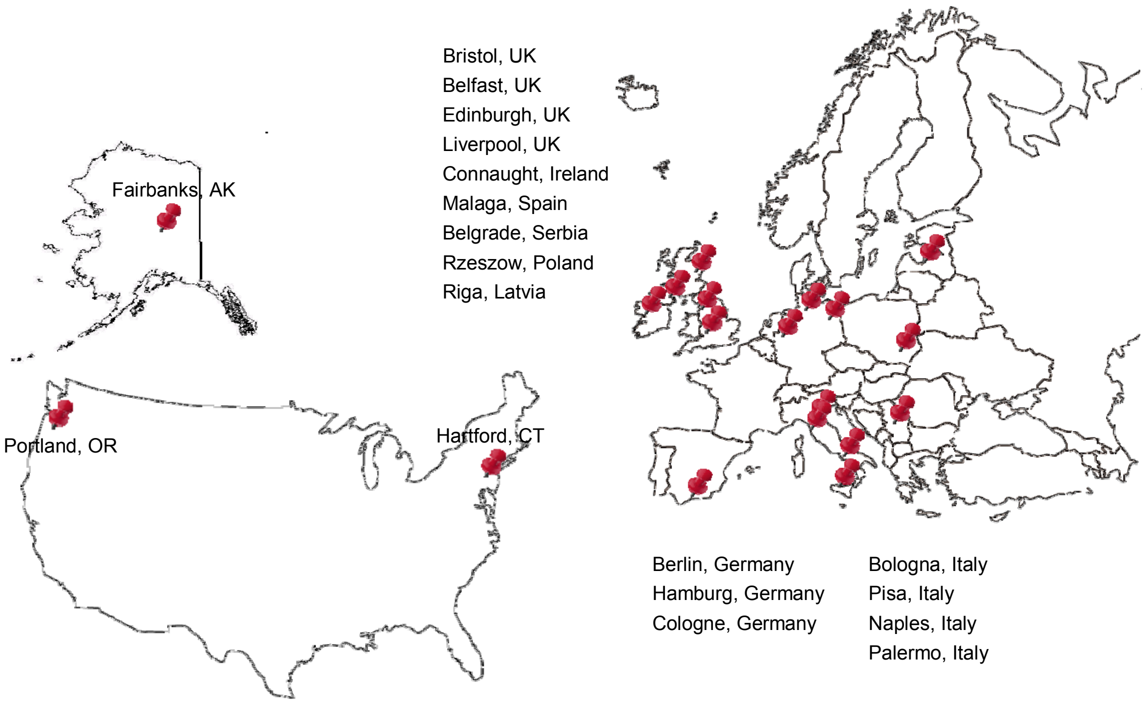

Figure 14: Cities Which Gained First Direct Transatlantic Service Since 2000

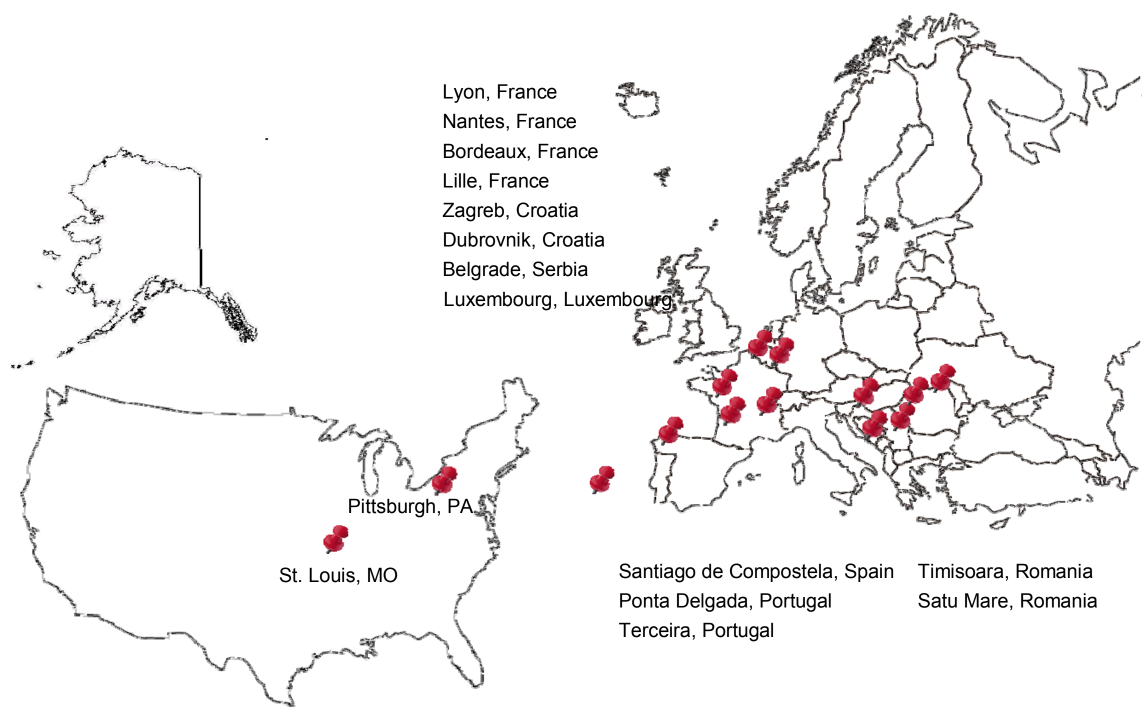

Figure 15: Cities Which Lost All Direct Transatlantic Service Since 2000

The largest of these European transatlantic hubs are those operated by the Big-3 European carriers: Air France-KLM, Lufthansa-Swiss and British Airways. Table 10 summarizes the so-called “Big-3 hubs.”

Table 10: Big-3 European Carrier Hubs

Big-3 European Carrier	Transatlantic Hubs	2007 U.S. Destinations	2007 # of Transatlantic Carriers	Alliance
Air France-KLM	Paris, France Amsterdam, Netherlands	14 17	10 8	SkyTeam
British Airways	London, United Kingdom	23	14	Oneworld
Lufthansa-Swiss	Frankfurt, Germany Munich, Germany Zurich, Switzeland	20 12 10	10 6 8	Star Alliance

The existence of alliances explains the large number of carriers providing transatlantic service to each of the Big-3 hubs. The Big-3 European carriers are aligned to the three major alliances – Star Alliance, SkyTeam and Oneworld. Alliance partners exchange passengers at their major hubs, and so carriers leverage the network effect by flying into these hubs. The equivalent Big-6 U.S. carrier hubs are listed in Table 11.

Table 11: Big-6 American Carrier Hubs

Big-6 American Carrier	Transatlantic Hubs	2007 Europe Destinations	2007 # of Transatlantic Carriers	Alliance
American Airlines	Dallas/Ft. Worth, TX Chicago, IL Miami, FL	4 20 9	3 19 10	oneworld
Continental Airlines	Houston, TX New York City (EWR) Cleveland, OH	4 51 1	6 38 1	SkyTeam[17]
Delta Air Lines	Atlanta, GA Cincinnati, OH New York City (JFK)	23 5 51	5 1 38	SkyTeam
Northwest Airlines	Minneapolis, MN Detroit, MI Memphis, TN	3 6 1	2 4 1	SkyTeam
United Airlines	Chicago, IL Washington, DC Denver, CO San Francisco, CA	20 13 3 6	19 12 2 7	Star Alliance
US Airways	Phoenix, PA Philadelphia, PA Charlotte, NC	1 19 3	1 4 2	Star Alliance

[17] In June 2008, Continental announced plans to join Star Alliance effective October 2009.

These hub cities will prove significant in the econometric market analysis presented in Chapter 5. However, it is worth comparing here the concentration of transatlantic gateways in the U.S. and Europe. Table 12 presents the top ten U.S. and European gateway cities by number of passengers.

Table 12: Ten Largest U.S. and European Transatlantic Gateway Cities

Rank	U.S. Gateways	Passengers Enplaned	Rank	European Gateways	Passengers Enplaned
1	New York	834,257	1	London	671,737
2	Chicago	268,499	2	Frankfurt	318,166
3	Washington	187,254	3	Paris	296,504
4	Los Angeles	170,604	4	Amsterdam	216,422
5	Atlanta	168,633	5	Rome	90,450
6	Boston	135,704	6	Munich	84,957
7	Philadelphia	128,538	7	Madrid	82,016
8	San Francisco	105,358	8	Dublin	69,780
9	Miami	92,884	9	Zurich	63,344
10	Detroit	87,950	10	Manchester	61,903

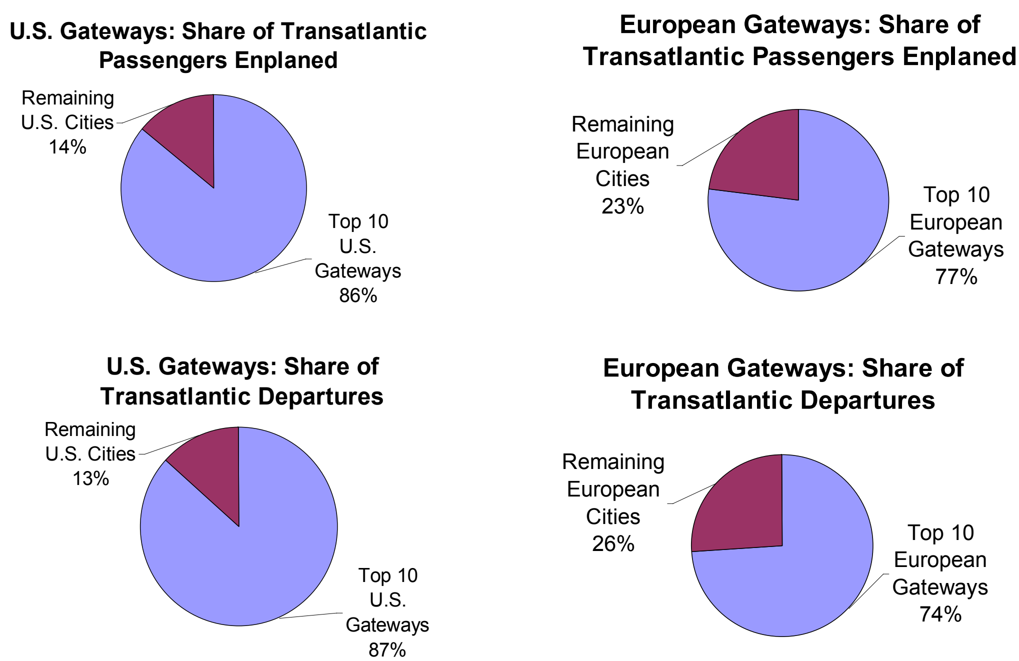

Figure 16: U.S. and European Gateway Share of Transatlantic Passengers and Departures

The top ten U.S. gateways account for 86% of all transatlantic passenger enplanements and 87% of all transatlantic departures. The top ten European gateways, on the other hand, account for only 77% of transatlantic passengers and 74% of transatlantic departures, as seen in Figure 16. Although European gateways are highly concentrated to the largest four hubs, overall U.S. gateways are more concentrated than those of Europe, where a greater proportion of traffic is fed through the smaller gateways. In fact if we ignore the top four gateways in both the U.S. and Europe, the spread (or standard deviation) of passengers enplaned in July 2007 at the remaining 48 European gateways is less than half that of the remaining 26 U.S. gateways.[18] This indicates that passengers are more evenly spread across the remaining 48 European gateways than the remaining 26 U.S. gateways.

Part of this difference is that in Europe, historically, it was very much the responsibility of the national government to preserve a "flag carrier" not only to provide air transportation to its residents, but also to represent the nation's interests abroad.[19] What we see in the list of top ten European gateways are the hub airports of nine major European carriers. But what is perhaps more telling are the carriers whose hubs represent the remaining 26% share of departures. Here are the hub cities of other national carriers, including Austrian, SAS, Brussels Airlines, Icelandair, Olympic, Turkish Airways, Tarom, LOT Polish Airlines, Czech Airlines, Aeroflot, Finnair, TAP Portugal and Air Malta, all with incentive (and in a few cases, government assistance) to serve major international centers like New York.

Conversely, the list of top ten U.S. gateways already includes hub cities of all six legacy U.S. carriers. There are no other U.S. carriers with transatlantic capabilities, so there are fewer forces fragmenting the U.S. gateways than those in Europe.

The data demonstrates a clear reliance on hubs as transatlantic gateways in both the U.S. and Europe. However the lower concentration of passengers and departures from the largest gateways in Europe is a function of historical precedent whereby over one dozen other flag carriers have drawn a considerable share of service away from the largest European gateways.

It is also worth noting that of the U.S.' 30 transatlantic gateways, there are four served only by U.S. carriers, but ten served only by non-U.S. carriers. All ten are served by European carriers flying to one of their hub or focus cities. In Europe, there are ten cities served only by European carriers and thirteen served only by U.S. carriers. Again, in this case, all thirteen are flown to the carriers' hub or focus cities. This is yet another indication that U.S. and foreign carriers alike seek to leverage network effects by flying from their hubs. We will explore this notion further in Chapter 5.

In this chapter we have summarized the transatlantic competitive landscape since 2000 and described the service levels of U.S. and European markets. We have seen that a majority of transatlantic service lost in Europe has come from European carriers stopping service and that losses in the U.S. have come from American carriers stopping service. Since 2000, U.S. carriers have gained a disproportionate share of transatlantic departures, destinations and passengers. This has occurred through the addition of new service from major U.S. gateways. The next step is to understand whether liberalization policy events have driven this new service.

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[18] The standard deviation of the passengers enplaned at remaining 48 European gateways is 24,308. The standard deviation of the smaller 26 U.S. gateways is 48,788.

[19] This phenomenon is being alluded to in the opening quotation of this thesis on Page 5.

Chapter 4

Policy Impacts on Transatlantic Service Levels

In this chapter we explore the impacts of individual policy events since 1990 on transatlantic service levels. Emphasis is placed on Open Skies agreements between the U.S. and individual European countries, but the impacts of alliances and antitrust immunity are also discussed. The goal is to identify trends in service levels following European-U.S. policy events to aid in understanding the impacts of continued liberalization.

We first review the Open Skies Agreements in place between the U.S. and European counties. We then explore aggregate service level changes following each of these agreements. We briefly discuss the impacts of antitrust immunity and partnerships, particularly the extent to which alliances in deregulated markets have led to the benefits often credited to liberalization. We highlight studies that have demonstrated the service level increases and fare reductions that leverage the required linkage between alliances and liberalization. We then summarize the overall conclusions of the impact of Open Skies on transatlantic service levels.

4.1 Open Skies Agreements

An Open Skies agreement is a bilateral air service agreement established by the governments of two nations.[20] These agreements are more liberal than traditional bilaterals in that they reduce government regulation of air services. Open Skies agreements with the U.S. allow air carriers of the U.S. and the foreign signatory to make unregulated decisions about routes, capacity, and pricing. They provide additional flexibility for airlines and their alliance partners by allowing for unlimited access to points in the signatory countries, unlimited access to intermediate and beyond points, and unrestricted codesharing rights.

It is also important to note that the U.S. DOT only grants antitrust immunity to partner carriers of Open Skies signatories. Therefore any benefits that come as a result of joint ventures – profit-sharing collaborations formed by immunized partners – rely upon the existence of an Open Skies agreement.

[20] In the case of the European Union, the term nation can also be used to refer to the political and economic union.

These benefits are further discussed in Section 4.3. The U.S. Department of State's Office of Aviation Negotiations establishes the key provisions of an Open Skies agreement as follows:[21]

Table 13: Key Provisions of an Open Skies Agreement Established by State Department

Condition	Description
Free Market Competition	No restrictions on international route rights; number of designated airlines; capacity; frequencies; or types of aircraft.
Pricing Determined by Market Forces	A fare can be disallowed only if both governments concur -- "double-disapproval pricing" -- and only for certain, specified reasons intended to ensure competition.
Fair and Equal Opportunity to Compete	For example: • All carriers -- designated and non-designated -- of both countries may establish sales offices in the other country, and convert earnings and remit them in hard currency promptly and without restrictions. Designated carriers are free to provide their own ground-handling services -- "self handling" -- or choose among competing providers. Airlines and cargo consolidators may arrange ground transport of air cargo and are guaranteed access to customs services. • User charges are non-discriminatory and based on costs.
Cooperative Marketing Arrangements	Designated airlines may enter into code-sharing or leasing arrangements with airlines of either country, or with those of third countries, subject to usual regulations. An optional provision authorizes code-sharing between airlines and surface transportation companies.
Provisions for Dispute Settlement and Consultation	Model text includes procedures for resolving differences that arise under the agreement.
Liberal Charter Arrangements	Carriers may choose to operate under the charter regulations of either country.
Safety and Security	Each government agrees to observe high standards of aviation safety and security, and to render assistance to the other in certain circumstances.
Optional 7th Freedom All-Cargo Rights	Provides authority for an airline of one country to operate all-cargo services between the other country and a third country, via flights that are not linked to its homeland.

The U.S. has signed Open Skies agreements with 94 countries (see complete list in Appendix I). Over one third of these agreements are with European countries. This is yet another indication of the leadership both regions have demonstrated in liberalizing their aviation markets, particularly with one another. The 34 European countries which have negotiated Open Skies agreements with the U.S., and the date of their signing, are listed in Table 14. [22]

The U.S. Department of State, which is responsible for negotiating Open Skies agreements, believes that these steps toward liberalization "lead to expanded demand for international aviation service and create new business for international air carriers" and that they "promote increased travel and trade, productivity, high-quality job opportunities and economic growth…by reducing government interference

[21] Open Skies Agreement Fact Sheet, Office of Aviation Negotiations. Bureau of Economic, Energy and Business Affairs, U.S. Department of State. June 1, 2006.
[22] Open Skies Partners, updated November 25, 2008. Released by the U.S. Department of State's Bureau of Economic, Energy and Business Affairs.

Table 14: European Countries with U.S. Open Skies Agreements as of 11/2008

Chronological Rank Open Skies with U.S.	Country	Covered by EU-U.S. Open Skies	Date Signed	All-Cargo 7th's
1	Netherlands	Yes	10/14/1992	No
2	Belgium	Yes	3/1/1995	No
3	Finland	Yes	3/24/1995	No
4	Denmark	Yes	4/26/1995	No
5	Norway	No	4/26/1995	No
6	Sweden	Yes	4/26/1995	No
7	Luxembourg	Yes	6/6/1995	Yes
8	Austria	Yes	6/14/1995	No
9	Iceland	No	6/14/1995	Yes
10	Switzerland	No	6/15/1995	No
11	Czech Republic	Yes	12/8/1995	Yes
12	Germany	Yes	2/29/1996	Yes
31	Romania	Yes	7/15/1998	No
32	Italy	Yes	11/11/1998	No
37	Portugal	Yes	12/22/1999	Yes
38	Slovak Republic	Yes	1/7/2000	Yes
42	Turkey	No	3/22/2000	No
47	Malta	Yes	10/12/2000	Yes
50	Poland	Yes	5/31/2001	Yes
53	France	Yes	10/19/2001	Yes
60	Albania	No	9/24/2003	Yes
72	Bosnia and Herzegovina	No	11/22/2005	Yes
78	Bulgaria	Yes	4/30/2007	Yes
79	Cyprus	Yes	4/30/2007	Yes
80	Estonia	Yes	4/30/2007	Yes
81	Greece	Yes	4/30/2007	Yes
82	Hungary	Yes	4/30/2007	Yes
83	Ireland	Yes	4/30/2007	Yes
84	Latvia	Yes	4/30/2007	Yes
85	Lithuania	Yes	4/30/2007	Yes
86	Slovenia	Yes	4/30/2007	Yes
87	Spain	Yes	4/30/2007	Yes
88	United Kingdom	Yes	4/30/2007	Yes
91	Croatia	No	3/13/2008	Yes

in the commercial decisions of air carriers, freeing them to provide affordable, convenient and efficient air service for consumers."[21]

As we presented in Chapter 2, a number of studies conclude that Open Skies agreements lead to benefits, primarily the economic benefit derived from increased traffic levels. The results of these studies are often cited by proponents of liberalization to argue in favor of further deregulation. Given our emphasis on transatlantic service, we explore the specific changes that resulted from liberalization in the 34 countries listed above. Our findings, presented in the next section, are that the impacts of Open Skies are less conclusive than those held by previous studies. The discrepancies are discussed in Chapter 5.

4.2 Changes Following Individual Agreements

As described in Chapter 1, we define transatlantic "service levels" between two countries to be composed of four metrics: passenger enplanements, number of city pairs, total departures and the number of carriers providing transatlantic service. The latter is one indicator of the level of competition in the market. Most studies have considered traffic growth as the most robust indicator of the "benefits" of Open Skies. However, it is also important to consider whether certain communities have lost transatlantic service (i.e. reduction in city pairs). We also evaluate whether liberalization does, as proponents predict, result in an increase in the number of competitors by reducing the barriers to entry into a given market.

For each of the European Open Skies signatories listed above, we evaluate the changes in these metrics following the signing of the agreement. Again here, the primary data source is the Air Carrier Statistics database, also known as the T-100 data bank, of the U.S. Department of Transportation. The database contains all international nonstop segment data for certificated U.S. air carriers and foreign carriers having at least one point of service in the U.S. or one of its territories. Carriers are required to report to the DOT their monthly "segment data" which comprise statistics for each individual segment they fly into or out of the U.S. In the subsequent analysis, we employ passenger segment data, which includes all O-D traffic onboard a particular segment. For example, traffic reported between Boston and London includes not only Boston-London local passengers but all passengers on board that originate "behind" Boston or terminate "beyond" London. These passengers comprise varying fractions of the total traffic and do not reflect demand in the Boston-London local market. Due to limitations in data, our analysis considers segment traffic rather than O-D traffic. This will tend to inflate demand (and service levels) to or from cities with substantial connecting traffic. We believe that traffic alone is a difficult measure to determine causation from Open Skies because we expect a natural growth in traffic year over year, regardless of other service level changes. Therefore equal emphasis is placed on number of city pairs, departures and carriers.

Throughout our discussion we will consider two hypotheses made by previous studies. The first, articulated by the Brattle Group (2002), is that "a firm may gain a long-term competitive advantage if it is the first either to enter a market or to significantly expand its market presence." Brattle suggests that first-mover and network advantages likely account for high traffic increases to the Netherlands, relative to other EU member states. This hypothesis would suggest that the increases following liberalization events dampen as time progresses. The second hypothesis, presented by Booz Allen Hamilton (2007) suggests that "liberalizing air transport markets has a positive effect in the five years following the signing of an Open Skies agreement." Beyond the initial five years, Booz Allen expects the growth rate to return to its long-term equilibrium, but at a higher output.

As a result, our analysis evaluates changes in four service level measures in the five years prior and post the signing of an Open Skies agreement with the U.S.[23] For the number of departures and passenger enplanements, annualized growth rates are averaged over the five-year period before and after the agreement. For number of city pairs and competitors, the absolute number is averaged over the same periods. The pre- and post-agreement values are compared to gain insight into the impact of Open Skies. We perform a statistical significance test to determine whether a significant change in service levels occurred following the signing of an Open Skies agreement. Given the small size of each of our samples (five data points prior- and five post-agreement) and that the data fails to conform to a specific distribution (e.g. normal, triangular, etc.), we must employ a nonparametric test. We perform the Wilcoxon Rank Sum test which is well-suited for two-sample problems with independent samples, described below.

Wilcoxon Rank Sum Test

The Wilcoxon Rank Sum test is a nonparametric alternative to the two-sample t-test and is particularly well-suited for smaller sample sizes. It compares two distributions to assess whether one has systematically larger values than the other based solely on a rank of the observations from the two samples. In order to demonstrate, let us use an example from our transatlantic data set. Suppose that we have samples of observations from two populations *A* and *B*, where *A* is number of Sweden's transatlantic city pairs in the five years prior to an agreement and *B* is the number of city pairs in the five years post agreement. Respectively, *A* and *B* contain n_A and n_B observations, in this case five apiece. Since Sweden signed its agreement with the U.S. in April 1995, the number of city pairs in 1990-1994 comprise our first sample *A*, and 1995-1999 comprise our sample *B*. The mean number of city pairs was 2.2 in period A and 2.0 in period B, summarized in the following table:

Table 15: Sample Wilcoxon Rank Sum Test (Sweden Data)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	2	2	2	2	2	2	2	2	2
			Average	**2.2**	**Average**	**2.0**			

One may initially make the observation that Sweden saw a drop in service levels following the signing of its Open Skies agreement with the U.S. However, we must instead determine whether Sweden experienced a statistically significant drop in service levels over the period. We wish to test the null hypothesis H_0 that $A = B$, or that the distribution of measurements is the same in our two samples. In

[23] Since T-100 data is only available beginning 1990, the Netherlands is limited to pre-agreement data spanning three years – July 1990 through 1992.

order to test H_0 we rank our ten observations and assign them values from 1 to 10, assigning tied values the average of their ranks. The Wilcoxon test statistic w_A is obtained by summing the ranks of group *A*. We compare w_A to the random variable *W* representing the distribution of a rank sum, which depends on the two sample sizes n_A and n_B (from a Wilcoxon Rank Sum Table, see Appendix III). Since we have no strong prior reason for expecting a shift in a particular direction, we employ a two-sided alternative test. Our two samples have systematically different distributions (null hypothesis rejected) when our *P-value* for the test is:

(H_1: $A \neq B$) P-value = 2 * pr ($W \leq w_A$) if w_A represents the small rank sum (lower tail)
P-value = 2 * pr ($W \geq w_A$) if w_A represents the larger rank sum (upper tail)

As is standard with the parametric *t-test*, a confidence interval of 95% is an appropriate threshold of statistical significance. We calculate the confidence interval for each of the four service level metrics of the 22 European countries with Open Skies agreements in place with the U.S. by 2007. We define an increase in service levels to be conclusive if, of those service metrics experiencing a statistically significant change, a majority increased following the signing of Open Skies. Similarly, a decrease is conclusive if a majority of statistically significant changes were negative.

The results of our Open Skies analysis are summarized in Table 16. **Of the 22 countries with U.S. Open Skies agreements in place by 2007, only seven demonstrated overall increases in service levels while six demonstrated overall reductions.** The four countries which signed Open Skies treaties with the U.S. but have not received service support the hypothesis that liberalization alone does not oblige service level increases.

Because we are using a 5-year period beyond the agreement to evaluate changes in service levels, late signers of Open Skies with the U.S. were evaluated using a post-agreement period which included the effects of 9/11. It is very difficult to separate out the effects of 9/11, so a consistent approach was applied. With new Open Skies agreements recently signed, future research will contribute additional data points to those presented here to better assess the impact of Open Skies.

Table 16: Results of Open Skies Analysis of 22 European Countries

Country	Date Signed	City Pairs	Departures	Passengers Enplaned	Competitors	Overall Change Following Open Skies?
Netherlands[1]	10/14/1992	▲	▼	▲	▲	Increase
Belgium	3/1/1995	▲	—	▲	—	Increase
Finland	3/24/1995	—	—	▼	▼	Decrease
Denmark	4/26/1995	▼	—	—	▼	Decrease
Norway	4/26/1995	—	—	—	▼	Decrease
Sweden	4/26/1995	—	—	▲	▼	Inconclusive
Luxembourg	6/6/1995	—	—	—	—	Inconclusive
Austria	6/14/1995	—	—	▲	—	Increase
Iceland	6/14/1995	▲	▲	▲	—	Increase
Switzerland	6/15/1995	▲	▲	—	▲	Increase
Czech Republic	12/8/1995	—	▼	▼	—	Decrease
Germany	2/29/1996	▲	—	—	—	Increase
Romania	7/15/1998	—	—	—	—	Inconclusive
Italy	11/11/1998	▲	—	—	—	Increase
Portugal	12/22/1999	—	—	—	—	Inconclusive
Slovak Republic[2]	1/7/2000	—	—	—	—	No Service
Turkey	3/22/2000	—	—	▼	—	Decrease
Malta[2]	10/12/2000	—	—	—	—	No Service
Poland	5/31/2001	—	—	—	—	Inconclusive
France	10/19/2001	▼	▼	—	▼	Decrease
Albania[2]	9/24/2003	—	—	—	—	No Service
Bosnia & Herzegovina[2]	11/22/2005	—	—	—	—	No Service

[1] Wilcoxon Rank Sum test could not be performed on the Netherlands due to a lack of available data prior to 1990

[2] Country had no service after signing of agreement

— Indicates no statistically significant change

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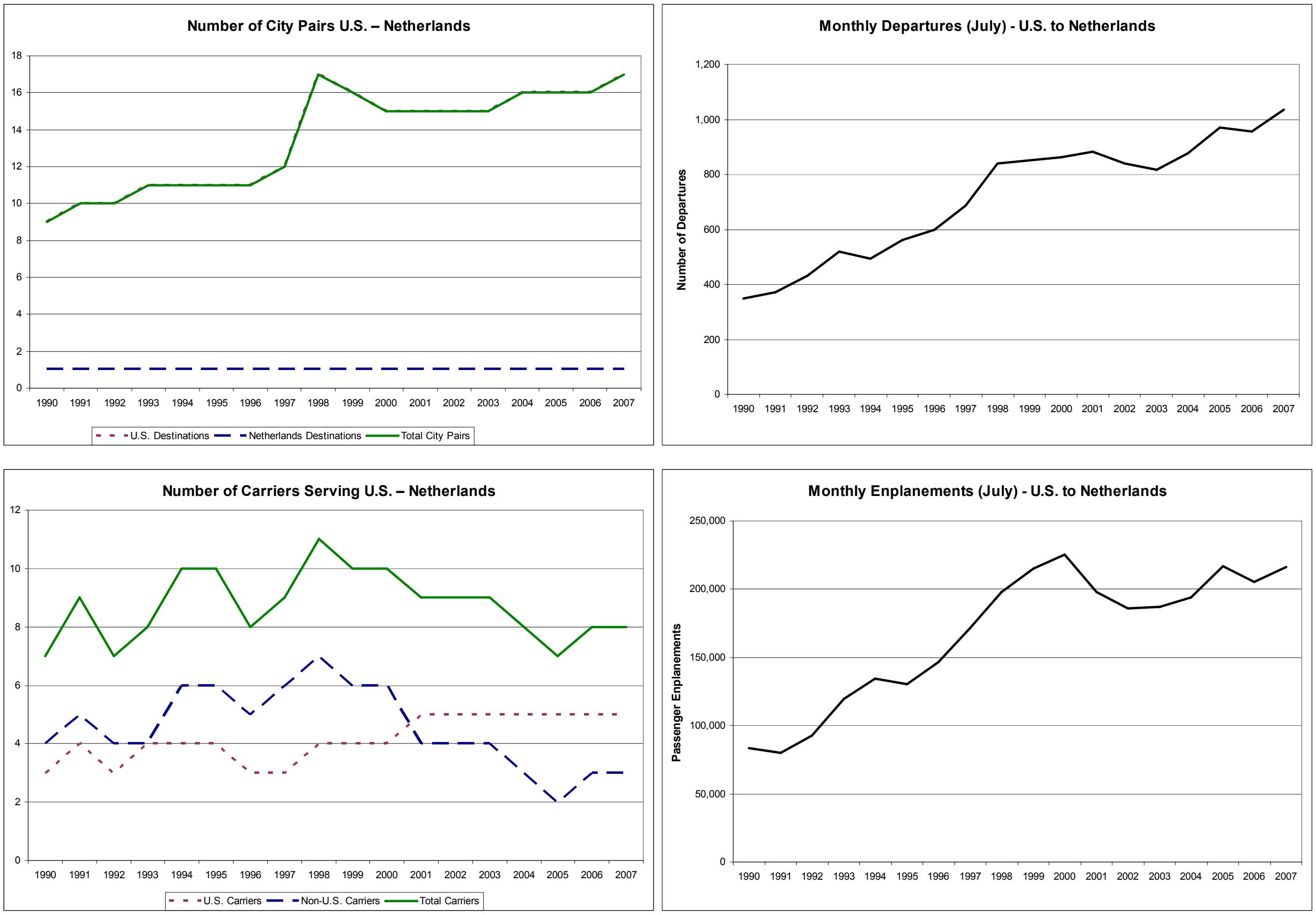
<u>The Netherlands</u> (Open Skies agreement signed October 1992)

Figure 17: U.S.-Netherlands Transatlantic Service Levels, 1990-2007



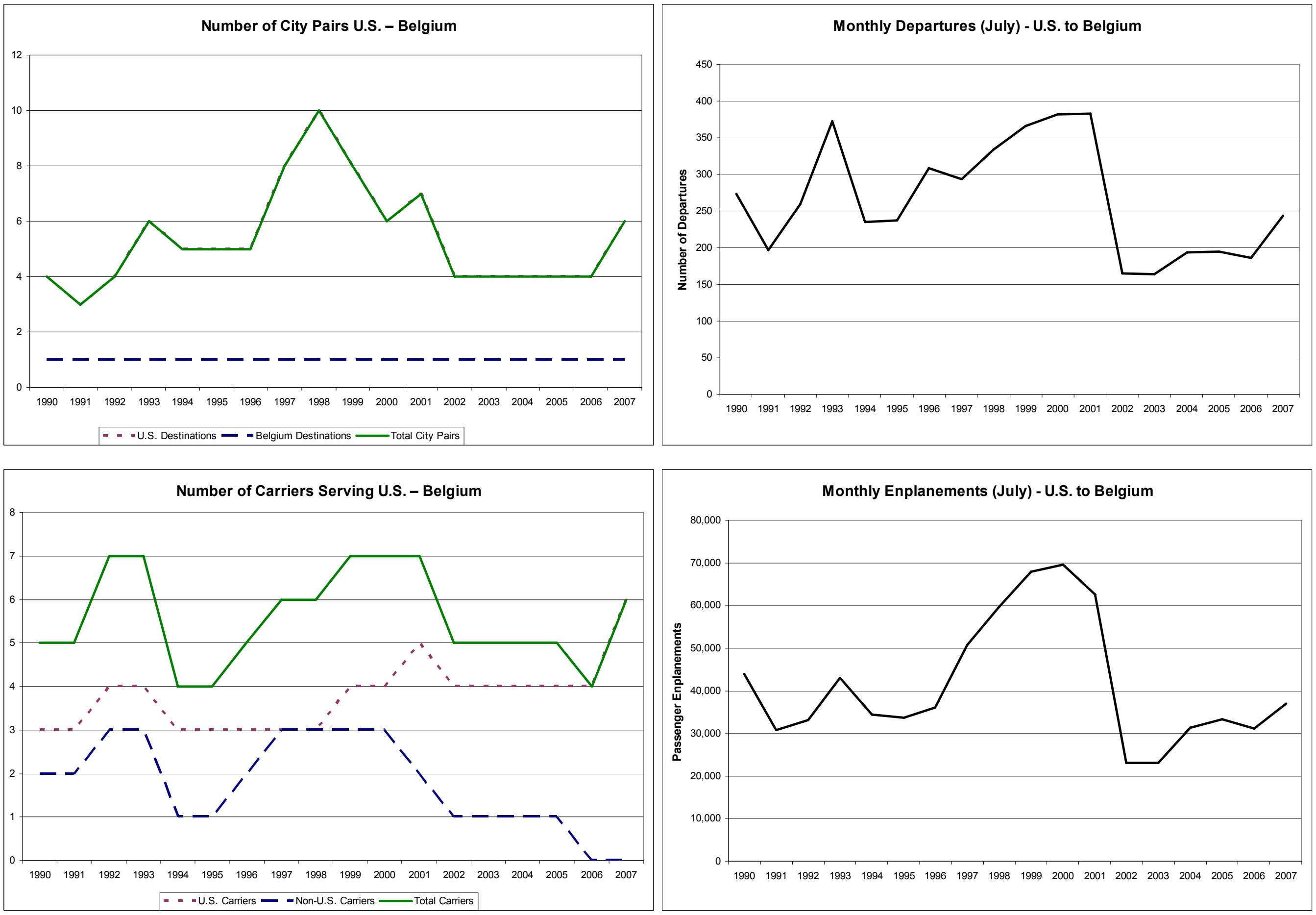
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Service Changes
# of City Pairs	9.67	11.20	Increase
# of Competitors	7.67	9.00	Increase
Departures Annual Growth Rate	11.08%	10.20%	Decrease
Enplanements Annual Growth Rate	5.55%	13.69%	Increase

The Netherlands is most often used to cite the benefits of air transportation liberalization. The Brattle Group hypothesizes that the Netherlands captured the largest proportion of new traffic stimulated by liberalization by leveraging the first-mover advantage. Indeed after the signing of Open Skies with the U.S., the number of city pairs between the two nations increased beyond 1991 levels and has since exceeded pre-agreement levels. Since Amsterdam is the Netherlands' only transatlantic gateway, all of these city pair additions represent new U.S. destinations being served nonstop to AMS. The number of departures and enplanements rose steadily following the signing of the agreement. However, even this oft-cited benefactor of liberalization saw a reduction in the rate of growth in departures following the signing of its agreement.

<u>Conclusion</u>: An overall increase in service levels.

Belgium (Open Skies agreement signed March 1995)

Figure 18: U.S.-Belgium Transatlantic Service Levels, 1990-2007



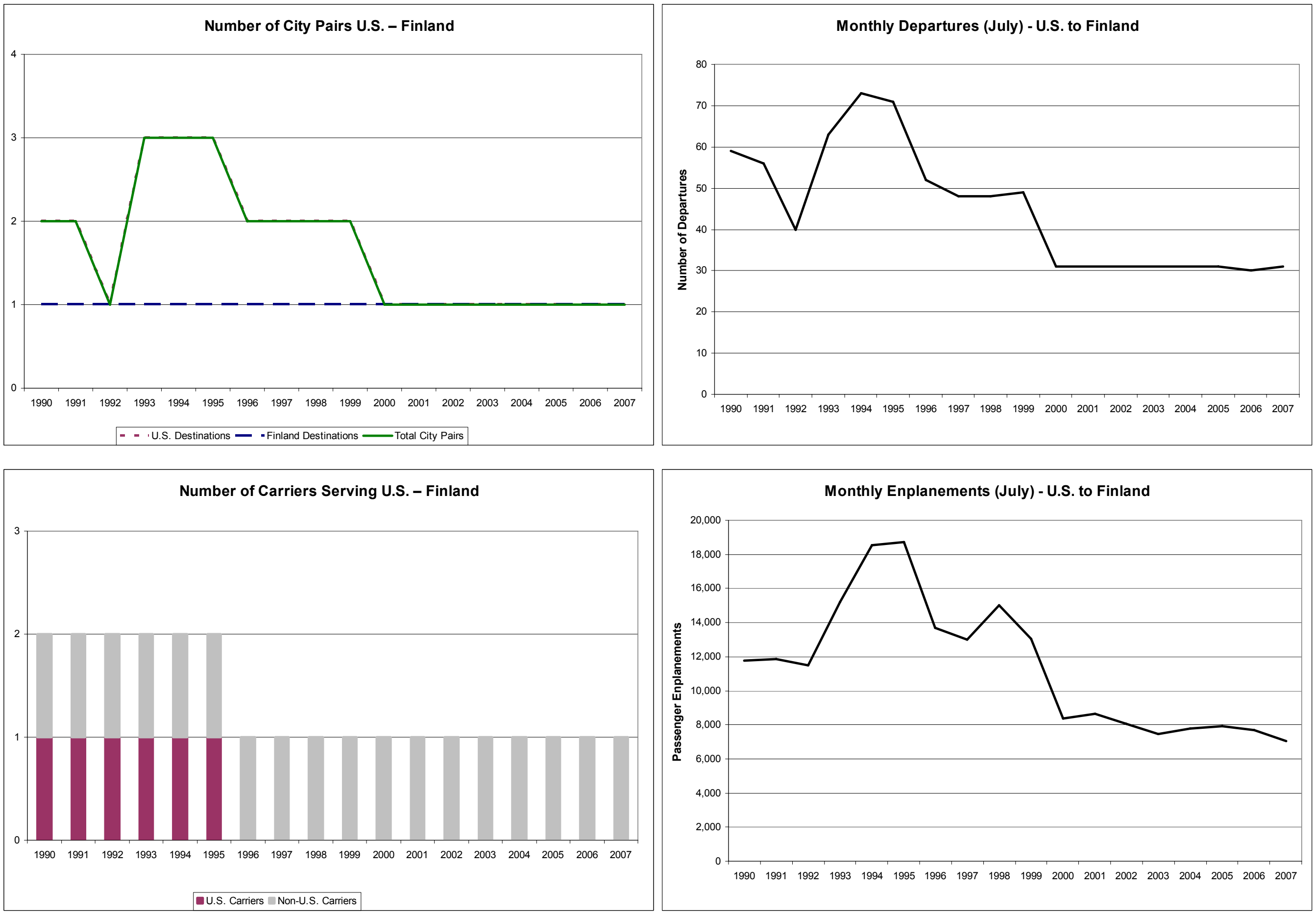
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	4.40	7.20	Increase	Yes
# of Competitors	5.60	5.60	None	--
Departures AGR	2.60%	9.91%	Increase	No
Enplanements AGR	-3.09%	15.48%	Increase	Yes

Belgium, the second Open Skies signatory and the Netherland's immediate neighbor to the south, saw increases in most service levels in the five years following its agreement with the U.S. The number of city pairs reached a historic peak in 1998, and the number of competitors peaked in 1999. By 2002, much of these service gains fell to pre-Open Skies levels, largely due to the collapse of Belgium's flag carrier SABENA and the demand downturn following 9/11. In addition, Belgium faced strong competition from neighbor Open Skies signatory the Netherlands, who enjoyed the "first mover" advantage. Still, in the five years following the signing of its agreement with the U.S., Belgium experienced overall gains in service.

Conclusion: During initial five years, an overall increase in service levels.

Finland (Open Skies agreement signed March 1995)

Figure 19: U.S.-Finland Transatlantic Service Levels, 1990-2007



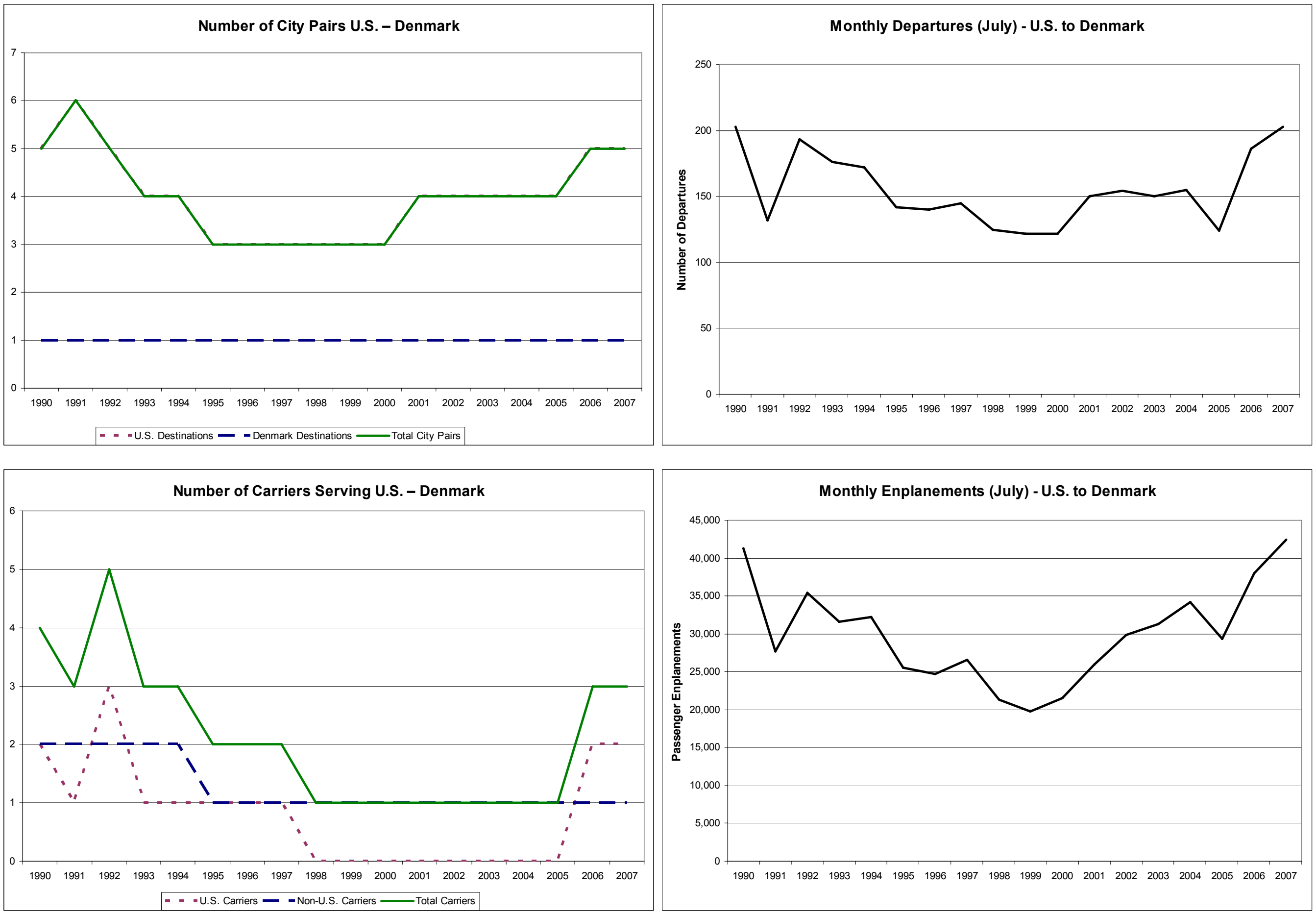
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.20	2.20	None	--
# of Competitors	2.00	1.20	Decrease	Yes
Departures AGR	9.93%	-7.02%	Decrease	No
Enplanements AGR	12.96%	-5.73%	Decrease	Yes

Finland, the third Open Skies signatory with the U.S., saw immediate drops in service levels after signing its agreement in 1995. By 2000, Finland had lost two-thirds of its city pairs, half of its transatlantic competitors, and over half of its U.S. departures and enplanements. Since 1995, no U.S. carrier has provided service to Finland. The trend in enplanements has continued to drop since the signing of Open Skies in 1995.

Conclusion: An overall reduction in service levels.

Denmark (Open Skies agreement signed April 1995)

Figure 20: U.S.-Denmark Transatlantic Service Levels, 1990-2007



Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	4.80	3.00	Decrease	Yes
# of Competitors	3.60	1.60	Decrease	Yes
Departures AGR	0.04%	-6.29%	Decrease	No
Enplanements AGR	-3.45%	-8.72%	Decrease	No

Denmark experienced a drop in transatlantic service levels in the five years following its Open Skies agreement with the U.S., although it has since been able to recover to near pre-Open Skies levels. Between 1995 and 2000, Denmark reached a historic low of three city pairs with the U.S. Between 1998 and 2005, Denmark had lost all U.S. carrier service and was served only by SAS (as compared to five competitors in 1992). July departures reached a low of 122 in 2000, and in 2007 had not yet reached pre-Open Skies levels. July enplanements reached a ten-year minimum in 1999 and only reached pre-Open Skies levels in 2007, twelve years after the agreement's signing.

Conclusion: During first five years of agreement, an overall reduction in service levels.

Norway (Open Skies agreement signed April 1995)

Figure 21: U.S.-Norway Transatlantic Service Levels, 1990-2007

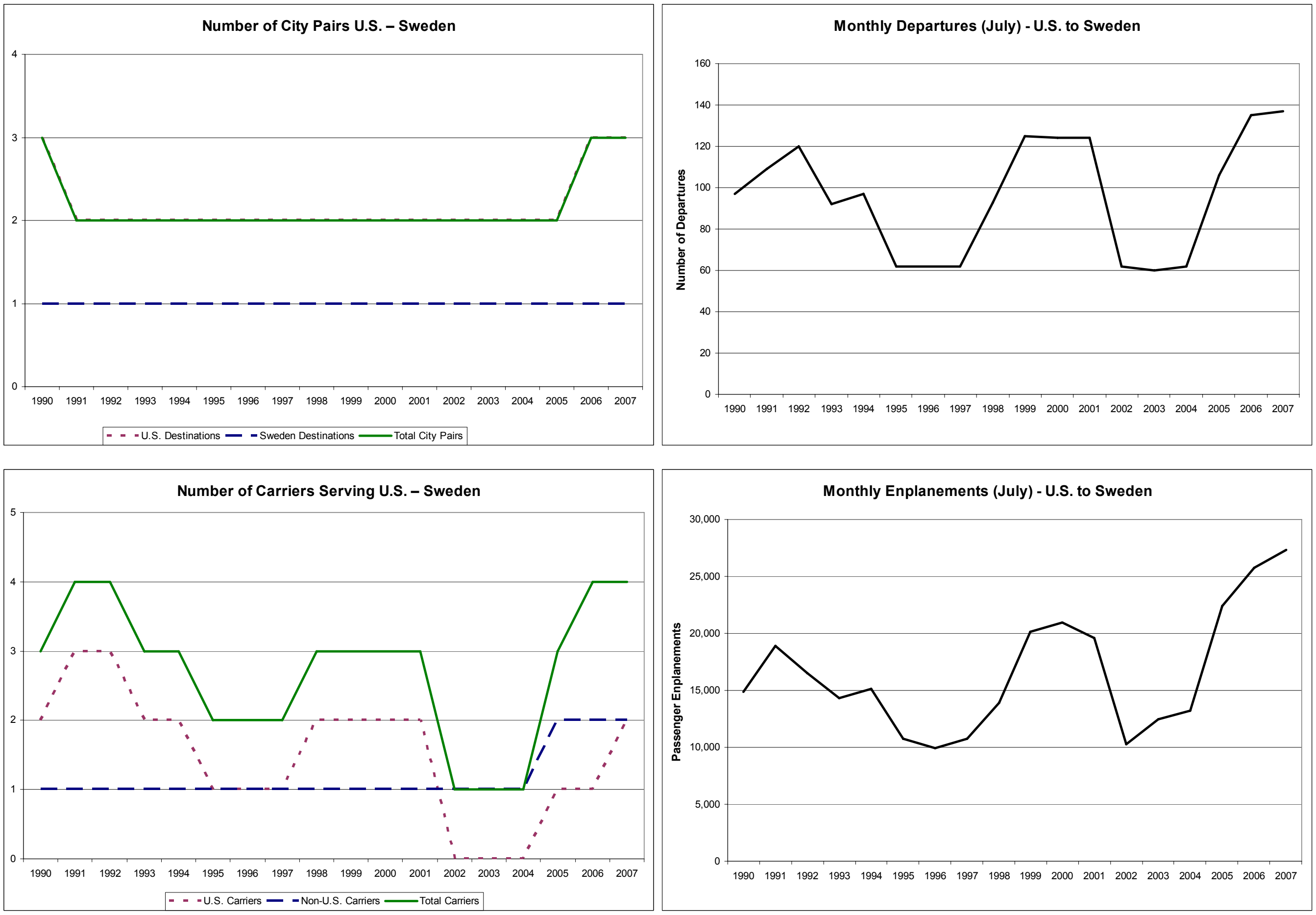
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	1.00	1.20	Increase	No
# of Competitors	2.00	1.20	Decrease	Yes
Departures AGR	0.90%	-0.11%	Decrease	No
Enplanements AGR	-2.52%	15.24%	Increase	No

Following the signing of its U.S. Open Skies agreement in 1995, Norway experienced a one-year (1999) upward spike in service levels as a result of Northwest Airlines' short-lived service between Minneapolis and Oslo. Since 1990, however, Norway has seen an aggregate reduction in monthly departures and transatlantic competitors. Prior to its Open Skies agreement, Norway was served by both a U.S. carrier and SAS. Since 2000, however, at most only one carrier has provided service to Oslo, the only Norwegian city with transatlantic service. Since 2004, Continental Airlines has provided the only direct service between the U.S. and Norway with one flight per day out of its Newark hub.

Conclusion: An overall decrease in service levels.

Sweden (Open Skies agreement signed April 1995)

Figure 22: U.S.-Sweden Transatlantic Service Levels, 1990-2007



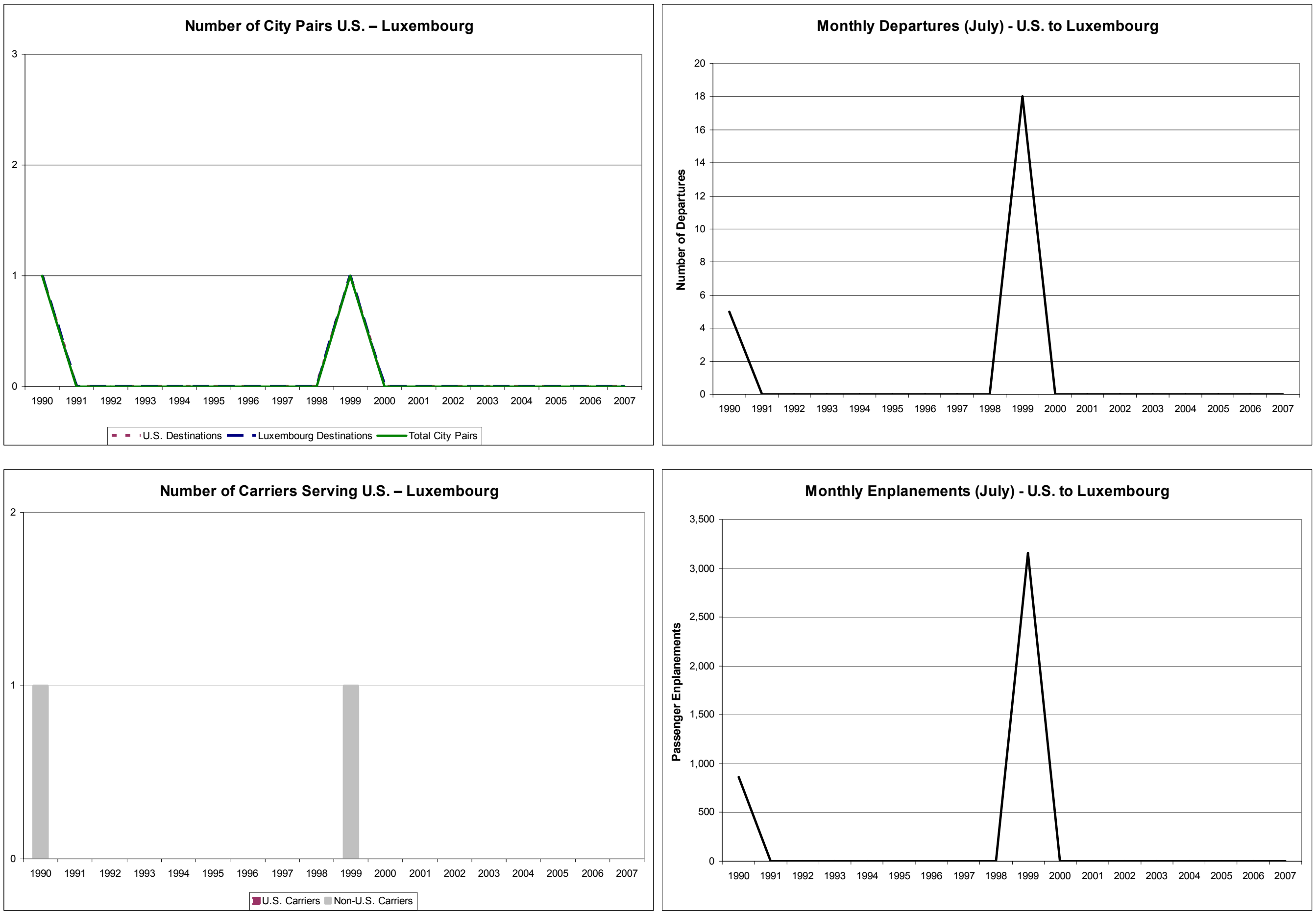
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.20	2.00	Decrease	No
# of Competitors	3.40	2.40	Decrease	Yes
Departures AGR	1.14%	9.67%	Increase	No
Enplanements AGR	1.73%	9.16%	Increase	Yes

Sweden maintained high levels of transatlantic service in the early 1990's, but saw subsequent drops until 1995 when its Open Skies agreement was signed with the U.S. Since 1995, Sweden's transatlantic service levels experienced increases over the first five years, followed by decreases below pre-Open Skies levels by 2004. July departures experienced historic lows in 1995-1997, the first three years following the signing of Open Skies. During the period from 2002-2004, a historic low one carrier served Sweden from the U.S. compared to four prior to Open Skies. Since 2004, service levels have recovered and most recently have exceeded pre-Open Skies levels. However, the historic highs and lows in the first five years of the agreement make the Swedish case study of the impacts of Open Skies at best inconclusive.

Conclusion: Increase in enplanements but decrease in number of competitors - inconclusive.

Luxembourg (Open Skies agreement signed June 1995)

Figure 23: U.S.-Luxembourg Transatlantic Service Levels, 1990-2007



Service Level	5-Year Pre Avg.	5-Year Post Avg.	Service Changes
# of City Pairs	0.20	0.20	No Change
# of Competitors	0.20	0.20	No Change
Departures Annual Growth Rate	--	--	Insufficient Data
Enplanements Annual Growth Rate	--	--	Insufficient Data

Luxembourg had no transatlantic service in the years leading up to its Open Skies agreement with the U.S. in 1995. After a short-lived service to Newark in 1999, Luxair canceled its transatlantic service and returned Luxembourg to pre-Open Skies service levels. Despite the signing of an Open Skies agreement, service levels have not increased beyond pre-agreement levels.

Conclusion: No substantial increase in service levels after signing of agreement - inconclusive.

Austria (Open Skies agreement signed June 1995)

Figure 24: U.S.-Austria Transatlantic Service Levels, 1990-2007

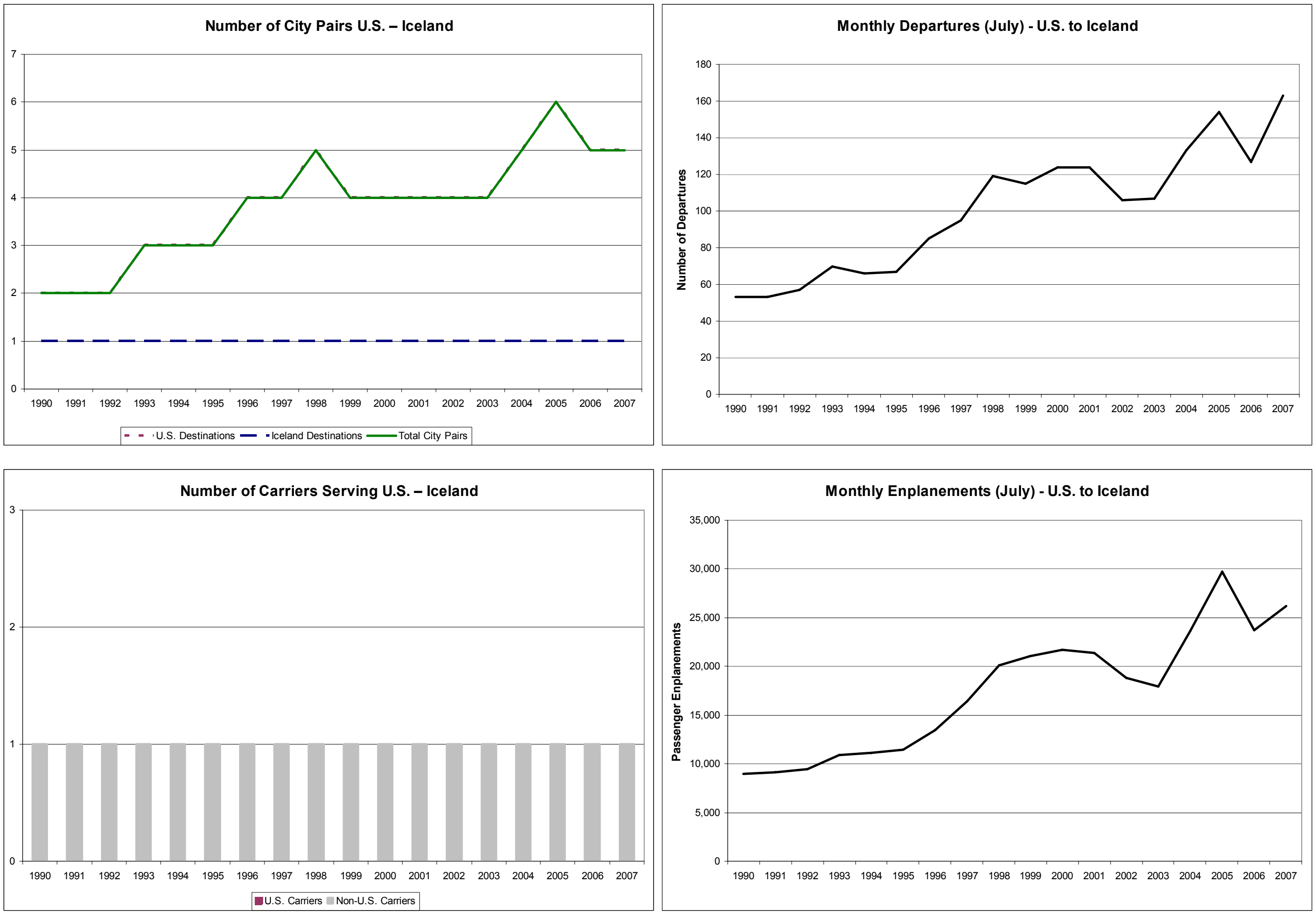
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	1.40	2.00	Increase	No
# of Competitors	2.80	2.00	Decrease	No
Departures AGR	2.45%	24.04%	Increase	No
Enplanements AGR	4.38%	25.76%	Increase	Yes

Austria experienced increases in city pairs and growth rates of departures and enplanements following the signing of its Open Skies agreement in 1995. Beyond the first five years of the agreement, however, the number of competitors providing transatlantic service to Austria dropped from pre-agreement levels to only one carrier (Austrian Airlines) over seven years. Austria represents a net increase in service levels following Open Skies, but the drop in number of competitors dampens the gains.

Conclusion: An overall increase in service levels.

Iceland (Open Skies agreement signed June 1995)

Figure 25: U.S.-Iceland Transatlantic Service Levels, 1990-2007



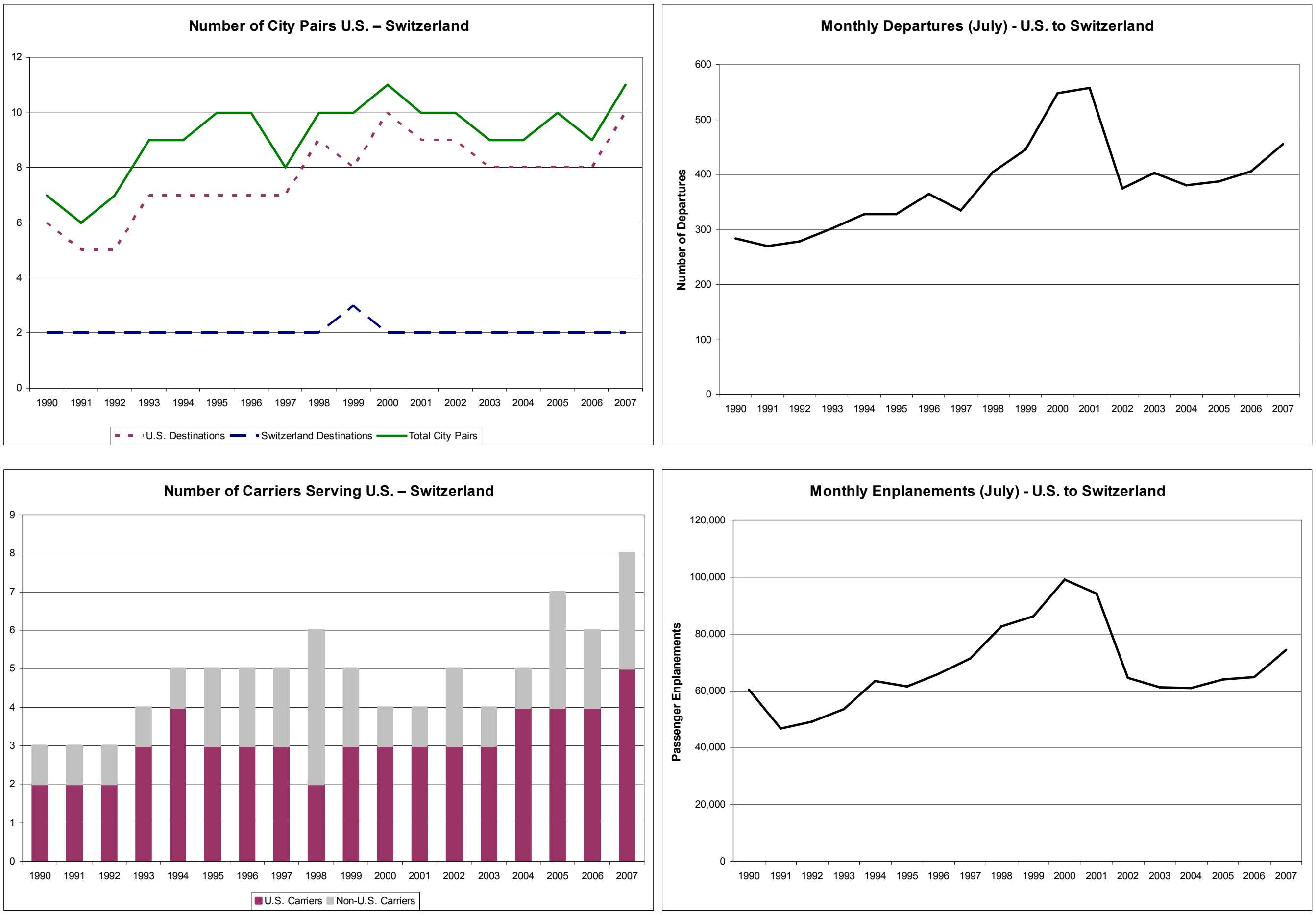
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.40	4.00	Increase	Yes
# of Competitors	1.00	1.00	None	--
Departures AGR	6.16%	12.41%	Increase	Yes
Enplanements AGR	5.72%	13.89%	Increase	Yes

Iceland experienced an increase in the number of city pairs and growth rates of departures and enplanements since 1995. All of this growth has come from Icelandair, the only carrier to provide direct transatlantic service to Reykjavik. A study of the fare impacts of Open Skies in Iceland would shed light on the impacts of limited competition on U.S.-Iceland service.

Conclusion: Overall growth following liberalization with the U.S.

<u>Switzerland</u> (Open Skies agreement signed June 1995)

Figure 26: U.S.-Switzerland Transatlantic Service Levels, 1990-2007



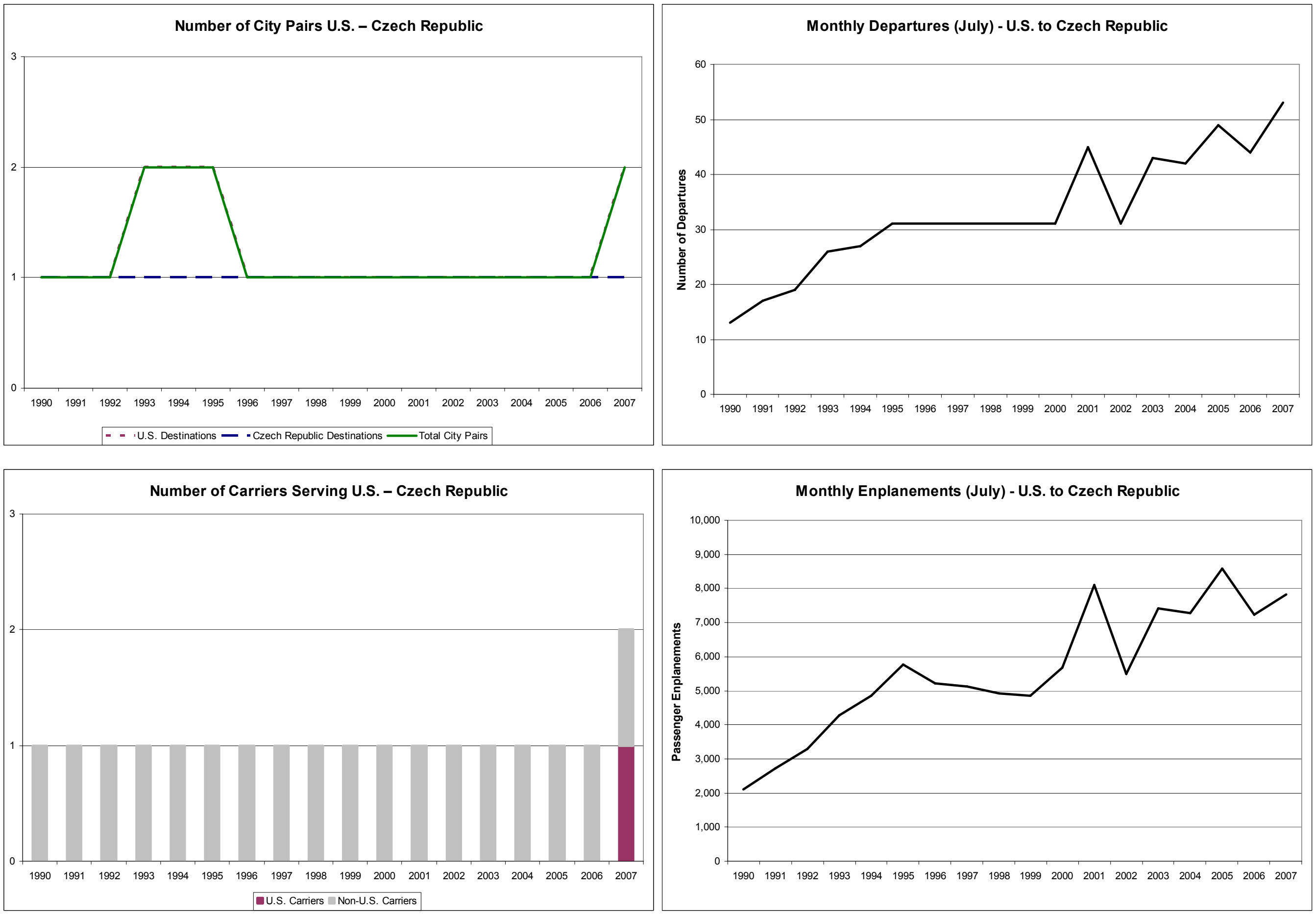
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	7.60	9.60	Increase	Yes
# of Competitors	3.60	5.20	Increase	Yes
Departures AGR	3.83%	6.88%	Increase	Yes
Enplanements AGR	2.55%	6.47%	Increase	No

Switzerland has seen a steady increase in transatlantic service levels since 1995, although growth was already apparent in the years leading up to the agreement. The number of city pairs has grown slowly whereas the level of competition has increased significantly since before its Open Skies agreement with the U.S. Growth rates in departures and enplanements increased following the agreement.

<u>Conclusion</u>: Overall steady growth since signing Open Skies with the U.S.

Czech Republic (Open Skies agreement signed December 1995)

Figure 27: U.S.-Czech Republic Transatlantic Service Levels, 1990-2007



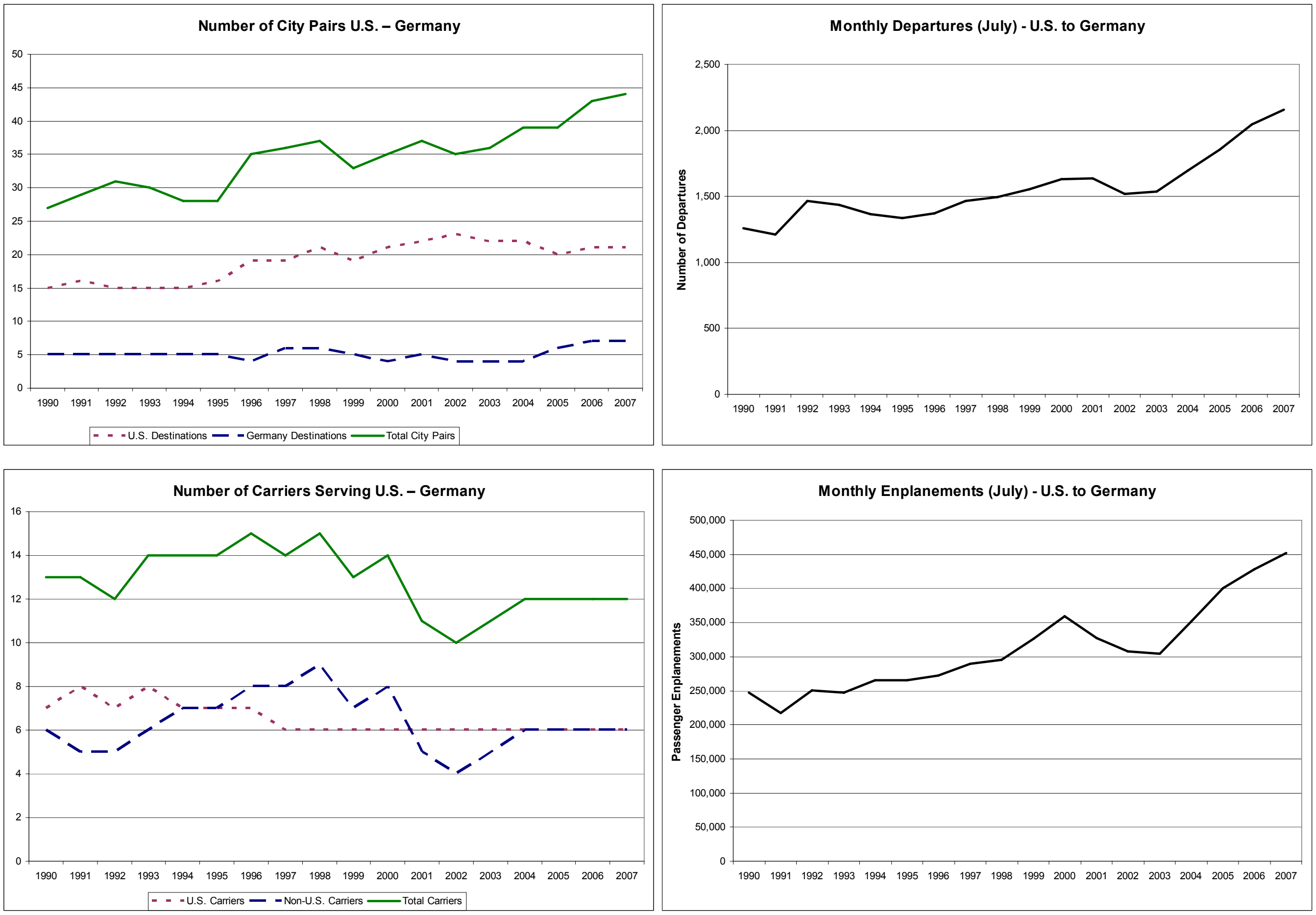
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	1.60	1.00	Decrease	No
# of Competitors	1.00	1.00	None	--
Departures AGR	19.61%	0.00%	Decrease	Yes
Enplanements AGR	22.46%	0.06%	Decrease	Yes

In the first five years following the signing of Open Skies with the U.S., the Czech Republic saw a drop in transatlantic service levels. The number of city pairs dropped from two to one while the number of competitors remained fixed at one. The number of departures remained constant at 31 and total passenger enplanements dropped steadily by 15% through 1999, recovering to pre-Open Skies levels in 2000. Despite steady growth since 2002, which perhaps would not have been possible without Open Skies, the data indicates that the Czech Republic experienced a reduction in service levels in the five years following its Open Skies agreement.

Conclusion: During first five years of agreement, an overall reduction in service levels.

Germany (Open Skies agreement signed February 1996)

Figure 28: U.S.-Germany Transatlantic Service Levels, 1990-2007



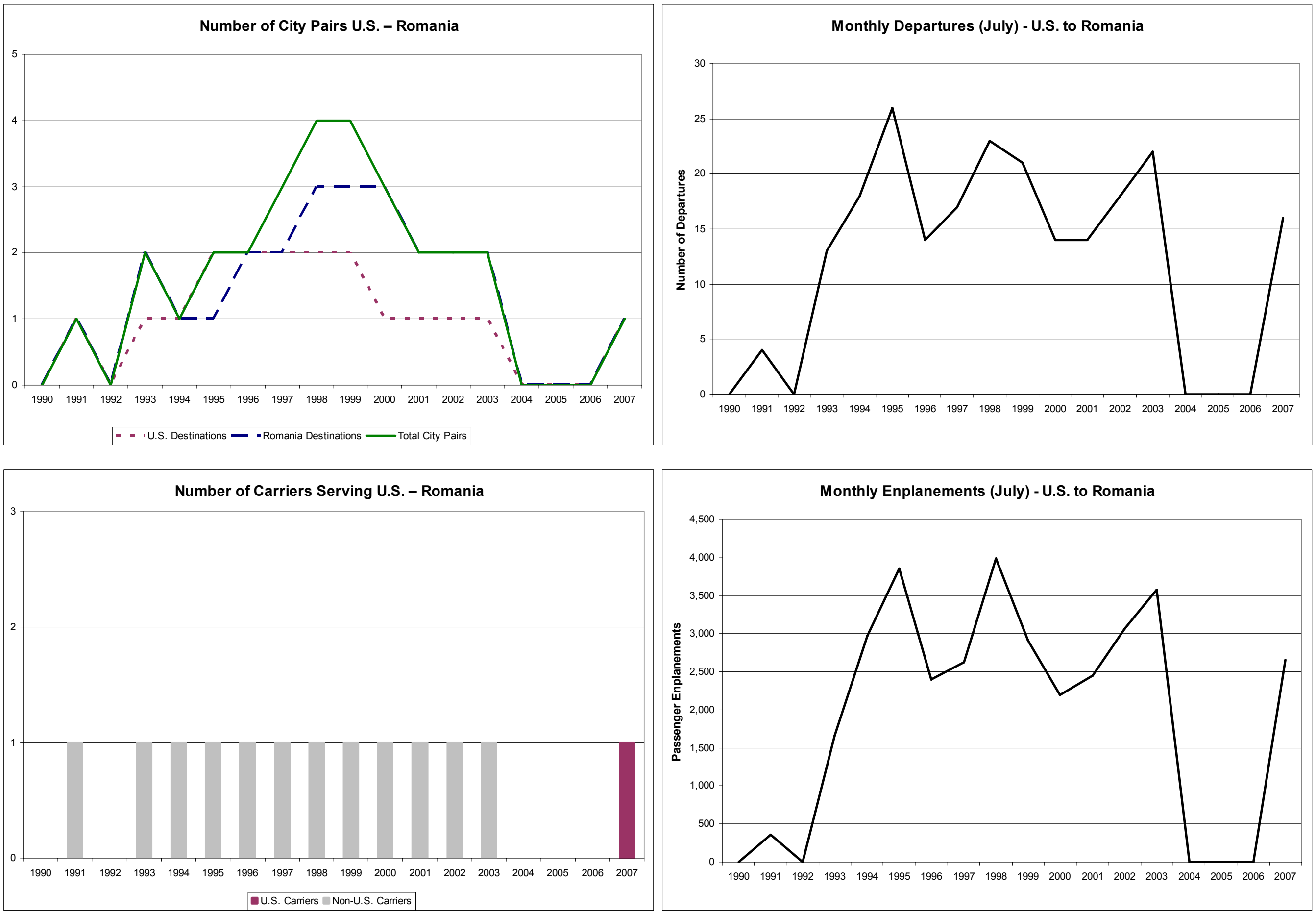
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	29.20	35.20	Increase	Yes
# of Competitors	13.40	14.20	Increase	No
Departures AGR	1.69%	4.08%	Increase	No
Enplanements AGR	1.88%	6.26%	Increase	No

Germany is often used to cite the benefits of air transportation liberalization. Indeed, following the signing of its Open Skies agreement with the U.S. in 1996, the number of city pairs (28 in 1995) steadily increased (44 in 2007). Similarly, the number of July departures and enplanements rose steadily from 1996 onwards with the exception of the three years following 9/11 in which overall transatlantic demand levels saw a decline. However, beyond the first five years of the agreement, the total number of transatlantic competitors remained the same as pre-agreement levels (14). It is interesting to note that the number of transatlantic competitors in Germany has yet to reach pre-Open Skies levels.

Conclusion: An overall increase in service levels during the first five years of the agreement.

Romania (Open Skies agreement signed July 1998)

Figure 29: U.S.-Romania Transatlantic Service Levels, 1990-2007



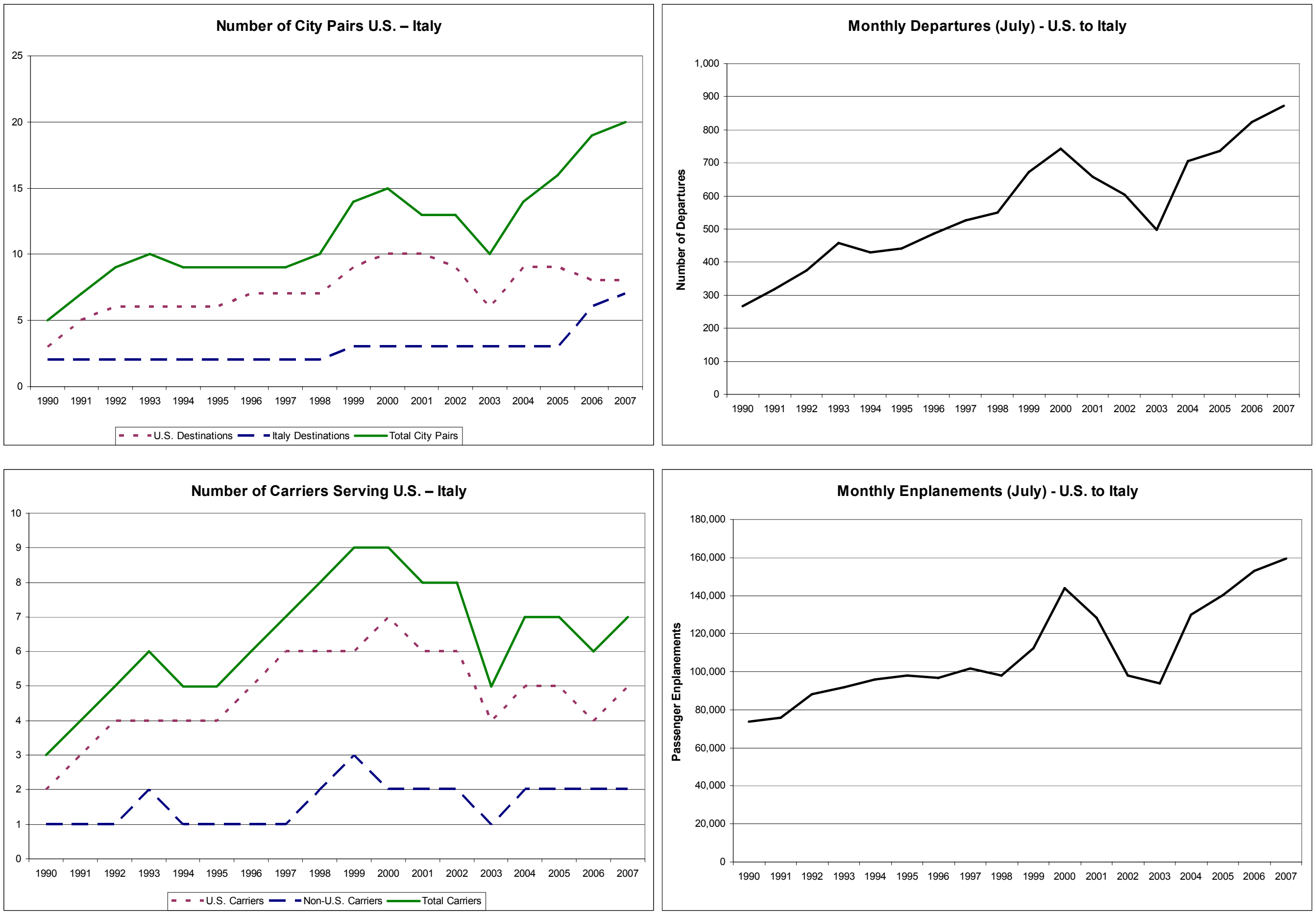
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.40	2.60	Increase	No
# of Competitors	1.00	1.00	None	--
Departures AGR	18.69%	1.75%	Decrease	No
Enplanements AGR	26.40%	0.33%	Decrease	No

When Romania signed its Open Skies agreement with the U.S. in 1998, it was experiencing historic high levels of transatlantic enplanements and city pairs. During the first five years of the agreement, Romania saw half of its city pairs eliminated, and its number of departures and enplanements dropped to pre-agreement levels. By 2004, all transatlantic service to Romania had been lost and has since been restored in a limited capacity by U.S. carrier Delta Air Lines from its JFK hub. However, in the first five years following the agreement, the data is not conclusive.

Conclusion: Inconclusive due to lack of statistically significant indicators.

Italy (Open Skies agreement signed November 1998)

Figure 30: U.S.-Italy Transatlantic Service Levels, 1990-2007



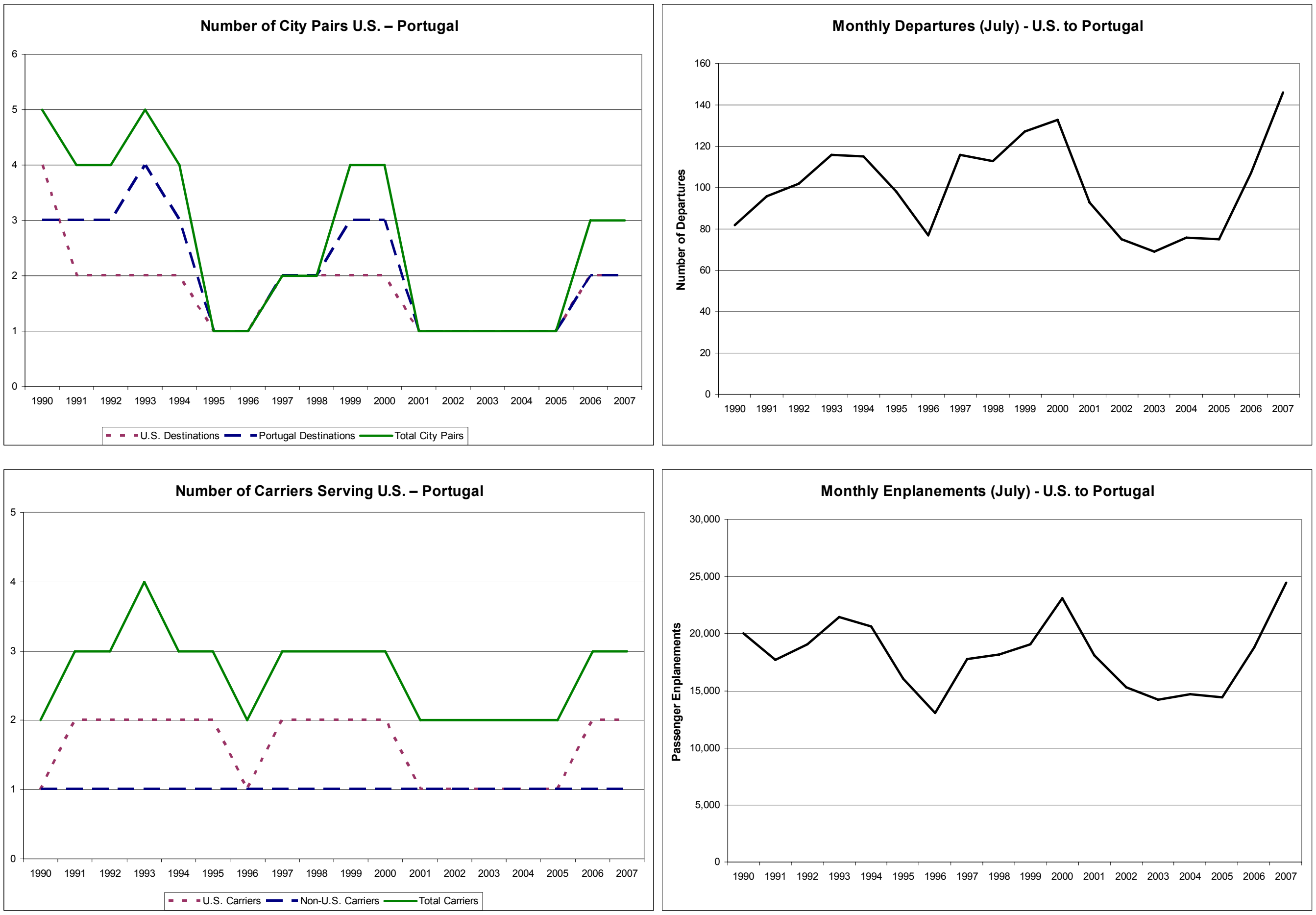
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	9.20	13.00	Increase	Yes
# of Competitors	6.20	7.80	Increase	No
Departures AGR	3.93%	-0.90%	Decrease	No
Enplanements AGR	1.35%	0.82%	Decrease	No

In the first five years after signing an Open Skies agreement with the U.S., Italy saw an increase in city pairs and carriers providing transatlantic service, but a reduction in the growth rates of departures and enplanements. Furthermore, the effects of 9/11 dampen the gains of Open Skies since it is a price-elastic tourism destination heavily affected by demand downturns.

Conclusion: During the first five years, an overall increase in transatlantic service levels.

Portugal (Open Skies agreement signed December 1999)

Figure 31: U.S.-Portugal Transatlantic Service Levels, 1990-2007



Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.00	1.60	Decrease	No
# of Competitors	2.80	2.20	Decrease	No
Departures AGR	4.85%	-8.51%	Decrease	No
Enplanements AGR	0.41%	-3.88%	Decrease	No

Portugal saw a statistically insignificant reduction in all four service level measures in the first five years after signing its Open Skies agreement with the U.S. Portugal had dropped to four city pairs before Open Skies following prior losses. In the first five years of the agreement, the number of city pairs dropped to one, the lowest level since 1990. Portugal also experienced an immediate drop in number of competitors during the first five years of Open Skies, again to historic lows. The total number of competitors has yet to reach the pre-Open Skies peak of four. Both the number of transatlantic departures and enplanements dropped immediately following Open Skies and only began to recover in 2005, six years after the agreement was signed.

Conclusion: Lack of statistically significant change renders this case inconclusive.

Slovak Republic (Open Skies agreement signed January 2000)

Service Level	5-Year Pre Avg.	5-Year Post Avg.	Service Changes
# of City Pairs	0.00	0.00	No Service
# of Competitors	0.00	0.00	No Service
Departures Annual Growth Rate	--	--	Insufficient Data
Enplanements Annual Growth Rate	--	--	Insufficient Data

The Slovak Republic had no transatlantic service in the years leading up to its Open Skies agreement with the U.S. in 2000. Despite the signing of an Open Skies agreement, no service has been added to date.

Conclusion: No addition of service after signing of agreement.

Turkey (Open Skies agreement signed March 2000)

Figure 32: U.S.-Turkey Transatlantic Service Levels, 1990-2007

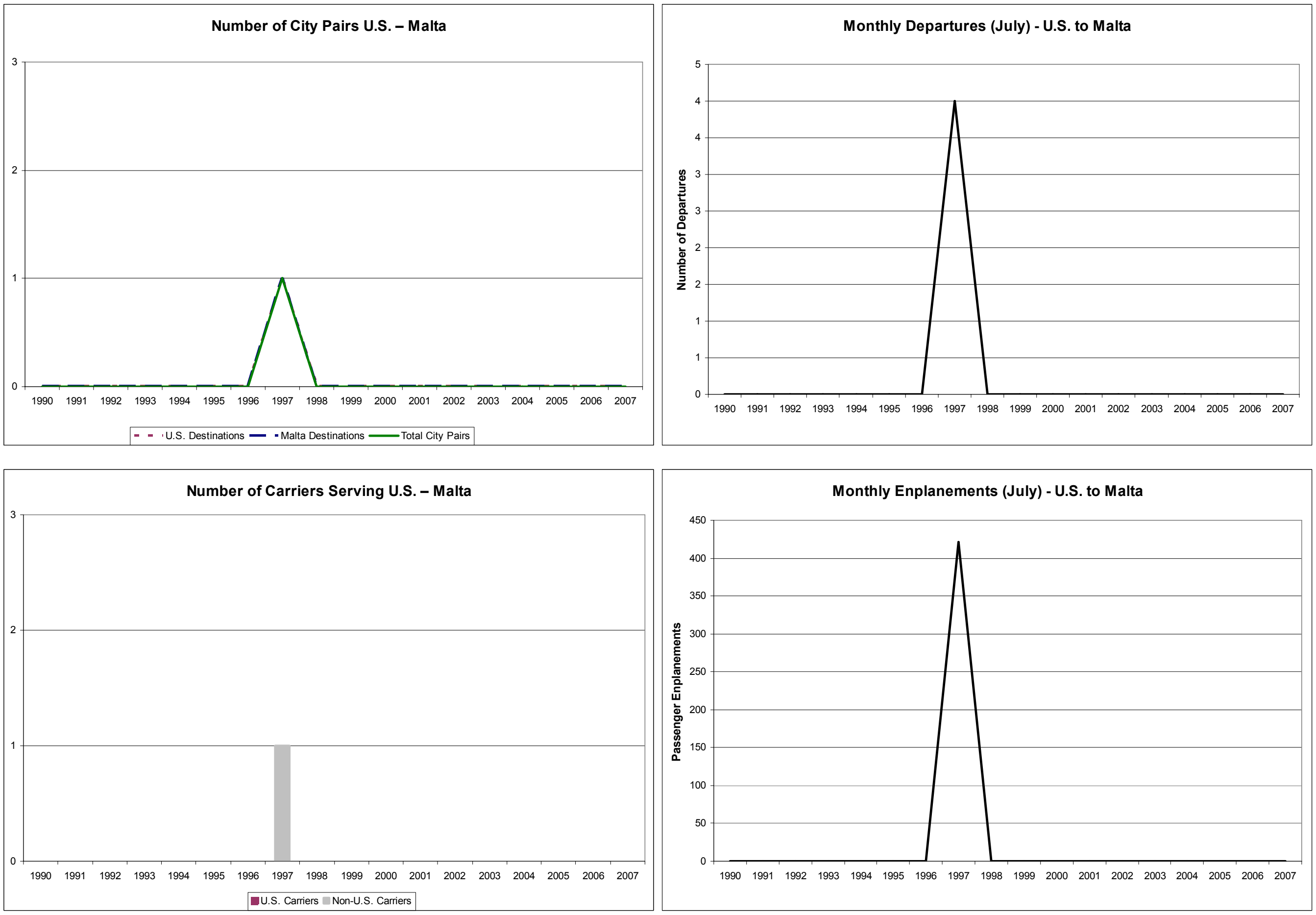
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	2.00	2.40	Increase	No
# of Competitors	1.60	2.00	Increase	No
Departures AGR	35.61%	-2.54%	Decrease	No
Enplanements AGR	33.51%	0.14%	Decrease	Yes

In the first five years after signing an Open Skies agreement with the U.S., Turkey saw an increase in city pairs and carriers providing transatlantic service but a reduction in the growth rates of departures and enplanements. The number of transatlantic departures reached its peak in 1999 and, since entering into the agreement, has yet to return to that level. Transatlantic enplanements reached their peak in 2000, but have yet to return to pre-agreement levels, seven years after the agreement was signed. However only the reduction in enplanements demonstrates statistical significance, rendering this case an overall reduction.

Conclusion: An overall reduction in service levels.

Malta (Open Skies agreement signed October 2000)

Figure 33: U.S.-Malta Transatlantic Service Levels, 1990-2007



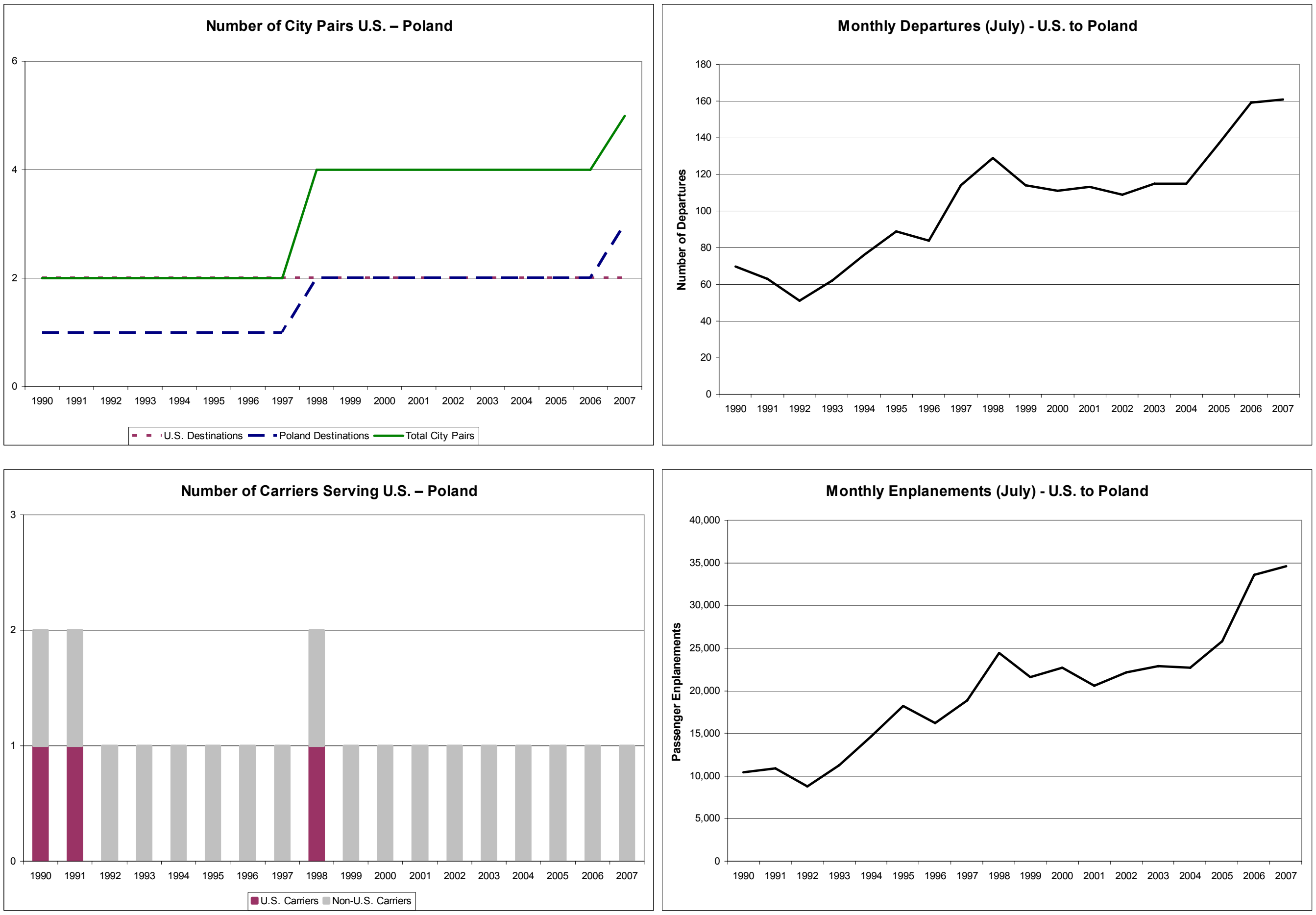
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	0.20	0.00	Decrease	No
# of Competitors	0.20	0.00	Decrease	No
Departures AGR	--	--	--	--
Enplanements AGR	--	--	--	--

Malta had no transatlantic service in the years leading up to its Open Skies agreement with the U.S. in 2000. After a short-lived weekly service to JFK in 1997, Balkan Bulgarian Airlines canceled its transatlantic service and returned Malta to pre-Open Skies levels. Despite the signing of an Open Skies agreement, service levels never reached pre-agreement levels.

Conclusion: No addition of service to Malta after signing of agreement.

Poland (Open Skies agreement signed May 2001)

Figure 34: U.S.-Poland Transatlantic Service Levels, 1990-2007



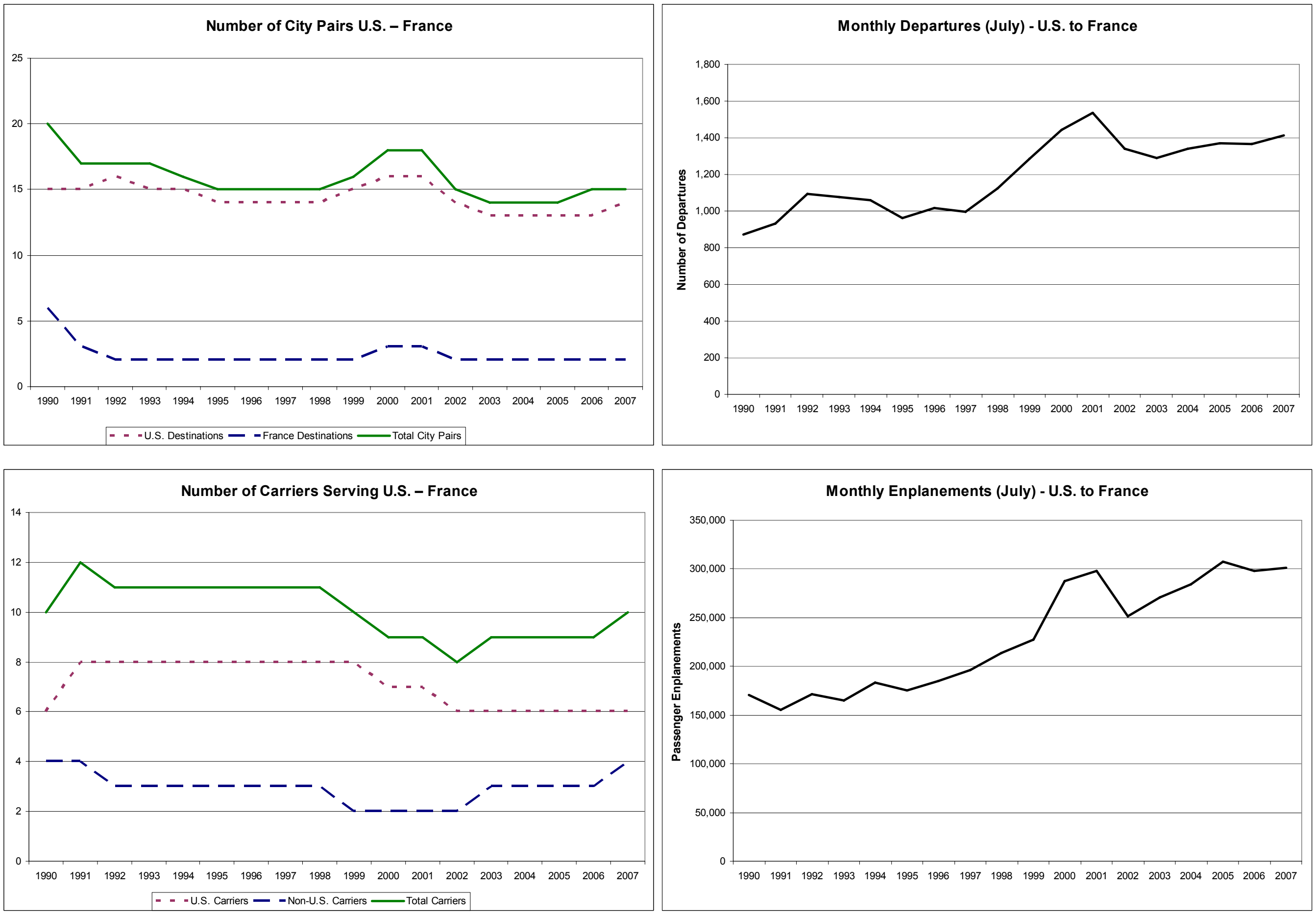
Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	3.20	4.00	Increase	No
# of Competitors	1.20	1.00	Decrease	No
Departures AGR	5.80%	4.58%	Decrease	No
Enplanements AGR	5.70%	2.86%	Decrease	No

Poland signed an Open Skies agreement with the U.S. immediately prior to the attacks of 9/11. Transatlantic demand subsequently dropped, and Poland's upward trend in transatlantic service indeed slowed. In the first five years of the agreement, the number of city pairs increased without statistical significance. Yet over this period, the number of transatlantic competitors, monthly departures and enplanements dropped without significance.

Conclusion: No statistically significant change in service levels - inconclusive.

France (Open Skies agreement signed October 2001)

Figure 35: U.S.-France Transatlantic Service Levels, 1990-2007



Service Level	5-Year Pre Avg.	5-Year Post Avg.	Change	95% Significant
# of City Pairs	16.40	14.40	Decrease	Yes
# of Competitors	10.00	8.80	Decrease	Yes
Departures AGR	8.62%	-0.73%	Decrease	Yes
Enplanements AGR	10.70%	1.77%	Decrease	No

France signed its Open Skies agreement with the U.S. immediately following the attacks of 9/11. France saw a reduction in transatlantic service levels in the first five years of its agreement. Although during this period France exceeded pre-agreement enplanement levels, the number of city pairs, competitors, and departures all declined. Therefore it appears as if the growth in passengers enplaned is largely due to Air France's expansion of Charles de Gaulle as a global hub (versus local Paris traffic). Indeed, between July 2001 July and 2007, Air France carried 30,000 additional passengers to CDG. The relevance of this increase in hub traffic will be further discussed in the next chapter.

Conclusion: An overall decrease in service levels during the first five years of its agreement.

Albania (Open Skies agreement signed September 2003)

Service Level	5-Year Pre Avg.	5-Year Post Avg.	Service Changes
# of City Pairs	0.00	0.00	No Service
# of Competitors	0.00	0.00	No Service
Departures Annual Growth Rate	--	--	Insufficient Data
Enplanements Annual Growth Rate	--	--	Insufficient Data

Albania had no transatlantic service in the years leading up to its Open Skies agreement with the U.S. in 2003. Despite the signing of an Open Skies agreement, no service has been added to date.

Conclusion: No addition of service after signing of agreement.

Bosnia and Herzegovina (Open Skies agreement signed November 2005)

Service Level	5-Year Pre Avg.	5-Year Post Avg.	Service Changes
# of City Pairs	0.00	0.00	No Service
# of Competitors	0.00	0.00	No Service
Departures Annual Growth Rate	--	--	Insufficient Data
Enplanements Annual Growth Rate	--	--	Insufficient Data

Bosnia and Herzegovina had no transatlantic service in the years leading up to its Open Skies agreement with the U.S. in 2005. Despite the signing of an Open Skies agreement, no service has been added to date.

Conclusion: No addition of service after signing of agreement.

Croatia and the remaining European Union member nations: Bulgaria, Cyprus, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Slovenia, Spain, United Kingdom

(EU-U.S. Open Skies agreement signed April 2007, Croatia signed March 2008)

Croatia last had transatlantic service in 1991, when Pan American World Airways provided weekly service to Zagreb from JFK. Since 1991, no carrier has provided service between Croatia and the U.S. Despite the signing of an Open Skies agreement, no carrier has announced direct service to Croatia.

Conclusion: No planned service to Croatia since signing of agreement.

In April 2007, EU and U.S. officials signed an Open Skies accord, which would apply provisionally to the eleven member nations that did not already have an Open Skies agreement in place with the U.S.: Bulgaria, Cyprus, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Slovenia, Spain and the United Kingdom. According to OAG data, only Ireland and Spain have seen more than a 5% increase in the number of transatlantic departures scheduled. The United Kingdom has seen an increase in departures scheduled to London Heathrow, but no aggregate increase in departures scheduled. Moreover, no addition of intra-European service has been announced by U.S. carriers.

Conclusion: Although years of data will be required for this retrospective approach, initial metrics indicate service level growth for Ireland and Spain, with little change identified elsewhere.

4.3 Antitrust Immunity and Alliances

As demand for international travel has increased, U.S. carriers have built alliances with their foreign counterparts in order to carry “behind” and “beyond” traffic through their hub-and-spoke networks. Without the cabotage rights discussed in Chapter 2, carriers are unable to build extensive networks inside foreign territory and must therefore rely on partner carriers to provide service beyond those large cities served directly from their domestic hubs. Alliances with foreign carriers can be limited to marketing partnerships and extend to joint ventures. The most common types are “codesharing” alliances and “antitrust immunized” alliances. Approval of both alliance arrangements requires careful examination of their impact on competition in both domestic and international markets. The U.S. DOT’s

Office of International Aviation processes codeshare applications while the U.S. DOT's Office of Aviation Analysis processes antitrust immunity applications.[24]

Codesharing agreements allow carriers to designate a flight number on partner flights, which allows both carriers to sell and ticket one another's flights. Generally, codeshare partners will negotiate a percentage of a flight's capacity available to the partner at a prorated price. Codeshare partners are also able to coordinate their flight schedules to optimize connectivity, but they are not able to fully integrate their schedules as immunized carriers can.

Antitrust immunity (AI) grants partner carriers exemption from prosecution under antitrust laws, allowing them to fully coordinate schedules, prices and operations. Joint ventures are immunized partnerships in which carriers integrate some of their operations and share profits. The U.S. DOT is responsible for granting AI to U.S. carriers and their partners (whether U.S. or foreign). The agency has established a precedent of only granting antitrust immunity to partner carriers of Open Skies signatories. Therefore any benefits that come as a result of immunized alliances or joint ventures rely upon the establishment of an Open Skies agreement.

A study by U.S. Department of Justice economist W. Tom Whalen (2005) found that codesharing results in fare decreases of 5-10% and passenger volume increases of 22-45%. Antitrust immunity results in fare decreases of 14-22% and passenger volume increases of 51-88%. According to the study, "this result is consistent with the hypothesis that the primary effect of the alliance is an internalization of [the double marginalization] demand externality." That is to say that under an immunized alliance, the additional cost of transfer prices are not passed on to the consumer, as they are in a purely codesharing agreement.

Whalen goes on to suggest that capacity changes on transatlantic segments following Open Skies treaties are actually a result of AI alliances rather than the treaties themselves. The study claims that the expectation that Open Skies should result in lower fares on connecting routes is incorrect. Instead, "all of the capacity expansion associated with Open Skies treaties is due to expansion by carriers with immunized alliances on routes between their hubs" and not the actual agreement. This conclusion is supported by evidence that in the past, "Open Skies agreements did not lead to capacity increases from a variety of carriers," but rather immunized carriers flying to their hubs. As seen in Section 4.2, our findings are consistent with this conclusion.

A U.S. DOT (2000) study confirmed that "alliance-based networks are the principal driving force behind transatlantic price reductions and traffic gains." In other words, the data suggests that

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[24] Full list of codeshare alliances available here: http://ostpxweb.dot.gov/aviation/X-40%20Role_Files/coderpt.pdf
A complete list of immunized alliances is included in Appendix II.

deregulation alone has not consistently led to service level increases or fare decreases. Instead deregulation, as a prerequisite for immunization of alliances, has ultimately led to the service benefits we enjoy today. Indeed, even non-alliance carriers have experienced traffic growth as a result of economic growth, but this growth "is certainly modest relative to alliance carriers." In Chapter 5 we evaluate the explanatory power of immunized carrier hubs on transatlantic service levels.

4.4 Summary of Results

The results of our country-by-country analysis are summarized in Table 17Table 20. To review, we draw a conclusion about service level trends when a majority of statistically significant changes in the four metrics (city pairs, competitors, departures and enplanements) indicate an increase or decrease in service levels. The four cases of Slovak Republic, Malta, Albania, and Bosnia-Herzegovina are labeled "No Service" because they lacked consistent transatlantic service before and after the signing of their agreements. Although this represents neither a conclusive increase nor decrease in service, it supports the hypothesis that liberalization alone does not oblige service level increases.

Table 17: Pre and Post Open Skies Change in City Pairs

Country	Date Signed	5-Year Pre Avg: City Pairs	5-Year Post Avg: City Pairs	Service Changes	Wilcoxon Significance
Netherlands	10/14/1992	9.67	11.20	Increase	Not Applicable
Belgium	3/1/1995	4.40	7.20	Increase	95%
Finland	3/24/1995	2.20	2.20	No Change	<80%
Denmark	4/26/1995	4.80	3.00	Decrease	99.5%
Norway	4/26/1995	1.00	1.20	Increase	<80%
Sweden	4/26/1995	2.20	2.00	Decrease	<80%
Luxembourg	6/6/1995	0.20	0.20	No Change	<80%
Austria	6/14/1995	1.40	2.00	Increase	80%
Iceland	6/14/1995	2.40	4.00	Increase	99%
Switzerland	6/15/1995	7.60	9.60	Increase	97.5%
Czech Republic	12/8/1995	1.60	1.00	Decrease	90%
Germany	2/29/1996	29.20	35.20	Increase	99.5%
Romania	7/15/1998	2.40	2.60	Increase	<80%
Italy	11/11/1998	9.20	13.00	Increase	99%
Portugal	12/22/1999	2.00	1.60	Decrease	<80%
Slovak Republic	1/7/2000	0.00	0.00	No Service	No Service
Turkey	3/22/2000	2.00	2.40	Increase	<80%
Malta	10/12/2000	0.20	0.00	Decrease	No Service
Poland	5/31/2001	3.20	4.00	Increase	<80%
France	10/19/2001	16.40	14.40	Decrease	97.5%
Albania	9/24/2003	0.00	0.00	No Service	No Service
Bosnia and Herzegovina	11/22/2005	0.00	0.00	No Service	No Service

Table 18: Pre and Post Open Skies Change in Competitors

Country	Date Signed	5-Year Pre Avg: Competitors	5-Year Post Avg: Competitors	Service Changes	Wilcoxon Significance
Netherlands	10/14/1992	7.67	9.00	Increase	Not Applicable
Belgium	3/1/1995	5.60	5.60	No Change	<80%
Finland	3/24/1995	2.00	1.20	Decrease	95%
Denmark	4/26/1995	3.60	1.60	Decrease	99.5%
Norway	4/26/1995	2.00	1.20	Decrease	95%
Sweden	4/26/1995	3.40	2.40	Decrease	95%
Luxembourg	6/6/1995	0.20	0.20	No Change	<80%
Austria	6/14/1995	2.80	2.00	Decrease	80%
Iceland	6/14/1995	1.00	1.00	No Change	<80%
Switzerland	6/15/1995	3.60	5.20	Increase	97.5%
Czech Republic	12/8/1995	1.00	1.00	No Change	<80%
Germany	2/29/1996	13.40	14.20	Increase	80%
Romania	7/15/1998	1.00	1.00	No Change	<80%
Italy	11/11/1998	6.20	7.80	Increase	90%
Portugal	12/22/1999	2.80	2.20	Decrease	90%
Slovak Republic	1/7/2000	0.00	0.00	No Service	No Service
Turkey	3/22/2000	1.60	2.00	Increase	<80%
Malta	10/12/2000	0.20	0.00	Decrease	No Service
Poland	5/31/2001	1.20	1.00	Decrease	<80%
France	10/19/2001	10.00	8.80	Decrease	95%
Albania	9/24/2003	0.00	0.00	No Service	No Service
Bosnia and Herzegovina	11/22/2005	0.00	0.00	No Service	No Service

Table 19: Pre and Post Open Skies Change in Departures

Country	Date Signed	5-Year Pre Avg: Annual Dep. Growth	5-Year Post Avg: Annual Dep. Growth	Service Changes	Wilcoxon Significance
Netherlands	10/14/1992	11.08%	10.20%	Decrease	Not Applicable
Belgium	3/1/1995	2.60%	9.91%	Increase	90%
Finland	3/24/1995	9.93%	-7.02%	Decrease	80%
Denmark	4/26/1995	0.04%	-6.29%	Decrease	90%
Norway	4/26/1995	0.90%	-0.11%	Decrease	80%
Sweden	4/26/1995	1.14%	9.67%	Increase	90%
Luxembourg	6/6/1995	--	--	No Service	95%
Austria	6/14/1995	2.45%	24.04%	Increase	90%
Iceland	6/14/1995	6.16%	12.41%	Increase	99%
Switzerland	6/15/1995	3.83%	6.88%	Increase	97.5%
Czech Republic	12/8/1995	19.61%	0.00%	Decrease	99.5%
Germany	2/29/1996	1.69%	4.08%	Increase	90%
Romania	7/15/1998	18.69%	1.75%	Decrease	80%
Italy	11/11/1998	3.93%	-0.90%	Decrease	<80%
Portugal	12/22/1999	4.85%	-8.51%	Decrease	<80%
Slovak Republic	1/7/2000	--	--	No Service	No Service
Turkey	3/22/2000	35.61%	-2.54%	Decrease	<80%
Malta	10/12/2000	--	--	No Service	No Service
Poland	5/31/2001	5.80%	4.58%	Decrease	<80%
France	10/19/2001	8.62%	-0.73%	Decrease	95%
Albania	9/24/2003	--	--	No Service	No Service
Bosnia and Herzegovina	11/22/2005	--	--	No Service	No Service

Table 20: Pre and Post Open Skies Change in Passenger Enplanements

Country	Date Signed	5-Year Pre Avg: Annual Pax Growth	5-Year Post Avg: Annual Pax Growth	Service Changes	Wilcoxon Significance
Netherlands	10/14/1992	5.55%	13.69%	Increase	Not Applicable
Belgium	3/1/1995	-3.09%	15.48%	Increase	99%
Finland	3/24/1995	12.96%	-5.73%	Decrease	95%
Denmark	4/26/1995	-3.45%	-8.72%	Decrease	80%
Norway	4/26/1995	-2.52%	15.24%	Increase	80%
Sweden	4/26/1995	1.73%	9.16%	Increase	97.5%
Luxembourg	6/6/1995	--	--	No Service	95%
Austria	6/14/1995	4.38%	25.76%	Increase	95%
Iceland	6/14/1995	5.72%	13.89%	Increase	99.5%
Switzerland	6/15/1995	2.55%	6.47%	Increase	80%
Czech Republic	12/8/1995	22.46%	0.06%	Decrease	99%
Germany	2/29/1996	1.88%	6.26%	Increase	<80%
Romania	7/15/1998	26.40%	0.33%	Decrease	<80%
Italy	11/11/1998	1.35%	0.82%	Decrease	<80%
Portugal	12/22/1999	0.41%	-3.88%	Decrease	<80%
Slovak Republic	1/7/2000	--	--	No Service	No Service
Turkey	3/22/2000	33.51%	0.14%	Decrease	97.5%
Malta	10/12/2000	--	--	No Service	No Service
Poland	5/31/2001	5.70%	2.86%	Decrease	<80%
France	10/19/2001	10.70%	1.77%	Decrease	80%
Albania	9/24/2003	--	--	No Service	No Service
Bosnia and Herzegovina	11/22/2005	--	--	No Service	No Service

The results of our Open Skies analysis are summarized in Table 21. **Of the 22 countries with U.S. Open Skies agreements in place by 2007, only seven demonstrated overall increases in service levels while six demonstrated overall reductions.** The seven which experienced gains are the Netherlands, Belgium, Austria, Iceland, Switzerland, Germany and Italy. The six countries experiencing decreases in service levels are Finland, Denmark, Norway, the Czech Republic, Turkey and France. We have deemed five cases inconclusive due to mixed evidence or a lack of statistically significant indicators. Given a lack of data for 2008 Open Skies signatories, the impacts of EU-U.S. Open Skies are still uncertain.

One limitation of the data is that for countries signing an agreement with the U.S. after 1997, post-agreement data includes the effects of 9/11 on service levels. More generally, the data includes impacts from individual economic and political events, as well as periods of armed conflict. Unfortunately, the impacts of these events cannot be separated from those of the Open Skies agreements. Additionally, countries with no service to the U.S. before or after the signing of Open Skies cannot be evaluated using the same statistical tests as those with service, yet they are not inconclusive. Instead, they fail to demonstrate a conclusive increase in service levels as a result of Open Skies, as we have defined it.

Our findings are consistent with those of InterVISTAS (2006), which concluded that "liberalization is a necessary but not sufficient condition for traffic growth." Of course, "no new services can result if there is no underlying demand to support them." Yet to presuppose that city pairs without service will receive nonstop service in a liberalized regime is incorrect. It is equally incorrect to assume that city pairs with existing service will not see reduction in service levels in a liberalized regime. In the next chapter we build an econometric model to validate the conclusion that the existence of Open Skies is not a dominant explanatory factor of transatlantic service levels.

Table 21: Final Results of Open Skies Analysis of 22 European Countries

Country	Date Signed	City Pairs	Departures	Passengers Enplaned	Competitors	Overall Change Following Open Skies?
Netherlands[1]	10/14/1992	▲	▼	▲	▲	Increase
Belgium	3/1/1995	▲	—	▲	—	Increase
Finland	3/24/1995	—	—	▼	▼	Decrease
Denmark	4/26/1995	▼	—	—	▼	Decrease
Norway	4/26/1995	—	—	—	▼	Decrease
Sweden	4/26/1995	—	—	▲	▼	Inconclusive
Luxembourg	6/6/1995	—	—	—	—	Inconclusive
Austria	6/14/1995	—	—	▲	—	Increase
Iceland	6/14/1995	▲	▲	▲	—	Increase
Switzerland	6/15/1995	▲	▲	—	▲	Increase
Czech Republic	12/8/1995	—	▼	▼	—	Decrease
Germany	2/29/1996	▲	—	—	—	Increase
Romania	7/15/1998	—	—	—	—	Inconclusive
Italy	11/11/1998	▲	—	—	—	Increase
Portugal	12/22/1999	—	—	—	—	Inconclusive
Slovak Republic[2]	1/7/2000	—	—	—	—	No Service
Turkey	3/22/2000	—	—	▼	—	Decrease
Malta[2]	10/12/2000	—	—	—	—	No Service
Poland	5/31/2001	—	—	—	—	Inconclusive
France	10/19/2001	▼	▼	—	▼	Decrease
Albania[2]	9/24/2003	—	—	—	—	No Service
Bosnia & Herzegovina[2]	11/22/2005	—	—	—	—	No Service

[1] Wilcoxon Rank Sum test could not be performed on the Netherlands due to a lack of available data prior to 1990
[2] Country had no service after signing of agreement
— Indicates no statistically significant change

Chapter 5

Econometric Market Analysis

In previous chapters, we analyzed transatlantic aviation markets since 1990 in the face of liberalization and increasing competition. In Chapter 3 we identified movement towards the use of concentrated hubs as transatlantic gateways as well as the disproportionate growth of U.S. carriers over the Atlantic. In Chapter 4 we saw that Open Skies has resulted in both increases and decreases in transatlantic service levels, and that growth resulting from immunized alliance expansion has relied upon liberalized regulatory regimes.

In this chapter we perform several regression analyses to validate the conclusions drawn in previous chapters. The chapter is separated into three sections. The first contains a review of literature in the field of air transportation econometric analysis. The focus here is to identify common explanatory variables used to describe service levels for a given market. The second section summarizes the market characteristics of U.S. and European cities with transatlantic service. These characteristics are used as explanatory variables in the subsequent econometric model. In the third section we specify the model and discuss the findings.

5.1 Background and Literature Review

In our final analysis we seek to identify what factors explain transatlantic service levels in a particular market. Regression analysis allows us to estimate the relationship between service levels and a set of explanatory variables. We recall, however, that regression is a test of correlation and not causation. Therefore, we will test the null hypothesis that certain explanatory variables *fail* to explain service levels since we cannot, with certainty, determine that they explain them. One such null hypothesis is that the signing of an Open Skies agreement has no significant impact on service levels. We also test how well certain geographic and socioeconomic indicators predict service levels.

An econometric or regression model will never provide an exact fit, but some models provide a closer fit than others. The R^2 (r-square) value measures a model's "goodness of fit" to the actual dependent variable data. It is possible to build a model with high R^2 (close to one) whose explanatory variables clearly have no relationship to the dependent variable. For example, Japan's annual fish exports may correlate very well with air traffic demand between New York and Miami, but the model does not make a sensible prediction about how changes in the explanatory variable will lead to changes in traffic. In other words, R^2 alone is not the only measure of the quality of a model. A good model must use variables that make intuitive sense.

Furthermore, a model with a high R^2 may be poor if its explanatory variables are not statistically significant. Significance is tested using the t-statistic, which is calculated by dividing a regression coefficient by its standard error. A t-statistic larger than some critical value indicates that the coefficient was able to be estimated with a fair amount of accuracy and is therefore deemed significant. However, variables with extremely large t-statistics might be serially correlated with the dependent variable and should be avoided. Lastly, a good model's variable coefficients should have signs that meet our a priori hypotheses. In our analysis we will rely on an "adjusted R^2" which applies negative weight as an increasing number of explanatory variables are incorporated into the model.

Since we are ultimately interested in identifying those variables with the greatest explanatory power, we begin with a review of the literature in transportation demand modeling. Most of the theory in the field surrounds the forecasting of passenger demand between two points of interest. These so-called "gravity models" describe the attraction between two cities, regions, or countries in an attempt to quantify passenger or cargo traffic between the two.

Gravity models are derived from economic or social supply variables that can be categorized into two groups: geo-economic and service-related factors (Rengaraju and Thamizh Arasan, 1992; Kanafani, 1983). Geo-economic factors describe the economic activities and geographical characteristics of the areas around the airports and the routes involved (Jorge-Calderón, 1997) whereas service-related factors are characteristics of the air transport system that are under the control of the airlines (Grosche et al., 2007). In our analysis we seek to explain service levels across all carriers to all transatlantic destinations, so we will ignore service-related factors (e.g. frequency, price, service quality) that seek to explain passenger preference for a particular carrier over another.

Virtually all gravity models incorporate distance between cities as an important geographical factor affecting their air travel demand. Indeed, we expect that increasing distance leads to reduced demand because of increased flying time (and in some extreme cases, limits in aircraft range) and cost of operations, as well as lower social and commercial interactions. However, Jorge-Calderón (1997) points out that, all else being equal, longer distances increase the attractiveness of air transport relative to other transportation modes. However, since there are no pragmatic mode alternatives for transatlantic travel, we ignore the role that competing service (train, car, etc.) that is common to gravity models.

The other most commonly used geo-economic factors are income and the population of the metropolitan area served (Grosche et al., 2007). We incorporate these factors, which intuitively impact transatlantic demand, into our regression analysis. We use the population of the airport catchment region first used by Moore and Soliman (1981) as opposed to simple city populations. Doganis (1966) was the first to observe passenger numbers at each airport as an indication of the demand between the two. Since our analysis seeks to explain service levels of one city (often a multi-airport system) or country to a host of cities, this metric has less meaning and is therefore not used.

Other factors used in gravity models include income distribution and a competition index (Brown and Watkins, 1968), number of phone calls and flying time (Verleger, 1972), percentage of university degree holders, number of full-time employees, type of city and big-city proximity factor (Rengaraju and Thamizh Arasan, 1992), political and cultural relationships between two countries (Russon and Riley, 1993), and many others. Although some of these variables, particularly the city type, competition index and relationships between two countries, are intuitively correlated to transatlantic service levels, a lack of accurate data across our sample prevents their use in the model.

Our research explores the impact that liberalization, particularly Open Skies, has on transatlantic service levels. As a result, we incorporate an Open Skies variable in our European model to determine whether cities in Open Skies countries experience higher-than-expected service levels relative to their non-Open Skies counterparts. In addition, we incorporate a hub variable as proposed by Jorge-Calderón (1997) for both the U.S. and European models. The model is specified and described in Section 5.3.

Again, gravity models describe the attraction between two cities, regions, or countries in the attempt to quantify passenger or cargo traffic between the two. Our model differs in that we seek to explain service levels to all transatlantic destinations for a particular city or country. For example, we seek to explain transatlantic service levels from a particular U.S. city to all European destinations, and vice versa. Again, we have defined service levels to refer to four metrics: number of city pairs, competitors, destinations and passenger enplanements. We therefore run four separate regressions for the U.S. and another four for Europe.

Once again the primary data source is the Air Carrier Statistics database, also known as the T-100 data bank, of the U.S. Department of Transportation. The database contains all international nonstop segment data for certificated U.S. air carriers and foreign carriers having at least one point of service in the U.S. or one of its territories. Our sample includes all 32 U.S. cities and 59 European cities with any transatlantic service between 2000 and 2007 (including those that lost service) and the 37 European countries with either transatlantic service between 2000 and 2007 or an Open Skies agreement with the U.S. The socio-geographic characteristics of these markets are presented in the next section.

5.2 U.S. and European Cities with Transatlantic Service

In Chapter 3 we presented the 32 U.S. and 59 European cities that had transatlantic service at any point between 2000 and 2007. In this section, we provide additional socio-geographic indicators that we incorporate into the econometric model. As identified in the previous section, our model uses the following factors to describe transatlantic service levels:

- Population of greater metropolitan area
- GDP per capita
- Distance
- Hub dummy
- Open Skies dummy

Our dependent variables are the measures of service levels defined earlier: number of city pairs, competitors, destinations and passenger enplanements. A separate regression is run for each measure. We use 2007 data in order to capture the largest set of countries with an Open Skies agreement in place, to ensure that post-9/11 demand was fully recovered, and to best match the 2007/2008 socio-economic statistics we were able to obtain. Our data is presented in Table 22, Table 23, and Table 24.

Our U.S. data sample includes all 32 U.S. cities that had transatlantic service at any point between 2000 and 2007. Population data reflects that of the Combined Statistical Area (CSA), defined by the U.S. Office of Management and Budget (OMB) to include residents of cities, adjacent metropolitan and micropolitan statistical areas. CSA population and income figures were obtained through the U.S. Census Bureau.

An initial review of the data would suggest that there indeed is a negative impact of distance to service levels. Some of the largest cities on the list, such as Los Angeles and San Francisco, have lower service levels than cities of similar size in the East. Similarly, cities with low income per capita, such as San Juan, Pittsburgh, Miami, Memphis and Fairbanks, have lower aggregate service levels than cities with high income per capita. However, these cities are also smaller, on average, than those with high per capita income (Boston, New York, Washington DC, San Francisco) so we will explore the combined effect of income and population in our model. We also see that cities which serve as hubs for transatlantic carriers experience higher service levels than their non-hub counterparts. This may be due to the hub status itself, but also that airlines tend to locate their hubs in major population and economic regions of the country.

Our European analysis includes both a city-level and country-level data set. For the city-level analysis, our data includes all 59 European cities that had transatlantic service at some point between 2000 and 2007. For the country-level analysis, our data includes all countries with either transatlantic service between 2000 and 2007 or an Open Skies agreement with the U.S. by July 2007. Urban Area Population reflects the population of a city and its surrounding metropolitan area, and was estimated in 2008 by World Gazetteer. Unfortunately, reliable income or GDP data could only be found for half of our dataset so we elected to leave it out of the city-level analysis. The Open Skies dummy variable reflects whether a given city is located in a country with a U.S. Open Skies agreement. The Big-3 hub dummy variable indicates whether an airport in a given market serves as a major hub to one of the Big-3 European carriers: Air France-KLM, British Airways, or Lufthansa-Swiss. A simple hub variable as in the U.S. dataset was meaningless in the European dataset since most cities serve as a hub to a national carrier.

An initial review of the European data also confirms our a priori hypothesis that there is a negative correlation between distance and service levels, as was the case with U.S. cities. Some of the largest cities on the list, such as Moscow and Istanbul, have lower service levels than cities of similar size in Western Europe (see Table 23). We also see that some of the largest cities in Europe – such as Düsseldorf/Cologne, Istanbul, Moscow, Barcelona and Berlin – have relatively low service levels. It is difficult to develop an initial sense of the service levels of Open Skies countries relative to the others. These factors play a non-intuitive role in determining service levels in Europe, and we hope to develop further insights through our econometric model.

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Table 22: U.S. Cities with Transatlantic Service 2000-2007 and Related Data

U.S. Metropolitan Area[25]	CSA Population 2007[26]	Per Capita Income[26]	Distance (miles)[27]	Big-6 Hub[28]	Destinations 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Anchorage, AK	359,180	$25,287	4,470	0	1	1	14	2,801
Atlanta, GA	5,626,400	$25,033	4,200	1	23	5	921	168,633
Boston, MA	7,476,689	$26,856	3,250	0	15	12	695	135,704
Charlotte, NC	2,277,074	$23,417	3,980	1	3	2	91	20,422
Chicago, IL	9,745,165	$24,581	3,940	1	20	19	1,328	268,499
Cincinnati, OH	2,176,749	$22,947	3,950	1	5	1	140	22,254
Cleveland, OH	2,896,968	$22,319	3,730	1	1	1	31	3,493
Dallas/Ft.Worth, TX	6,498,410	$23,616	4,740	1	4	3	216	40,567
Denver, CO	2,998,878	$26,011	4,660	1	3	2	92	22,519
Detroit, MI	5,405,918	$24,275	3,730	1	6	4	449	87,950
Fairbanks, AK	51,926	$19,814	4,210	0	1	1	4	812
Ft. Myers, FL	623,724	$24,542	4,440	0	2	1	21	4,205
Hartford, CT	1,306,151	$25,874	3,340	0	1	1	31	3,290
Houston, TX	5,729,027	$21,701	4,840	1	4	6	352	66,510
Las Vegas, NV	1,880,449	$21,210	5,210	0	4	5	79	17,645
Los Angeles, CA	17,755,322	$21,170	5,440	0	9	14	657	170,604
Memphis, TN	1,280,533	$20,327	4,350	1	1	1	31	6,729
Miami, FL	5,413,212	$20,454	4,410	1	9	10	401	92,884
Minneapolis/St. Paul, MN	3,538,781	$26,219	4,000	1	3	2	155	38,185
New York, NY	21,961,994	$26,604	3,440	1	51	38	4,599	834,257
Orlando, FL	2,693,552	$21,232	4,330	0	7	6	204	55,073

[25] As before, multi-airport systems within a Combined Statistical Area (CSA) are listed as one city. For our analysis, Ft. Lauderdale is considered to be part of the Miami market, Sanford part of the Orlando market, Oakland part of the San Francisco market and Baltimore part of the Washington, DC market. In addition, Newark Liberty International (EWR) and John F. Kennedy International (JFK) together comprise the New York City market.
[26] U.S. Census Bureau
[27] All cities must be measured from a common point. Rather than selecting the geographic center of Europe, which may bias the impact of distance, we instead use London, which is both the most served European destination and one of the closest to the U.S.
[28] Refers to a primary hub for a Big-6 transatlantic carrier. In this case, these are hubs for the six U.S. legacy carriers (see Table 11).

U.S. Metropolitan Area	CSA Population 2007	Per Capita Income	Distance (miles)	Big-6 Hub	Destinations 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Philadelphia, PA	6,385,461	$23,699	3,530	1	19	4	736	128,538
Phoenix, AZ	4,179,427	$21,907	5,260	1	1	1	25	6,535
Pittsburgh, PA	2,446,703	$20,935	3,710	0	0	0	0	0
Portland, OR	2,159,720	$22,592	4,900	0	1	1	31	7,674
Raleigh/Durham, NC	1,635,974	$24,698	3,860	0	1	1	30	4,391
San Francisco, CA	7,264,887	$30,769	5,350	1	6	7	345	105,358
San Juan, PR[29]	2,509,007	$9,140	4,180	0	1	1	13	2,862
Seattle, WA	4,038,741	$25,744	4,780	0	4	4	134	29,334
St. Louis, MO	2,866,517	$22,698	4,190	0	0	0	0	0
Tampa, FL	2,697,731	$21,784	4,400	0	1	1	22	3,959
Washington, DC	8,241,912	$28,175	3,650	1	13	12	932	187,254

Table 23: European Cities with Transatlantic Service 2000-2007 and Related Data

European City[30]	Urban Area Population[31]	Distance[32] (miles)	Open Skies with U.S.[33]	Big-3 Hub[34]	Destinations 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Amsterdam, Netherlands	6,579,720	3,630	1	1	17	8	1,035	216,422
Athens, Greece	3,829,018	4,920	0	0	3	4	161	32,343
Barcelona, Spain	4,959,864	3,820	0	0	3	3	123	20,084
Belfast, United Kingdom	645,536	3,160	0	0	2	2	36	6,029
Belgrade, Serbia and Montenegro	1,766,534	4,500	0	0	0	0	0	0
Berlin, Germany	4,040,690	3,960	1	0	1	2	60	8,112

29 Puerto Rico is included since U.S. territories are covered by U.S. aviation bilateral agreements.

30 Note here that multi-airport systems within an urban area are listed as one city. For our analysis, London is composed of Heathrow (LHR), Gatwick (LGW), Stansted (STN) and Luton (LTN) airports. Paris is composed of both Charles de Gaulle (CDG) and Orly (ORY) airports.

31 2008 World Gazetteer data from Eurostat. 2007 data not available.

32 All cities must be measured from a common point. Rather than selecting the geographic center of the U.S., which may bias the impact of distance, we instead use New York, which is both the most served U.S. destination and one of the closest to Europe.

33 Indicates whether city is located in country that had an Open Skies agreement with the U.S. in 2007.

34 Indicates whether city serves as a major hub to a Big-3 European carrier: Air France-KLM, British Airways, or Lufthansa-Swiss (see Table 10).

European City	Urban Area Population	Distance (miles)	Open Skies with U.S.	Big-3 Hub	Destinations 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Birmingham, United Kingdom	3,704,574	3,370	0	0	1	1	31	4,498
Bologna, Italy	385,813	4,130	1	0	1	1	9	2,199
Bristol, United Kingdom	551,066	3,350	0	0	1	1	31	3,883
Brussels, Belgium	2,175,008	3,360	1	0	6	6	244	36,907
Bucharest, Romania	2,192,372	4,740	1	0	1	1	16	2,651
Budapest, Hungary	2,578,731	4,360	0	0	1	2	52	9,007
Connaught, Ireland	503,083	3,060	0	0	2	1	21	2,956
Copenhagen, Denmark	2,387,192	3,840	1	0	5	3	203	42,379
Dublin, Ireland	1,058,265	3,170	0	0	6	5	339	69,780
Dusseldorf, Germany[35]	11,817,132	3,740	1	0	8	4	201	27,906
Edinburgh, United Kingdom	1,250,000	3,250	0	0	2	2	91	14,119
Frankfurt, Germany	3,133,739	3,850	1	1	20	10	1,392	318,166
Geneva, Switzerland	470,000	3,860	1	0	1	2	62	10,985
Glasgow, United Kingdom	1,633,187	3,210	0	0	4	4	131	20,626
Hamburg, Germany	3,266,896	3,800	1	0	1	1	31	4,177
Helsinki, Finland	1,262,805	4,100	1	0	1	1	31	7,029
Istanbul, Turkey	13,179,865	5,000	1	0	2	2	87	17,439
Kiev, Ukraine	2,989,638	4,680	0	0	1	2	45	8,817
Koeln/Bonn (Cologne), Germany[35]	11,817,132	3,760	1	0	1	1	31	4,516
Krakow, Poland	756,757	4,290	1	0	2	1	35	7,439
Lisbon, Portugal	2,634,878	3,360	1	0	2	3	133	22,092
Liverpool, United Kingdom[36]	5,019,446	3,310	0	0	1	1	12	1,071
London, United Kingdom	13,063,441	3,340	0	1	23	14	3,285	671,737
Lyon, France	1,798,395	3,830	1	0	0	0	0	0
Madrid, Spain	6,270,551	3,580	0	0	8	5	383	82,016
Malaga, Spain	561,250	3,650	0	0	0	0	0	0
Manchester, United Kingdom[36]	5,019,446	3,330	0	0	7	8	347	61,903

[35] Given overlapping catchment areas for Düsseldorf and Cologne, whose airports are 45 miles apart, we aggregate their service levels for the regression analysis.
[36] Given overlapping catchment areas for Liverpool and Manchester, with airports 30 miles apart, we aggregate their service levels for the regression analysis.

European City	Urban Area Population	Distance (miles)	Open Skies with U.S.	Big-3 Hub	Destinations 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Milan, Italy	4,308,403	3,990	1	0	6	4	279	47,121
Moscow, Russia (European)	14,744,150	4,650	0	0	4	2	118	21,201
Munich, Germany	2,312,477	4,030	1	1	12	6	413	84,957
Naples, Italy	3,817,076	4,390	1	0	1	1	14	3,738
Nice, France	915,000	3,980	1	0	1	1	31	4,883
Oslo, Norway	568,809	3,670	1	0	1	1	31	4,894
Palermo, Italy	1,000,820	4,440	1	0	1	1	9	2,359
Paris, France	11,818,503	3,630	1	1	14	10	1,381	296,504
Pisa, Italy	90,482	4,120	1	0	1	1	18	2,430
Porto, Portugal	1,299,713	3,320	1	0	1	1	13	2,370
Prague, Czech Republic	1,406,142	4,070	1	0	2	2	53	7,836
Reykjavik, Iceland	201,000	2,580	1	0	5	1	163	26,197
Riga, Latvia	727,578	4,190	0	0	1	1	9	1,510
Rome, Italy	3,858,111	4,270	1	0	7	7	463	90,450
Rzeszow, Poland	740,000	4,490	1	0	1	1	8	1,741
Santiago De Compostela, Spain	92,919	3,280	0	0	0	0	0	0
Satu Mare, Romania	130,059	4,710	1	0	0	0	0	0
Shannon, Ireland	9,222	3,070	0	0	5	5	250	48,255
Stockholm, Sweden	1,964,805	3,910	1	0	3	4	137	27,352
Stuttgart, Germany	2,334,683	3,910	1	0	1	1	30	4,495
Terceira, Portugal	54,996	2,460	1	0	0	0	0	0
Timisoara, Romania	359,132	4,500	1	0	0	0	0	0
Venice, Italy	297,743	4,140	1	0	3	2	80	11,376
Vienna, Austria	2,113,619	4,230	1	0	4	2	109	23,187
Warsaw, Poland	2,251,474	4,250	1	0	2	1	118	25,453
Zurich, Switzerland	1,025,499	3,920	1	1	10	8	394	63,344

Table 24: European Countries with Service To or Open Skies With U.S. 2000-2007

European Country[37]	Population[38] 2007	Income Per[39] Capita (USD)	Nominal GDP[40] 2007 ($millions)	Big-3 Hub[41]	City Pairs 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Albania	3,130,000	$3,290	$10,619	0	0	0	0	0
Austria	8,206,524	$42,700	$373,943	0	4	2	109	23,187
Belgium	10,445,852	$40,710	$453,636	0	6	6	244	36,907
Bosnia and Herzegovina	3,907,000	$3,790	$14,780	0	0	0	0	0
Bulgaria*	7,761,000	$4,590	$39,609	0	0	0	0	0
Croatia*	4,551,000	$10,460	$51,356	0	0	0	0	0
Cyprus*	818,200	$24,940	$21,303	0	0	0	0	0
Czech Republic	10,241,138	$14,450	$175,309	0	2	2	53	7,836
Denmark	5,415,978	$54,910	$311,905	0	5	3	203	42,379
Estonia*	1,332,893	$13,200	$21,278	0	0	0	0	0
Finland	5,261,008	$44,400	$245,013	0	1	1	31	7,029
France	64,473,140	$38,500	$2,560,255	1	15	10	1,412	301,387
Germany	82,210,000	$38,860	$3,322,147	1	44	12	2,157	452,035
Greece*	11,147,000	$29,630	$314,615	0	3	4	161	32,343
Hungary*	10,076,000	$11,570	$138,388	0	1	2	52	9,007
Iceland	304,334	$54,100	$20,003	0	5	1	163	26,197
Ireland*	4,234,925	$48,140	$258,574	0	13	6	610	120,991
Italy	59,337,888	$33,540	$2,104,666	0	20	7	872	159,673
Latvia*	2,290,237	$9,930	$27,341	0	1	1	9	1,510
Lithuania*	3,596,617	$9,920	$38,345	0	0	0	0	0
Luxembourg	468,571	$75,880	$50,160	0	0	0	0	0
Malta	402,668	$15,310	$7,419	0	0	0	0	0
Netherlands	16,402,414	$45,820	$768,704	1	17	8	1,035	216,422

[37] Thirty-seven European nations with either transatlantic service at any point between 2000 and 2007 or an Open Skies agreement with the U.S.
[38] 2007 data from Eurostat available at www.ec.europa.eu/eurostat
[39] World Bank data statistics for 2007, Atlas methodology in US dollars
[40] International Monetary Fund data produced April 2008
[41] Indicates home country of a Big-3 European carrier: Air France-KLM, British Airways, or Lufthansa-Swiss (see Table 10).

European Country	Population 2007	Income Per Capita (USD)	Nominal GDP 2007 ($millions)	Big-3 Hub	City Pairs 2007	Competitors 2007	Departures July 2007	Passengers July 2007
Norway	4,671,700	$76,450	$391,498	0	1	1	31	4,894
Poland	38,115,967	$9,840	$420,284	0	5	1	161	34,633
Portugal	10,605,870	$18,950	$223,303	0	3	3	146	24,462
Romania	22,329,977	$6,150	$165,983	0	1	1	16	2,651
Russia (European)*	141,950,000	$7,560	$1,289,582	0	4	2	118	21,201
Serbia and Montenegro*	7,780,000	$4,730	$44,653	0	0	0	0	0
Slovakia	5,431,363	$11,730	$74,988	0	0	0	0	0
Slovenia*	2,011,070	$20,960	$46,084	0	0	0	0	0
Spain*	45,200,737	$29,450	$1,438,959	0	11	5	506	102,100
Sweden	3,047,752	$46,060	$455,319	0	3	4	137	27,352
Switzerland	7,252,000	$59,880	$423,938	1	11	8	456	74,329
Turkey	70,586,256	$8,020	$663,419	0	2	2	87	17,439
Ukraine*	46,398,114	$2,550	$140,484	0	1	2	45	8,817
United Kingdom*	60,587,300	$42,740	$2,772,570	1	41	17	3,963	783,708

* Country did not have Open Skies agreement with the U.S. by July 2007.

5.3 Specification of Model

All regressions performed in this chapter are linear models that take the form of the following equation:[42]

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n$$

where y is the dependent or endogenous variable, and $x_1 ... x_n$ represent the independent, explanatory or exogenous variables. Coefficients $\beta_0 ... \beta_n$ are approximated by the method of ordinary least squares (OLS) estimation and represent the strength of the relationship of each explanatory variable to y.

For each of the three data sets (U.S. city, European city, and European country), a series of regressions is performed for each of the four service level measures. For each regression, we perform significance tests on the coefficient of each explanatory variable $\beta_0 ... \beta_n$ to test whether each is significantly different from 0. A coefficient that is not significantly different from 0 indicates that the explanatory variable has no statistically significant impact on the dependent variable. To do this we formulate a null hypothesis that coefficient β_n is equal to 0 and test it using the t-statistic.

$$H_0: \beta_n = 0$$

$$H_1: \beta_n \neq 0$$

The test statistic is then:

$$t_{\beta_n} = \frac{\beta_n}{s_{\beta_n}}$$

where $s_{\beta n}$ is the standard error of the coefficient β_n.

If $t_{\beta n} > t_{cr}$, where t_{cr} is a critical value obtained from a t-stat table for a given number of degrees of freedom and a level of significance α (usually $\alpha = 0.05$), we reject the null hypothesis with a confidence $1- \alpha$. For $\alpha = 0.05$ and a large number of observations, $t_{cr} \approx 1.96$, so a t-stat greater than 1.96 (or less than -1.96) indicates that the coefficient is significantly different from zero with 95% confidence. The t-stat percentiles for each of our regressions vary with our sample size and are therefore presented with the results in Section 5.4.

The sample data used throughout this research consists of T-100 International Segment data from 1990 through 2007. A single observation in the sample includes service level metrics aggregated across all destinations for a particular market (whether it be a U.S. or European city, or European country) in a particular year. Therefore the total data sample contains both cross-sectional and time series data. We

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[42] Nonlinear regressions were also performed but resulted in an inferior fit relative to the linear models presented.

have used the time series data in the analyses presented in Chapters 3 and 4. However, the regressions presented here are performed only on 2007 cross-sectional data in order to investigate how service levels depend on different factors while capturing the largest set of countries with an Open Skies agreement in place.

5.3.1 U.S. City Analysis

We begin first with our model of the 32 U.S. cities with transatlantic service at any point between 2000 and 2007. The following variables are used for our regression:

Dependent Variables:

DESTINATIONS	represents the number of distinct European destinations served from each observed city in 2007.
DEPARTURES	represents the number of total departures to Europe from each observed city for the month of July 2007.
COMPETITORS	represents the number of unique carriers (both U.S. and foreign) that provided service to Europe in 2007.
PASSENGERS	represents the number of total nonstop passenger enplanements to Europe departing from each observed city in July 2007.

Independent Variables:

CSA GDP	represents the total Gross Domestic Product (GDP) of the Combined Statistical Area (CSA) calculated as product of GDP per capita and CSA population.
DISTANCE	represents the distance in nonstop miles between each observed city and London.[27]
HUB	is a dummy variable that equals 1 if the observed origin city is a hub of a Big-6 American carrier and 0 otherwise.

Separate regressions were run using population and income per capita separately and independently, but the resulting R^2 and adjusted R^2 values were substantially lower than when they were combined into the *CSA GDP* variable.

Multicollinearity

Before performing our regressions we first test for multicollinearity between the independent variables. Multicollinearity occurs when two or more independent variables are highly correlated, a condition which may lead to inaccurate estimates of coefficients. Additionally, a high degree of collinearity will increase the standard errors of the coefficients, which moves the t-ratios closer to 0 (or insignificance). Significant variables may appear to be insignificant in a model with high multicollinearity. One way to test for multicollinearity is to construct a correlation matrix, as seen in Table 25.

Table 25: Correlation Matrix for U.S. City Data

	DISTANCE	*HUB*	*CSA GDP*
DISTANCE	1.000		
HUB	-0.080	1.000	
CSA GDP	-0.074	0.319	1.000

The closer a correlation is to 1 or -1, the more correlated two variables are. Here we observe that the *HUB* variable is correlated with the *CSA GDP* variable. The larger the economic presence (a function of size and average wealth) of a particular city, the more likely that it serves as a hub to one of the six U.S. legacy carriers. We expect that carriers choose to situate their hubs in large population and economic centers of the U.S. Similarly, the abundant availability of air transportation may entice people and companies to locate near a particular city, further growing *CSA GDP*.

Despite the indication of correlation between *HUB* and *CSA GDP*, both variables are important for comparisons against the European city analysis. The goal of our regression analyses is not only to determine which factors describe service levels, but to identify which factors explain differences in service levels between the U.S. and Europe. We therefore include both the *HUB* and *CSA GDP* variables in the model.

The final regression models for the U.S. city analysis are as follows:

$$\left.\begin{matrix} DESTINATIONS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{CSA\ GDP} x_{CSA\ GDP} + \beta_{DISTANCE} x_{DISTANCE} + \beta_{HUB} x_{HUB}$$

Results are presented in Section 5.4.

5.3.2 European City Analysis

Next we model service levels for the 59 European cities with transatlantic service at any time between 2000 and 2007. Given overlapping catchment areas for Düsseldorf and Cologne/Bonn, whose airports are 45 miles apart, we aggregate their service levels for the regression analysis. We do the same for Manchester and Liverpool, whose airports are 30 miles apart. We therefore have 57, rather than 59, observations for our European city analysis. Indeed, the model's fit improves relative to the case where the service levels are left separated for these four markets. The following variables are used for our regression:

Dependent Variables:

DESTINATIONS represents the number of distinct U.S. destinations served from each observed city in 2007.

DEPARTURES represents the number of total departures to the U.S. from each observed city for the month of July 2007.

COMPETITORS represents the number of unique carriers (both U.S. and foreign) that provided service to the U.S. in 2007.

PASSENGERS represents the number of total nonstop passenger enplanements to the U.S. departing from each observed city in July 2007.

Independent Variables:

POPULATION represents the total urban area and metropolitan population of each observed city.

DISTANCE represents the distance in nonstop miles between each observed city and New York City.[32]

OPEN SKIES is a dummy variable that equals 1 if the observed origin city is located in a country that signed an Open Skies agreement with the U.S. by July 2007, 0 otherwise.

HUB is a dummy variable that equals 1 if the observed origin city is a hub of a Big-3 transatlantic carrier and 0 otherwise.

Multicollinearity

To test for multicollinearity, we once again construct a correlation matrix, Table 26.

Table 26: Correlation Matrix for European City Data

	POPULATION	*DISTANCE*	*OPEN SKIES*	*HUB*
POPULATION	1.000			
DISTANCE	0.176	1.000		
OPEN SKIES	-0.085	0.226	1.000	
HUB	0.337	-0.083	0.132	1.000

Here again we observe that the *HUB* variable is correlated with the *POPULATION* variable. In other words, the larger a particular city the more likely that it serves as a hub to one of the Big-3 European carriers. We expect that carriers choose to situate their hubs in large population centers of Europe. Similarly, a sizeable local O-D market is a precondition for the development and sustenance of a major international carrier, particularly in Europe where the market is highly fragmented.

Although the data suggests that *HUB* and *POPULATION* are correlated, both variables are important for comparisons against the U.S. city analysis. Once again, we not only wish to identify which factors describe service levels, but also to compare the explanatory factors between the U.S. and Europe. We therefore include both the *HUB* and *POPULATION* variables in the model.

We also observe small correlation between *DISTANCE* and *OPEN SKIES*. This is likely a result of what Jorge-Calderón (1997) describes as lower social and commercial interactions between nations separated by greater distances. However, there are notable exceptions to this relationship – UK, Ireland and Spain without Open Skies, Turkey, Romania and Albania with – so it would not be sufficient to include only one of the two variables in the model. In addition, we seek to compare the impact of *DISTANCE* directly to the U.S. city model and to determine the specific impact that *OPEN SKIES* has on service levels. We therefore include both variables in the model.

The final regression models for the European city analysis are as follows:

$$\left.\begin{matrix} DESTINATIONS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{POPULATION} x_{POPULATION} + \beta_{DISTANCE} x_{DISTANCE} + \beta_{OPEN\ SKIES} x_{OPEN\ SKIES} + \beta_{HUB} x_{HUB}$$

5.3.3 European Country Analysis

Next we model service levels for the 37 European countries with either transatlantic service at any point between 2000 and 2007 or an Open Skies agreement with the U.S. by July 2007. The following variables are used for our regression:

Dependent Variables:

CITY PAIRS	represents the number of city pairs to the U.S. in July 2007 served from all cities in the observed country.
DEPARTURES	represents the number of total departures to the U.S. from each observed country for the month of July 2007.
COMPETITORS	represents the number of unique carriers (both U.S. and foreign) that provided service to the U.S. from the observed country in 2007.
PASSENGERS	represents the number of total nonstop passenger enplanements to the U.S. departing from the observed country in July 2007.

Independent Variables:

POPULATION	represents the total population of the observed country.
GDP	represents the nominal 2007 Gross Domestic Product (GDP) of the observed country.
DISTANCE	represents the distance in nonstop miles between each observed capital city or primary aviation gateway and New York City.[32]
OPEN SKIES	is a dummy variable that equals 1 if the observed country had an Open Skies agreement with the U.S. by July 2007, and 0 otherwise.
HUB	is a dummy variable that equals 1 if the observed origin country serves as the home to a Big-3 transatlantic carrier and 0 otherwise.

Multicollinearity

Table 27: Correlation Matrix for European Country Data

	POPULATION	*DISTANCE*	*OPEN SKIES*	*HUB*	*GDP*
POPULATION	1.000				
DISTANCE	0.078	1.000			
OPEN SKIES	-0.059	-0.269	1.000		
HUB	0.326	-0.314	0.165	1.000	
GDP	0.724	-0.274	0.094	0.684	1.000

From the correlation matrix we observe that the *POPULATION* variable is highly correlated to the *GDP* variable. This is expected, since Gross Domestic Product is a function of the population and GDP per capita (or average personal wealth) of a country. In the U.S. city analysis, a series of regressions demonstrated that including both variables did not provide additional explanatory power. Similar tests demonstrate the same for the European country analysis, so we leave *POPULATION*, which is one of two inputs to *GDP*, out of the regression models.

We also once again observe that the *HUB* variable is highly correlated with the *GDP* variable. As already mentioned, the Big-3 European carriers' hubs tend to be located in Europe's large economic centers to leverage their large O-D populations. Despite this correlation, both variables are important for comparisons against the U.S. and European city analyses, and so we include both in the model.

Although we observe a correlation between *HUB* and *DISTANCE*, this is due to the fact that the Big-3 European carriers are situated in Western Europe. However, we cannot make the assumption that all Western European nations benefit from the hub effect or that Eastern European nations cannot benefit from HUB status, and so we include both variables in the model. There is also a negative correlation between *DISTANCE* and *GDP*, mainly because the larger, wealthier set of countries is in Western and Northern Europe. Countries of Eastern and Southern Europe are both further from the U.S. and tend to be smaller and less wealthy, as reflected in their GDP's. However, there are exceptions to this phenomenon and we are interested in their direct impacts, so we include both variables in the model.

As in the European City analysis, we observe a small correlation between *DISTANCE* and *OPEN SKIES*. However, because of notable outliers and the importance of the *OPEN SKIES* variable in our analysis, we include both variables in the model.

The final regression models for the European country analysis are as follows:

$$\left.\begin{matrix} CITY\ PAIRS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{GDP}x_{GDP} + \beta_{DISTANCE}x_{DISTANCE} + \beta_{OPEN\ SKIES}x_{OPEN\ SKIES} + \beta_{HUB}x_{HUB}$$

5.4 Results and Conclusions

In our regression analysis we seek to identify what factors explain transatlantic service levels in U.S. and European markets. The explanatory power of a particular variable is best understood by comparing the model's "fit" with and without the variable. An increase in the adjusted R^2 value indicates that the variable added more explanatory power to the model than it detracted by making the model less simple. We must also ensure that a coefficient is statistically different from zero with 95% confidence.

5.4.1 U.S. City Analysis

We recall that the regression models for the U.S. city analysis are as follows:

$$\left.\begin{matrix} DESTINATIONS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{CSA\ GDP} x_{CSA\ GDP} + \beta_{DISTANCE} x_{DISTANCE} + \beta_{HUB} x_{HUB}$$

We first perform a regression without the *HUB* dummy variable in order to determine the specific impact of adding it to the model. We believe that the explanatory power of the *CSA GDP* and *DISTANCE* variables will be high based on plots of the observed data as a function of the two variables (separately), seen in Figure 39 Figure 39.

The regression results before and after the addition of the HUB variable are summarized in Table 28. For our U.S. city analysis, we have 32 data points and 2-3 independent variables, and so we have 29 and 30 degrees of freedom, respectively. Our critical t-statistic for this regression is 2.04 at the 95% confidence interval.

For the first regression set (without *HUB*), *CSA GDP* and *DISTANCE* explain over 75% of the variation in the four service level measures. Both *CSA GDP* and *DISTANCE* are significantly different from 0 with 95% confidence with the exception of *DISTANCE* in explaining *COMPETITORS*, which is significantly different from 0 with 85% confidence.

The addition of the *HUB* dummy variable reduces the overall fit of the model, in part due to the multicollinearity in the model described in Section 5.3.1. Given that the *HUB* variable is not statistically different from zero even at 40% confidence, we conclude that a majority of the explanatory power is a result of the most significant variable, *CSA GDP*. It is interesting to note the negative *HUB* coefficient

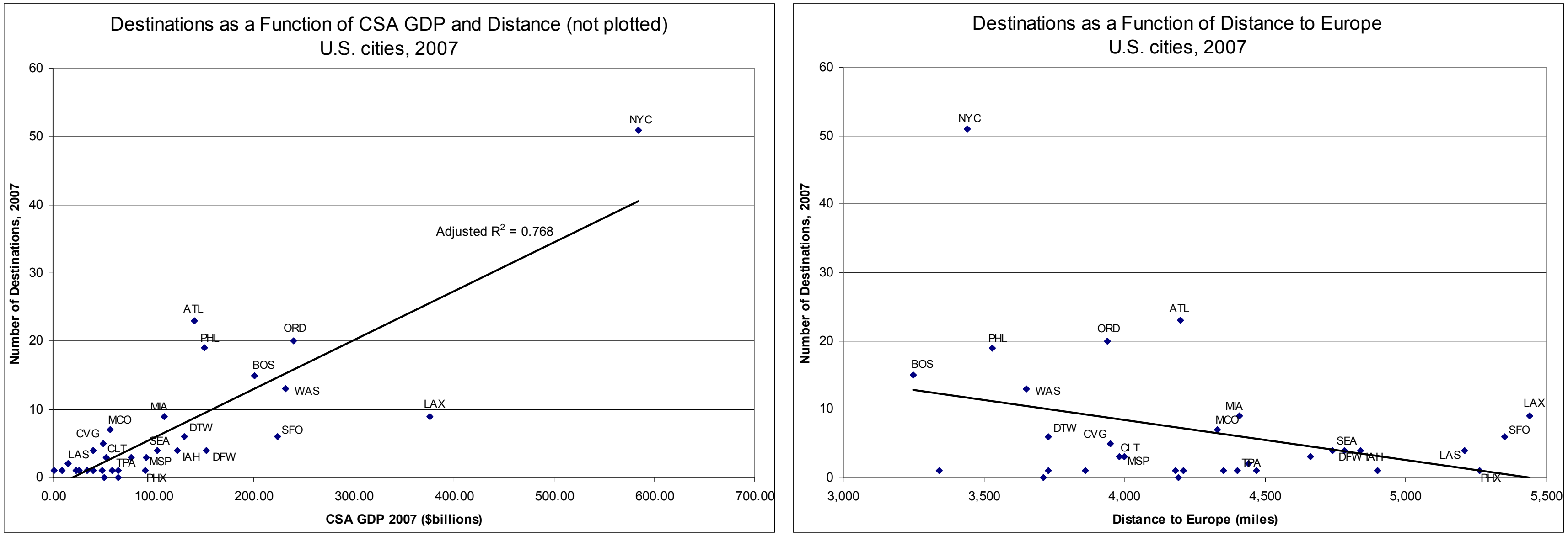

Figure 36: U.S. City Destinations versus CSA GDP and Distance

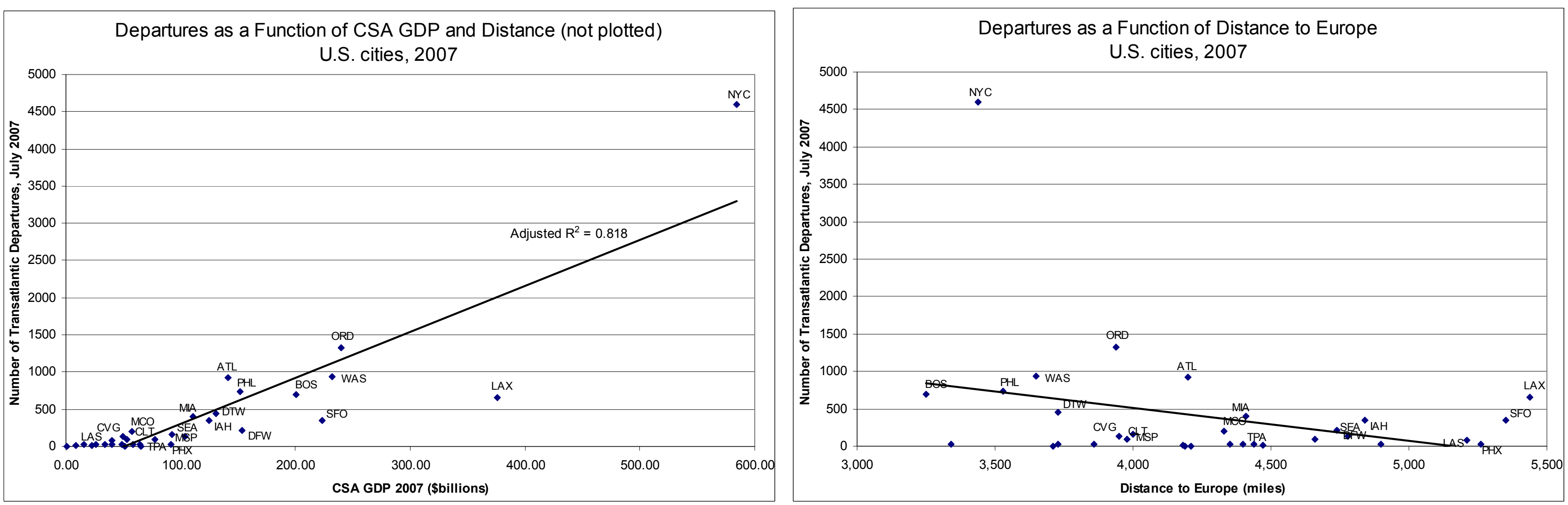

Figure 37: U.S. City Departures versus CSA GDP and Distance

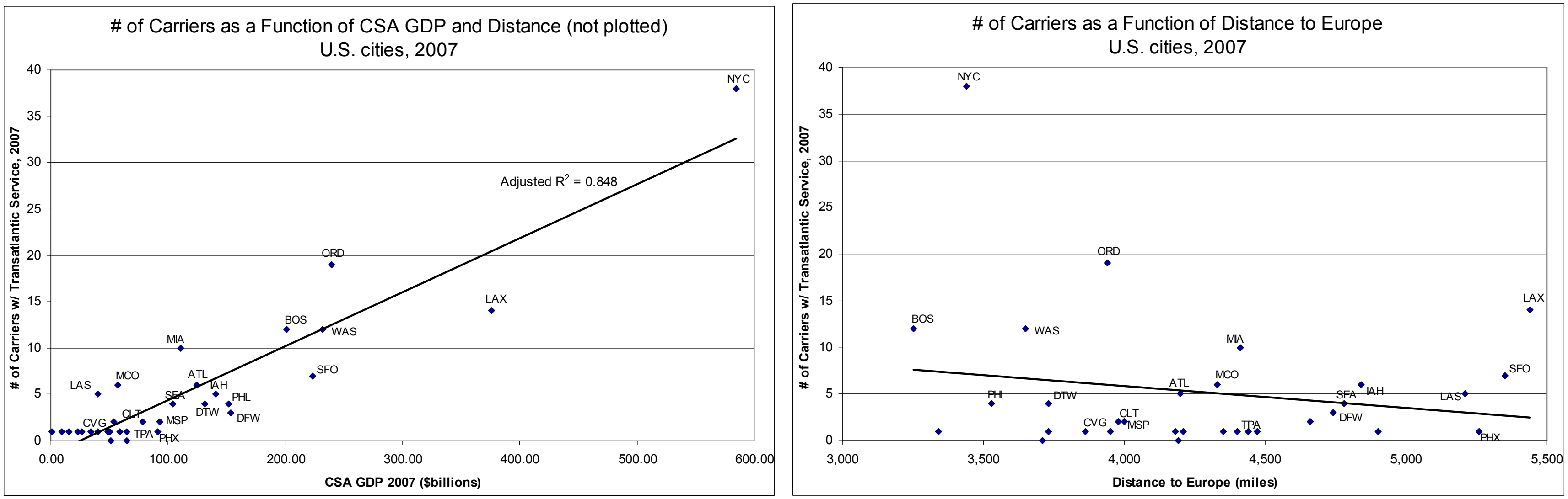

Figure 38: Number of Transatlantic Carriers at U.S. Cities versus CSA GDP and Distance

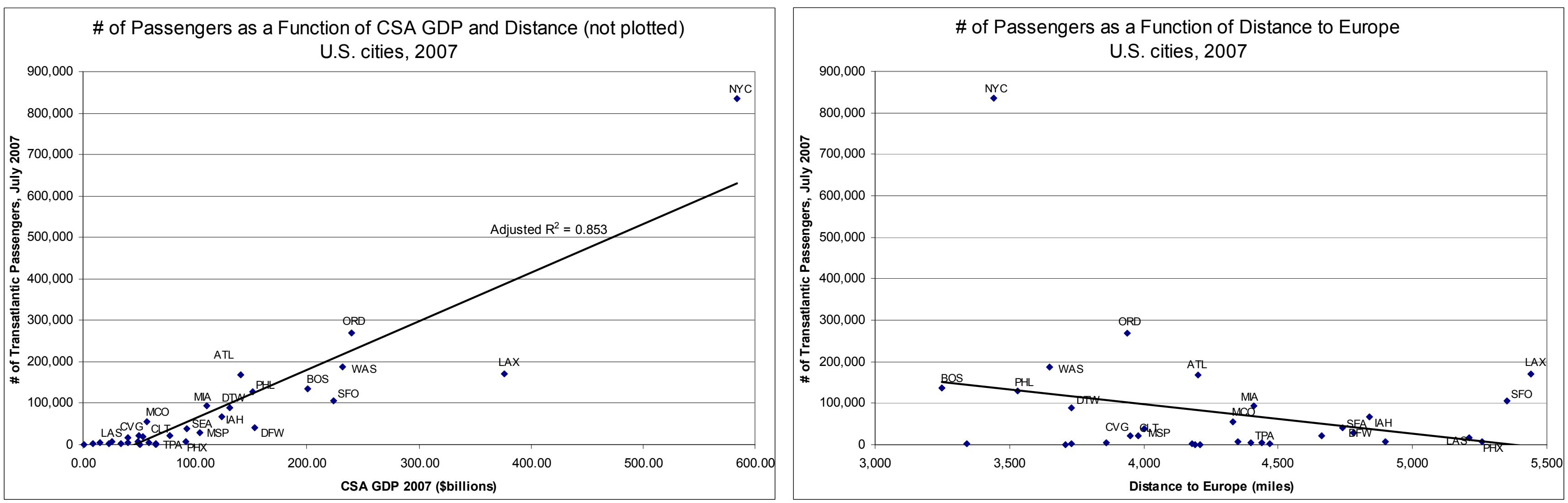

Figure 39: Number of Transatlantic Passengers at U.S. Cities versus CSA GDP and Distance

for the *COMPETITORS* regression, which indicates that hub cities draw fewer transatlantic competitors than their non-hub counterparts.

In summary, transatlantic service levels of U.S. cities are mostly explained by their respective population size and economic presence. Secondly, service levels are inversely proportional to a city's proximity to Europe. And perhaps most interestingly, a city's status as a hub does little to explain transatlantic service levels to Europe.

Table 28: U.S. City Regression Results

U.S. Cities: 2007 European Destinations

	Coefficients	*Standard Error*	*t Stat*
Intercept	19.2501	6.5089	2.9575
CSA GDP	0.0698	0.0074	9.4557
Distance	-0.0048	0.0015	-3.2183
Adjusted R^2	0.7684		

U.S. Cities: 2007 European Destinations

	Coefficients	*Standard Error*	*t Stat*
Intercept	18.4392	6.6446	2.7751
Distance	-0.0047	0.0015	-3.1441
Hub Dummy	1.3915	1.8403	0.7561
CSA GDP	0.0679	0.0078	8.6694
Adjusted R^2	0.7649		

U.S. Cities: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	1188.4941	477.1924	2.4906
CSA GDP	6.0470	0.5410	11.1766
Distance	-0.3477	0.1089	-3.1940
Adjusted R^2	0.8178		

U.S. Cities: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	1173.1870	491.7648	2.3857
Distance	-0.3465	0.1109	-3.1236
Hub Dummy	26.2656	136.1997	0.1928
CSA GDP	6.0118	0.5798	10.3691
Adjusted R^2	0.8116		

U.S. Cities: 2007 Number of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	4.8525	3.9255	1.2361
CSA GDP	0.0578	0.0045	12.9848
Distance	-0.0015	0.0009	-1.6403
Adjusted R^2	0.8483		

U.S. Cities: 2007 Number of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	5.3683	4.0028	1.3411
Distance	-0.0015	0.0009	-1.6744
Hub Dummy	-0.8850	1.1086	-0.7983
CSA GDP	0.0590	0.0047	12.4977
Adjusted R^2	0.8464		

U.S. Cities: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	175053.5120	78762.8499	2.2225
CSA GDP	1151.9397	89.3009	12.8995
Distance	-53.4373	17.9702	-2.9737
Adjusted R^2	0.8530		

U.S. Cities: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	173056.8953	81188.3287	2.1315
Distance	-53.2723	18.3128	-2.9090
Hub Dummy	3426.0326	22486.0120	0.1524
CSA GDP	1147.3449	95.7187	11.9866
Adjusted R^2	0.8479		

5.4.2 European City Analysis

We recall that the regression models for the European city analysis are as follows:

$$\left.\begin{matrix} DESTINATIONS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{POPULATION} x_{POPULATION} + \beta_{DISTANCE} x_{DISTANCE} + \beta_{OPEN\ SKIES} x_{OPEN\ SKIES} + \beta_{HUB} x_{HUB}$$

We first perform a regression without the *HUB* and *OPEN SKIES* dummy variables in order to determine the specific impact of adding them to the model. In contrast with the U.S. city analysis, we believe that the explanatory power of the *POPULATION* and *DISTANCE* variables will be low based on plots of the observed data as a function of the two variables (separately), seen in Figure 40. The data does not appear to conform to a trend in either population or distance.

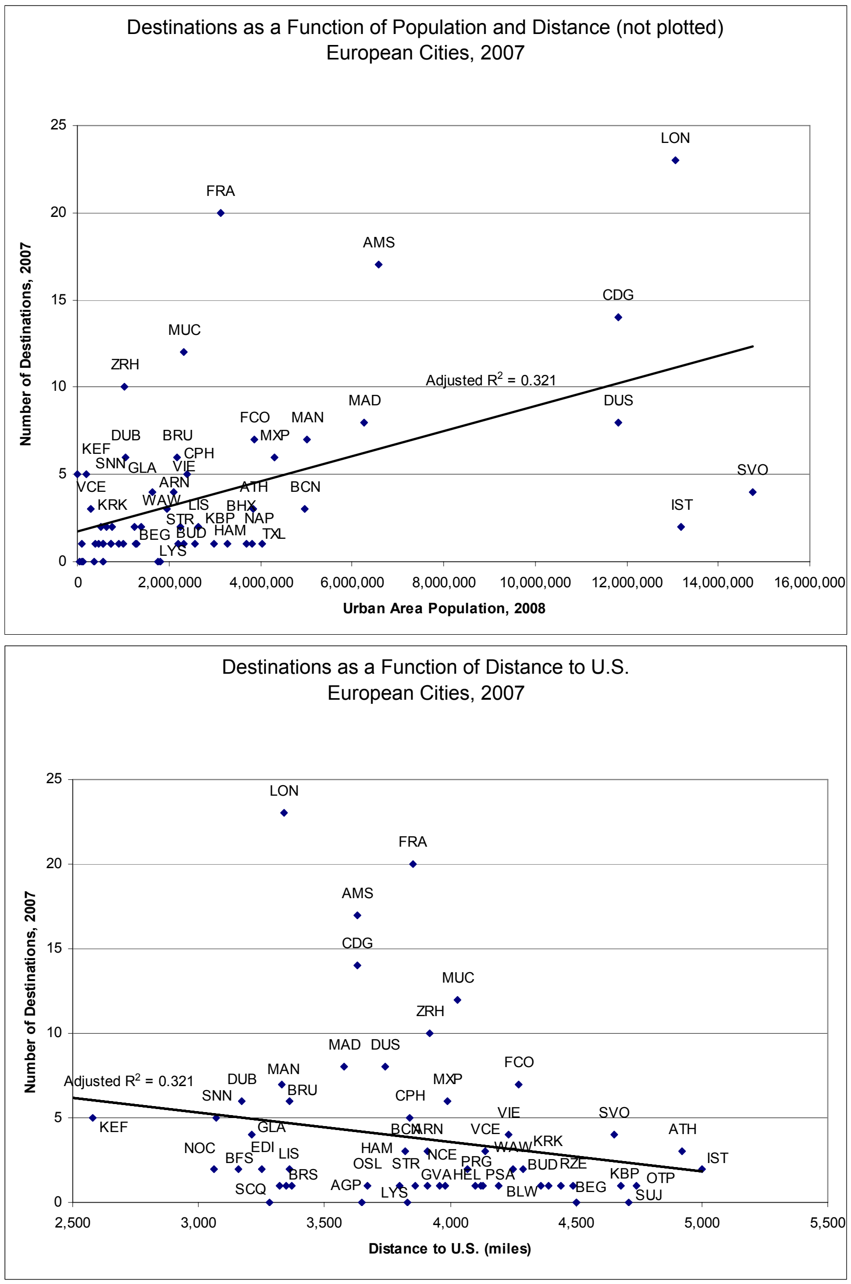

Figure 40: European City Destinations versus Population and Distance

The regression results before and after the addition of the *OPEN SKIES* dummy variable are summarized in Table 29. For our European city analysis, we have 57 data points and 2-4 independent variables, and so we have 55, 54 and 53 degrees of freedom, respectively. Our critical t-statistic for this regression is 2.01 at the 95% confidence interval.

For the first regression set (without *OPEN SKIES* and *HUB*), *POPULATION* and *DISTANCE* explain less than 25% of the variation in the four service level measures. Although both *POPULATION* and *DISTANCE* are significant with 95% confidence, more than 75% of the variation of service levels is explained by variables that are not yet included in the model. In other words, transatlantic service levels of European cities are explained less by their respective size and proximity to the U.S. than for their American counterparts. We next test how much of this variation is explained by the existence of an Open Skies agreement with the U.S.

Table 29: European City Regression Results

European Cities: 2007 U.S. Destinations

	Coefficients	*Standard Error*	*t Stat*
Intercept	11.6297	3.8063	3.0554
POPULATION	0.0000	0.0000	5.0311
DISTANCE	-0.0026	0.0010	-2.6402
Adjusted R^2	0.3211		

European Cities: 2007 U.S. Destinations

	Coefficients	*Standard Error*	*t Stat*
Intercept	11.8161	3.7886	3.1189
POPULATION	0.0000	0.0000	5.1797
DISTANCE	-0.0029	0.0010	-2.8829
OPEN SKIES	1.4674	1.1640	1.2606
Adjusted R^2	0.3284		

European Cities: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	961.5524	384.9908	2.4976
POPULATION	0.0001	0.0000	5.2408
DISTANCE	-0.2529	0.0999	-2.5303
Adjusted R^2	0.3344		

European Cities: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	967.3634	388.3644	2.4909
POPULATION	0.0001	0.0000	5.2048
DISTANCE	-0.2627	0.1039	-2.5275
OPEN SKIES	45.7350	119.3203	0.3833
Adjusted R^2	0.3237		

European Cities: 2007 Number of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	7.5682	2.3196	3.2626
POPULATION	0.0000	0.0000	5.0410
DISTANCE	-0.0016	0.0006	-2.6132
Adjusted R^2	0.3210		

European Cities: 2007 Number of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	7.6081	2.3390	3.2527
POPULATION	0.0000	0.0000	5.0174
DISTANCE	-0.0016	0.0006	-2.6216
OPEN SKIES	0.3144	0.7186	0.4375
Adjusted R^2	0.3107		

European Cities: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	190128.5543	81557.8741	2.3312
POPULATION	0.0171	0.0034	5.0733
DISTANCE	-50.4049	21.1720	-2.3807
Adjusted R^2	0.3172		

European Cities: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	191396.5135	82265.5967	2.3266
POPULATION	0.0172	0.0034	5.0420
DISTANCE	-52.5394	22.0136	-2.3867
OPEN SKIES	9979.3035	25275.1272	0.3948
Adjusted R^2	0.3064		

The addition of the *OPEN SKIES* dummy variable reduces the overall fit of the model and results in statistically insignificant coefficients. In other words, whether a city is located in an Open Skies country is statistically insignificant in explaining transatlantic service levels from that city. This is counter to proponents' arguments that Open Skies leads to increased service for a given country. We will further test this hypothesis in our European country analysis to follow.

Table 30: European City Regression Results for Modified Model

European Cities: 2007 U.S. Destinations

	Coefficients	Standard Error	t Stat
Intercept	11.8161	3.7886	3.1189
POPULATION	0.0000	0.0000	5.1797
DISTANCE	-0.0029	0.0010	-2.8829
OPEN SKIES	1.4674	1.1640	1.2606
Adjusted R^2	0.3284		

European Cities: 2007 U.S. Destinations

	Coefficients	Standard Error	t Stat
Intercept	7.7448	2.0879	3.7093
POPULATION	0.0000	0.0000	4.4306
DISTANCE	-0.0016	0.0006	-2.8813
OPEN SKIES	-0.1332	0.6475	-0.2057
HUB	11.8194	1.0453	11.3070
Adjusted R^2	0.8021		

European Cities: 2007 Transatlantic Departures

	Coefficients	Standard Error	t Stat
Intercept	967.3634	388.3644	2.4909
POPULATION	0.0001	0.0000	5.2048
DISTANCE	-0.2627	0.1039	-2.5275
OPEN SKIES	45.7350	119.3203	0.3833
Adjusted R^2	0.3237		

European Cities: 2007 Transatlantic Departures

	Coefficients	Standard Error	t Stat
Intercept	612.0220	277.1159	2.2085
POPULATION	0.0000	0.0000	3.9565
DISTANCE	-0.1490	0.0746	-1.9964
OPEN SKIES	-93.9580	85.9435	-1.0933
HUB	1031.5738	138.7368	7.4355
Adjusted R^2	0.6659		

European Cities: 2007 Number of Transatlantic Carriers

	Coefficients	Standard Error	t Stat
Intercept	7.6081	2.3390	3.2527
POPULATION	0.0000	0.0000	5.0174
DISTANCE	-0.0016	0.0006	-2.6216
OPEN SKIES	0.3144	0.7186	0.4375
Adjusted R^2	0.3107		

European Cities: 2007 Number of Transatlantic Carriers

	Coefficients	Standard Error	t Stat
Intercept	5.5036	1.6980	3.2413
POPULATION	0.0000	0.0000	3.6942
DISTANCE	-0.0010	0.0005	-2.1160
OPEN SKIES	-0.5129	0.5266	-0.9740
HUB	6.1097	0.8501	7.1872
Adjusted R^2	0.6476		

European Cities: 2007 Transatlantic Passengers

	Coefficients	Standard Error	t Stat
Intercept	191396.5135	82265.5967	2.3266
POPULATION	0.0172	0.0034	5.0420
DISTANCE	-52.5394	22.0136	-2.3867
OPEN SKIES	9979.3035	25275.1272	0.3948
Adjusted R^2	0.3064		

European Cities: 2007 Transatlantic Passengers

	Coefficients	Standard Error	t Stat
Intercept	115424.8178	58113.2359	1.9862
POPULATION	0.0097	0.0026	3.7536
DISTANCE	-28.2340	15.6496	-1.8041
OPEN SKIES	-19886.9624	18022.9930	-1.1034
HUB	220549.6312	29094.1327	7.5806
Adjusted R^2	0.6642		

Interestingly, the addition of the *HUB* dummy variable significantly increases the overall fit of the model. *HUB* becomes the most significant variable of the regression and provides the majority of the explanatory power of our final European city model. According to the model, cities which serve as hubs for Big-3 European carriers have, on average, 12 additional U.S. destinations served by six additional competitors, over 1,000 additional monthly transatlantic departures and 220,000 additional monthly enplanements. Also interesting is that, unlike in the U.S. model, European hubs tend to draw a larger number of transatlantic competitors.

Contrary to U.S. cities, transatlantic service to European cities are explained less by size and distance than by their status as a Big-3 carrier hub. Perhaps most surprising is that the existence of an Open Skies agreement is statistically insignificant in determining service levels to European cities.

5.4.3 European Country Analysis

We recall that the regression models for the European country analysis are as follows:

$$\left.\begin{matrix} CITY\ PAIRS \\ DEPARTURES \\ COMPETITORS \\ PASSENGERS \end{matrix}\right\} = \beta_0 + \beta_{GDP}x_{GDP} + \beta_{DISTANCE}x_{DISTANCE} + \beta_{OPEN\ SKIES}x_{OPEN\ SKIES} + \beta_{HUB}x_{HUB}$$

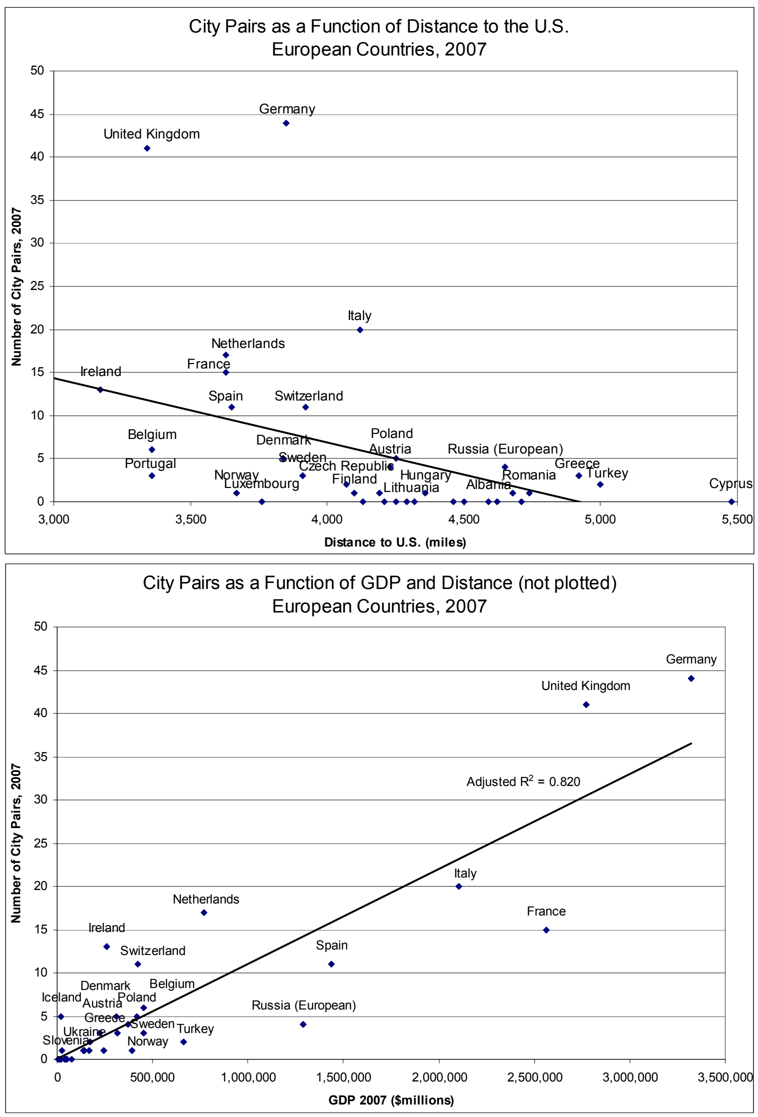

Figure 41: European Country City Pairs versus GDP and Distance

Table 31: European Country Regression Results

European Countries: 2007 City Pairs

	Coefficients	Standard Error	t Stat
Intercept	14.0121	5.6507	2.4797
DISTANCE	-0.0033	0.0013	-2.4992
GDP	0.0103	0.0009	11.4603
Adjusted R^2	0.8198		

European Countries: 2007 City Pairs

	Coefficients	Standard Error	t Stat
Intercept	15.7846	6.1484	2.5673
DISTANCE	-0.0036	0.0014	-2.5946
GDP	0.0104	0.0009	11.4024
OPEN SKIES	-1.1597	1.5299	-0.7580
Adjusted R^2	0.8175		

European Countries: 2007 Transatlantic Departures

	Coefficients	Standard Error	t Stat
Intercept	904.3292	524.4183	1.7244
DISTANCE	-0.2292	0.1227	-1.8678
GDP	0.7186	0.0838	8.5747
Adjusted R^2	0.7160		

European Countries: 2007 Transatlantic Departures

	Coefficients	Standard Error	t Stat
Intercept	1261.8781	551.8000	2.2868
DISTANCE	-0.2826	0.1235	-2.2889
GDP	0.7217	0.0816	8.8470
OPEN SKIES	-233.9260	137.3034	-1.7037
Adjusted R^2	0.7310		

European Countries: 2007 # of Transatlantic Carriers

	Coefficients	Standard Error	t Stat
Intercept	8.0192	2.4922	3.2178
DISTANCE	-0.0017	0.0006	-2.9001
GDP	0.0036	0.0004	9.1341
Adjusted R^2	0.7584		

European Countries: 2007 # of Transatlantic Carriers

	Coefficients	Standard Error	t Stat
Intercept	8.7254	2.7160	3.2126
DISTANCE	-0.0018	0.0006	-2.9566
GDP	0.0036	0.0004	9.0752
OPEN SKIES	-0.4620	0.6758	-0.6836
Adjusted R^2	0.7545		

European Countries: 2007 Transatlantic Passengers

	Coefficients	Standard Error	t Stat
Intercept	169614.0371	103751.1188	1.6348
DISTANCE	-43.6106	24.2825	-1.7960
GDP	146.6333	16.5805	8.8437
Adjusted R^2	0.7262		

European Countries: 2007 Transatlantic Passengers

	Coefficients	Standard Error	t Stat
Intercept	239584.8664	109271.7907	2.1926
DISTANCE	-54.0590	24.4533	-2.2107
GDP	147.2368	16.1544	9.1143
OPEN SKIES	-45778.3474	27189.9032	-1.6837
Adjusted R^2	0.7402		

We first perform a regression without the *HUB* and *OPEN SKIES* dummy variables in order to determine the specific impact of adding them to the model. Similarly to the U.S. city analysis but in contrast with the European city analysis, we believe that the explanatory power of the *GDP* and *DISTANCE* variables will be high based on initial plots of the observed data as a function of the two variables, seen in Figure 41. The data appears to conform reasonably to a linear trendline with the exception of a few outliers.

The regression results before and after the addition of the *OPEN SKIES* dummy variable are summarized in Table 31. For our European country analysis, we have 37 data points and 2-4 independent variables, and so we have 35, 34 and 33 degrees of freedom, respectively. Our t-stat for this regression is 2.03 at the 95% confidence interval and 1.69 at the 90% confidence interval.

For the first regression set (without *OPEN SKIES* and *HUB*), *GDP* and *DISTANCE* explain approximately 75% of the variation in the four service level measures. Both *GDP* and *DISTANCE* are significant with 90% confidence. *GDP* is the more significant variable and *DISTANCE* has a negative effect on service levels, as expected. As discussed in Section 5.3.3, there is some correlation between *GDP* and *DISTANCE* given the demographics of Western and Northern Europe relative to Eastern and Southern Europe. This likely explains some of the weaker significance and higher standard error of the *DISTANCE* variable. Since the model is already a good fit of the observed data, we want next to determine how much additional explanatory power is provided by the Open Skies dummy variable.

The addition of the *OPEN SKIES* dummy variable reduces the overall fit of the model and results in negative coefficients that are not statistically significant. In other words, countries with a U.S. Open Skies agreement statistically have lower transatlantic service levels than their non-Open Skies counterparts. This is counter to proponents' arguments that Open Skies leads to increased service to a particular country and is consistent with both our European city analysis and our policy impact analysis presented in Chapter 4.

Table 32: European Country Regression Results for Modified Model

European Countries: 2007 City Pairs

	Coefficients	*Standard Error*	*t Stat*
Intercept	15.7846	6.1484	2.5673
DISTANCE	-0.0036	0.0014	-2.5946
GDP	0.0104	0.0009	11.4024
OPEN SKIES	-1.1597	1.5299	-0.7580
Adjusted R^2	0.8175		

European Countries: 2007 City Pairs

	Coefficients	*Standard Error*	*t Stat*
Intercept	13.7935	5.5883	2.4683
DISTANCE	-0.0030	0.0013	-2.4007
GDP	0.0083	0.0011	7.6259
OPEN SKIES	-1.5571	1.3868	-1.1228
HUB	7.8156	2.6730	2.9239
Adjusted R^2	0.8515		

European Countries: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	1261.8781	551.8000	2.2868
DISTANCE	-0.2826	0.1235	-2.2889
GDP	0.7217	0.0816	8.8470
OPEN SKIES	-233.9260	137.3034	-1.7037
Adjusted R^2	0.7310		

European Countries: 2007 Transatlantic Departures

	Coefficients	*Standard Error*	*t Stat*
Intercept	1061.4914	483.9671	2.1933
DISTANCE	-0.2267	0.1087	-2.0850
GDP	0.5122	0.0941	5.4451
OPEN SKIES	-273.9251	120.1055	-2.2807
HUB	786.5863	231.4947	3.3979
Adjusted R^2	0.7962		

European Countries: 2007 # of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	8.7254	2.7160	3.2126
DISTANCE	-0.0018	0.0006	-2.9566
GDP	0.0036	0.0004	9.0752
OPEN SKIES	-0.4620	0.6758	-0.6836
Adjusted R^2	0.7545		

European Countries: 2007 # of Transatlantic Carriers

	Coefficients	*Standard Error*	*t Stat*
Intercept	7.5297	2.1710	3.4683
DISTANCE	-0.0015	0.0005	-2.9999
GDP	0.0024	0.0004	5.6730
OPEN SKIES	-0.7007	0.5388	-1.3005
HUB	4.6934	1.0384	4.5197
Adjusted R^2	0.8455		

European Countries: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	239584.8664	109271.7907	2.1926
DISTANCE	-54.0590	24.4533	-2.2107
GDP	147.2368	16.1544	9.1143
OPEN SKIES	-45778.3474	27189.9032	-1.6837
Adjusted R^2	0.7402		

European Countries: 2007 Transatlantic Passengers

	Coefficients	*Standard Error*	*t Stat*
Intercept	198428.2166	94521.2249	2.0993
DISTANCE	-42.5773	21.2392	-2.0047
GDP	104.1968	18.3698	5.6722
OPEN SKIES	-53993.6003	23457.2154	-2.3018
HUB	161553.8800	45212.0765	3.5732
Adjusted R^2	0.8085		

Although our original 2-variable model has strong explanatory power, the addition of the *HUB* dummy variable still increases the overall fit of the model. In this multivariate model, *GDP* remains the most significant variable, but *HUB* is highly significant as in the European city model. Again in this European model, unlike in the U.S. model, European hubs tend to draw a larger number of transatlantic competitors. Unlike U.S. cities, European cities receive transatlantic service less as a function of distance and Open Skies status and more as a function of GDP and status as a Big-3 carrier hub. Most surprising once again is that the existence of an Open Skies agreement is statistically insignificant and bears a negative correlation to transatlantic service levels to European countries.

5.5 Summary

In this chapter we performed a series of regression analyses on the transatlantic service levels of 32 U.S. cities, 59 European cities and 37 European countries. The goal was to determine which factors play the biggest role in determining transatlantic service levels to a given market and to investigate the specific impact of Open Skies. Our econometric models demonstrated the following:

- Of all the factors investigated, the total economic activity of a city or country (as measured by GDP) is the dominant factor in determining service levels to U.S. cities and European countries.
- Because of the tendency of hubs to exist in or near major economic centers, status as a Big-3 European carrier hub is the dominant factor in determining service levels to European cities.
- Unlike in Europe, whether a U.S. city serves as a hub has insignificant explanatory power.
- In both U.S. and European markets, distance across the Atlantic Ocean is negatively correlated to service levels
- The existence of an Open Skies agreement does not have a significant relationship to transatlantic service levels and, in fact, is negatively correlated to service levels across European countries.

We remind the reader that service level measures used in our regressions reflect nonstop segment data as opposed to O-D traffic data. The absolute number of passengers flown between the U.S. and a particular European city or country can be higher or lower than those enplaned on nonstop flights to that city or country. This limitation in our data will tend to inflate demand (and service levels) to or from cities with substantial connecting traffic. However, as with our Chapter 4 analysis, we believe that traffic is a difficult measure to determine causation from Open Skies because we expect a natural growth in traffic year over year, regardless of other service level changes.

This econometric analysis supplements the stakeholder, competitive, market and policy impact analyses conducted as part of this thesis. The results are consistent with these analyses in confirming that liberalization has yielded both increases *and* decreases in service since 1990. There is no statistically significant correlation between the existence of an Open Skies agreement and transatlantic service levels to that country. The regression also confirms European carriers' reliance on the network effects of their hubs, increasingly being adopted by U.S. carriers. In the next chapter we summarize the findings across all of our analyses and formalize our conclusions about the impacts of regulatory liberalization.

Chapter 6

Summary of Results and Conclusions

In this age of globalization, the once heavily regulated international aviation market is increasingly being liberalized. This movement from the status quo has proven contentious among air transportation stakeholders. Our research contributes to the debate over regulatory liberalization with an analysis of its effects in the transatlantic market.[43] In this thesis we have evaluated how competition in transatlantic aviation markets has evolved over the last decade and how regulatory liberalization has impacted service levels and competition in specific U.S. and European markets. In addition, we have explored the extent to which various market characteristics impact transatlantic service levels. This research was conducted in four parts: (1) a stakeholder analysis, (2) a competition and market analysis of transatlantic aviation, (3) a review of the policy impacts since 1990, and (4) an econometric market analysis. The results of each part are summarized below, followed by our research conclusions and suggested future work.

6.1 Summary of Results

Historically, air service agreements between nations have been negotiated by governments. A nation's air transportation rights have often been granted or restricted as a foreign policy tool and an economic vehicle seeking to protect national interests. International routes, city pairs, frequencies, fares and operating carriers have been determined by the governments negotiating a particular bilateral agreement. Significant research has been conducted of deregulation's impact on airfares and service. Studies have consistently found that since U.S. domestic deregulation in 1978, fares have declined overall, most communities have more commercial air service than they did under regulation, and the rate of accidents has continued its historic decline (GAO, 1996). As U.S. airlines focus increasingly on expanding their international networks in response to the globalized marketplace, many have sought the same operational freedoms internationally that they now enjoy domestically.

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[43] Again, in our research we use the term "transatlantic" to refer to the air transportation market between the United States and Europe. The latter includes both European Union member states and those not covered by EU aviation agreements.

Stakeholder Analysis

In our stakeholder analysis presented in Chapter 2, we outlined the core arguments in the debate over regulatory liberalization. Concerns over impacts on employment, safety and national security are most often cited by aviation stakeholders opposed to further international liberalization. Proponents, on the other hand, maintain that domestic and international competition will increase through the deregulation of aviation markets, and that increased competition benefits consumers. They often cite examples of liberalization policies that have resulted in service level increases, such as U.S. Open Skies agreements with the Netherlands and Germany. Although few dispute that increases in competition and service levels have benefited consumers, our research indicates that the signing of Open Skies agreements have led to both gains and reductions in service levels across the Atlantic.

Perhaps more fundamentally, liberalization takes many forms (e.g., operational, ownership, control, safety), and it is not clear that the demonstrated benefits of one form of deregulation can be used to predict the effects of other forms. In our stakeholder analysis we have identified a number of arguments made for or against liberalized foreign ownership of airlines that rely upon the consequences of U.S. domestic deregulation in 1978. Yet one cannot draw the immediate conclusion that changing foreign ownership laws would provide aggregate benefit on the basis that other forms of deregulation have provided benefit. Nor can the opposite argument be made. An assessment of the impacts of liberalization must be made case-by-case in order to capture the intricacies of individual cases of liberalization. And any such assessment must incorporate the indirect consequences of action as well as the opportunity costs of inaction.

We learned from our stakeholder analysis that, apart from uncovering operational inefficiencies, regulatory liberalization would grant U.S. carriers access to cheap capital to retire debt, consolidate, and invest in their product, enhancing their competitive position globally. Further immunization, joint ventures and cross-border consolidation allow carriers to develop their global networks to better serve the traveling public. Expanded global networks from financially stronger carriers will better connect U.S. businesses to the world while delivering economic synergies for investors. And numerous studies have shown that, with the appropriate legislative safeguards, removing regulations generates a social benefit that far outweighs any negative impacts.

Market and Competition Analysis

In our market and competitive analysis presented in Chapter 3 we see that, in aggregate since 2000, transatlantic markets have been served by an increasing number of competitors. However, we also identified fifteen cities (two in the U.S., thirteen in Europe) that have lost all direct transatlantic service since 1990. A majority of transatlantic service lost in Europe has come from European carriers canceling service. Similarly, losses in U.S. cities have come from American carriers stopping service.

Since 2000, nineteen cities (three in the U.S., sixteen in Europe) have received their first transatlantic service. A majority of service gained in Europe has come from U.S. carriers whereas a majority of new U.S. service has come from European carriers. As this would suggest, U.S. carriers have indeed gained a disproportionate share of new transatlantic service. Both the trends in service losses and gains suggest that U.S. and European carriers are increasingly flying from their primary hubs to new markets across the Atlantic in an effort to leverage the network effect of connections behind their hubs.

In addition, we identify a trend towards reduction in aircraft size, with U.S. carriers on average utilizing aircraft with 50 fewer seats across the Atlantic than their foreign counterparts. As transatlantic competition between larger cities becomes saturated, the demand for air service to smaller cities may increase, prompting the use of smaller aircraft. This phenomenon may disproportionally benefit those carriers with long-range fleets composed of smaller aircraft.

We also discover that although European gateways are highly concentrated to the largest four hubs, overall U.S. gateways are more concentrated than those of Europe, where a greater proportion of traffic is fed through smaller gateways. Part of this difference is that in Europe, historically, it was very much the responsibility of the national government to preserve a "flag carrier" not only to provide air transportation to its residents, but also to represent the nation's interests abroad.[44] The top ten European gateways serve as hub airports to nine major European carriers. But perhaps more telling is the number of carriers whose hubs exist at the remaining 42 European gateway cities. Here are the hub cities of other national carriers, like Austrian, SAS, Brussels Airlines, Icelandair, Olympic, Turkish Airways, Tarom, LOT Polish Airlines, Czech Airlines, Aeroflot, Finnair, TAP Portugal and Air Malta, all with incentive (and in a few cases, government assistance) to serve major international centers like New York. Conversely, the list of top ten U.S. gateways already includes hub cities of all six legacy U.S. carriers. There are no other U.S. carriers with transatlantic capabilities, so there are fewer forces fragmenting the U.S. gateways than those in Europe.

The market and competition analysis demonstrates a clear reliance on hubs as transatlantic gateways in both the U.S. and Europe. Since 2000, U.S. carriers have gained a disproportionate share of transatlantic departures, destinations and passengers. This has occurred through the addition of new service from major U.S. gateways. Our next step is to understand whether liberalization policy events have driven this new service.

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[44] This phenomenon is being alluded to in the opening quotation of this thesis on Page 5.

Impacts of Transatlantic Open Skies

In Chapter 4 we discover that of the 22 European countries with a U.S. Open Skies agreement prior to 2007, only seven experienced overall increases in transatlantic service levels following the signing of their agreements. Another six countries experienced overall reductions in service levels, and four without any service prior to the agreement remain without service today. This data supports the notion that liberalization alone is not sufficient to achieve increases in service levels.

Our analysis begins with a review the Open Skies Agreements in place between the U.S. and European counties. It is worth noting that over one third of the U.S.' Open Skies agreements have been established with European countries, which mirrors the tendency for air transportation between the two regions to be less regulated than in other parts of the world. Indeed, transatlantic service levels have been the subject of numerous studies that explore the benefits resulting from liberalization. Our findings from the analyses presented in Chapters 4 and 5 are that the impacts of Open Skies are less conclusive than those held by previous studies. The discrepancies are discussed in Section 6.2.

For each of the European Open Skies signatories, we evaluate the changes in service level metrics following the signing of the agreement. We define transatlantic "service levels" between two countries to comprise four metrics: passenger enplanements, number of city pairs, total departures and the number of carriers providing transatlantic service. The latter is one indicator of the level of competition in the market. Most studies have considered traffic growth as the most robust indicator of the "benefits" of Open Skies. However, it is also important to consider whether certain communities have lost transatlantic service (i.e. reduction in city pairs). We also evaluate whether liberalization does, as proponents predict, result in an increase in the number of competitors by reducing the barriers to entry into a given market.

Our analysis evaluates changes in four service level measures in the five years prior and post the signing of an Open Skies agreement with the U.S. For the number of departures and passenger enplanements, annualized growth rates are averaged over the five-year period before and after the agreement. For number of city pairs and competitors, the absolute number is averaged over the same periods. The pre- and post-agreement values are compared to gain insight into the impact of Open Skies. We perform a statistical significance test to determine whether a significant change in service levels occurred following the signing of an Open Skies agreement. Given the small size of each of our samples (five data points prior- and five post-agreement) and that the data fails to conform to a specific distribution (e.g. normal, uniform, triangular), we must employ a nonparametric test. We perform the Wilcoxon Rank Sum test which is well-suited for two-sample problems with independent samples.

We define an increase in service levels to be conclusive if, of those service metrics experiencing a statistically significant change, a simple majority increased following the establishment of Open Skies. Similarly, a decrease is conclusive if a majority of statistically significant changes were negative. To reiterate, of the 22 countries with U.S. Open Skies agreements in place by 2007, only seven demonstrated overall increases in service levels while six demonstrated overall reductions. The four countries which signed Open Skies treaties with the U.S. but have not received service support the hypothesis that liberalization alone does not oblige service level increases.

We then discuss the impacts of antitrust immunity and partnerships, particularly the extent to which alliances in deregulated markets have led to the benefits often credited to liberalization. We highlight studies that have demonstrated the service level increases and fare reductions that leverage the required linkage between alliances and liberalization. For example, a U.S. DOT (2000) study confirms that "alliance-based networks are the principal driving force behind transatlantic price reductions and traffic gains." In other words, the data suggests that deregulation alone has not consistently led to service level increases or fare decreases. Instead deregulation in the form of Open Skies, as a prerequisite for immunization of alliances, has ultimately led to the service benefits we enjoy today. In our final analysis, we build an econometric model to validate Chapter 4's conclusion that the existence of Open Skies is not a dominant explanatory factor of transatlantic service levels.

Econometric Market Analysis

In Chapter 5 we determine that Open Skies agreements demonstrate no statistically significant correlation to transatlantic service levels by performing an econometric analysis of U.S. and European markets. Our regression analysis evaluates transatlantic service levels of 32 U.S. cities, 59 European cities and 37 European countries, with the goal of determining which factors play the largest role in explaining transatlantic service levels to a particular market.

Of all the factors investigated, the total economic activity of a city or country (as measured by GDP) is the dominant factor in determining service levels to U.S. cities and European countries. Additionally, because of the tendency of hubs to exist in or near major economic centers, status as a Big-3 European carrier hub is the dominant factor in determining service levels to European cities. However unlike in Europe, whether a U.S. city serves as a hub has insignificant explanatory power.

Perhaps most notably, the existence of an Open Skies agreement does not have a significant relationship to transatlantic service levels and, in fact, is negatively correlated to service levels across European countries.

We recall from Chapter 3 that recent growth in transatlantic service has come from the Big-3 European and Big-6 American carriers. They continue to leverage their transatlantic hubs and the expanded networks that result from their participation in alliances. Due to statutory precedent, alliance growth is reliant upon the liberalization of bilaterals between the U.S. and respective European nations.

Therefore, the results of these analyses support the hypothesis that liberalization is a necessary, but not sufficient, step in achieving transatlantic service level growth.

6.2 Contrast with Other Studies

Our findings are consistent with those of InterVISTAS (2006), which concluded that "liberalization is a necessary but not sufficient condition for traffic growth." InterVISTAS builds a comprehensive econometric model to describe air traffic levels between country-pairs using various geographical, socioeconomic and regulatory variables. They evaluate current flight levels and determine whether traffic levels could support additional (or in some cases initial) service. Furthermore, if 5th freedom rights are available, InterVISTAS arbitrarily allocates half of the capacity to the fifth freedom market. In their model, if the country-pair can meet a 70% load factor and pre-established frequency requirements, they assume it will obtain new direct service. Otherwise, no nonstop traffic increases will occur. Yet in our analysis we found that over two thirds of cities that lost all transatlantic service since 1990 were served by direct flights with average load factors above 70%. The InterVISTAS model would have predicted that service, yet other factors deemed them unsustainable in the real world.

The InterVISTAS study also differs from our own in that it uses a regression analysis to explain traffic levels between two countries. In our research we use regression analysis to explain transatlantic service levels for a particular city because we are interested in service levels rather than traffic levels to Open Skies countries. As a result, our econometric analysis is able to produce specific results for different cities in the same country. Despite these discrepancies, the InterVISTAS study was original and comprehensive, and our conclusions align.

The Brattle Group (2002) estimates a 9-24% increase in international passenger demand between the U.S. and EU resulting from establishment of an Open Aviation Area (OAA) between the two. In calculating this number, Brattle makes three primary assumptions about an OAA environment, namely that (1) all cost savings are passed on to consumers, (2) the frequency of the number of flights increase by 10%, and (3) fares decrease by 18-28% thereby stimulating additional demand. However, the Brattle estimates reflect a regulation-free OAA as defined in Chapter 2 rather than the more pragmatic Open Skies treaty between the U.S. and EU. The effects of EU-U.S. Open Skies will admittedly be far less given restrictions on cabotage and foreign ownership.

To test their conclusions, Brattle uses evidence from previous liberalization events and evaluates the change in annual growth rates of traffic volume. The Brattle methodology differs from our own in a few ways. First, we examine all 34 European Open Skies signatories, whereas Brattle considers only the original fourteen EU member states, four of which lacked Open Skies agreements with the U.S. Next, the study's conclusion that liberalization is the basis for the observed transatlantic traffic growth appears inconclusive since three of four countries without Open Skies experienced increases in traffic growth rates over the test period. Similarly, two of ten Open Skies countries saw negative or insignificant changes in traffic growth rate over the same period. These conflicting cases are consistent with our findings presented in Chapter 4 that liberalization has led to both increases and decreases in service levels.

Booz Allen Hamilton (2007) updated the Brattle Group report and estimated an increase of 26 million passengers over five years following the establishment of a U.S.-EU OAA. Again, the expected effects will not be as great under EU-U.S. Open Skies. Booz Allen appropriately incorporates the effects of 9/11 and examines a larger subset of twenty EU and EFTA member states. However, Booz Allen's regression analysis only considers traffic increases as a measure of increased service levels whereas our study evaluates three additional service metrics.

The Brattle, Booz Allen and InterVISTAS studies all confirm our hypothesis that, regardless of artificial restrictions, traffic will grow because of economic growth. In addition, all three studies identify the importance of evaluating changes to transatlantic airfares in determining the effects of liberalization, yet the lack of high quality fare information precludes any detailed analysis of price impacts. As a result, all three studies rely on passenger volume as a more reliable measure of economic impact. They explore city pairs only as a secondary measure and do not evaluate competition or departures. As we have already discussed, our research explores four measures to determine changes in service levels: number of city pairs, competitors, departures and enplanements. We evaluate changes in service levels in the five years prior and post the signing of an Open Skies agreement.

The three above reports consider the total economic impacts of air transportation liberalization, whereas our research considers only service level impacts. Although the "benefits" of liberalization are indeed far-reaching, their calculation is based on assumptions that are beyond the scope of this research.

6.3 Conclusions and Future Research

Throughout our research, a few common themes prevail. First, as new entrant airlines have appeared and incumbent airlines expand their footprints, competition has increased both domestically and internationally. Although its consequences are still debated, increased competition brought about through the expansion of incumbent networks as well as new entrants in the U.S. relied upon the deregulation of the airline industry in 1978.

Second, as domestic markets have become increasingly saturated, carriers have emphasized international long-haul flying to capture higher yields and leverage proportionally lower unit costs.

Again, the flexibility to efficiently manage international capacity has become easier as global aviation markets become deregulated.

Third, carriers have long leveraged their hubs and focus cities when adding international capacity. New direct service to Europe has overwhelmingly been added by U.S. carriers flying from their hubs. Similarly, U.S. cities receiving new transatlantic service have received this service from non-U.S. carriers flying to their hubs.

Finally, our research has demonstrated that the liberalization of air transportation has resulted in service level gains in some markets and losses in others. While some Open Skies agreements have led to increases in service levels and/or competition, others have been followed by decreases in service or competition. The effects of liberalization depend on many factors not inherently common to all cases, and therefore must be evaluated on a case-by-case basis. Between the U.S. and Europe, liberalization alone has not consistently led to the increases in service or competition that proponents often cite.

We contest the argument that regulatory liberalization obliges competition and service level increases. However, we believe that those case studies that proponents most often cite (such as the Netherlands and Germany) could not have seen such favorable increases in service levels without the liberalization effects of Open Skies and antitrust immunity.

In lieu of the promise of increased service levels, the best arguments for liberalization highlight the costs that regulation imposes upon the consumer by not allowing for the optimal allocation of capital resources across the global network. For example, the cancelation of a route following an Open Skies agreement is one indication that the opportunity cost of that particular service is high given a deregulated set of alternatives. These costs of regulation (operating inefficiencies, opportunity costs, etc.) must be weighed against any service level gains in determining net utility to individual stakeholders. Since the costs and benefits of policy changes have been spread across many stakeholders at various points in time, movement from the status quo is understandably contentious. However, regulated markets bear the costs of restricted output levels that have not successfully been captured in the debates over liberalization.

Restrictions in time and data limited our ability to quantify the costs of operating inefficiencies and suboptimal resource allocation. It is very difficult to estimate what output levels to a particular market would have been without the granting of antitrust immunity and the expansion of alliances. However, it would be useful to further study the impacts of regulation across a network to quantify the specific impacts on particular stakeholder groups. This work would aid in developing vehicles for legislative change that incorporate protections and reparations for certain stakeholder groups.

As already discussed in previous chapters, an important limitation of our approach is that given the data we have access to, our "passenger enplanements" metric reflects nonstop traffic only. It considers all O-D traffic onboard a particular segment, including passengers who connect onward (in

Europe) to reach alternative destinations, or those who ultimately arrive in cities which they did not fly to directly from the U.S. For example, traffic reported between Philadelphia and Paris includes not only Philadelphia-Paris local passengers but all passengers on board that originate "behind" Philadelphia or terminate "beyond" Paris. These passengers comprise varying fractions of the total traffic and do not reflect demand in the Philadelphia-Paris local market. Due to limitations in data, our analysis considers segment traffic rather than O-D traffic. This will tend to inflate demand (and service levels) to or from cities with substantial connecting traffic. We believe that traffic alone is a difficult measure to determine causation from Open Skies because we expect a natural growth in traffic year over year, regardless of other service level changes. Therefore equal emphasis is placed on number of city pairs, departures and carriers. It would be very interesting to investigate how liberalization has impacted traffic to individual city pairs across nonstop and connecting itineraries.

Similarly, our study does not include a detailed analysis of the price impacts of liberalization. It is worthwhile to evaluate changes to transatlantic airfares as an additional measure of the effects of liberalization, yet the lack of high quality fare information makes such an analysis difficult. Although output volume is a useful measure of impact on consumers, further work could explore fare changes across a full set of origin-destination pairs following liberalization.

The regression analysis performed in this thesis is insufficient to identify those markets that could maintain profitable (or should expect to receive additional) transatlantic service. Many variables not captured in our model are used by airlines for market analysis. A more extensive econometric analysis, such as that developed by InterVISTAS (2006), might help forecast changes in service levels between the U.S. and Europe and elsewhere.

From our research we conclude that liberalization is a necessary, but not sufficient, step in achieving the optimal application of air transportation resources to serve the public. Traditional aviation bilaterals, while effective as foreign policy vehicles, have proven more costly in an increasingly globalized world. Without liberalization, many operating inefficiencies are never uncovered, resulting in a suboptimal allocation of limited capital resources. Many studies have shown that regulatory liberalization has resulted in traffic growth at unprecedented levels. Our research has shown that, while the service level growth phenomenon cannot be guaranteed, the potential for output growth is artificially constrained in regulated markets.

Appendix I: List of U.S. Open Skies Agreements

Source: U.S. Department of State Bureau of Economic, Energy and Business Affairs
Updated November 25, 2008

Partner	Application	Date Concluded	All-cargo 7th's	MALIAT Membership
1. *Netherlands	In Force	10/14/92	--	--
2. *Belgium	Provisional	3/1/95	--	--
3. *Finland	In Force	3/24/95	--	--
4. *Denmark	In Force	4/26/95	--	--
5. Norway	In Force	4/26/95	--	--
6. *Sweden	In Force	4/26/95	--	--
7. *Luxembourg	In Force	6/6/95	Yes	--
8. *Austria	In Force	6/14/95	--	--
9. Iceland	In Force	6/14/95	Yes	--
10. Switzerland	In Force	6/15/95	--	--
11. *Czech Republic	In Force	12/8/95	Yes	--
12. *Germany	Provisional	2/29/96	Yes	--
13. Jordan	In Force	11/10/96	--	--
14. Singapore	In Force	1/22/97	Yes	Yes
15. Taiwan	In Force	2/28/97	--	--
16. Costa Rica	In Force	5/8/97	--	--
17. El Salvador	In Force	5/8/97	Yes	--
18. Guatemala	In Force	5/8/97	Yes	--
19. Honduras	Provisional	5/8/97	Yes	--
20. Nicaragua	In Force	5/8/97	Chart Only	--
21. Panama	In Force	5/8/97	Yes	--
22. New Zealand	In Force	5/29/97	Yes	Yes
23. Brunei	In Force	6/20/97	Yes	Yes
24. Malaysia	In Force	6/21/97	Yes	--
25. Aruba	In Force	9/18/97	Yes	--
26. Chile	In Force	10/28/97	Yes	Yes
27. Uzbekistan	In Force	2/27/98	Yes	--
28. Korea	In Force	4/23/98	--	--
29. Peru	In Force	6/10/98	Yes	--
30. Netherland Antilles	In Force	7/14/98	Yes	--
31. *Romania	In Force	7/15/98	--	--
32. *Italy	C&R	11/11/98	--	--
33. U.A.E.	In Force	4/13/99	Yes	--
34. Pakistan	In Force	4/29/99	Yes	--

Partner	Application	Date Concluded	All-cargo 7th's	MALIAT Membership
35. Bahrain	In Force	5/24/99	Yes	--
36. Tanzania	Provisional	11/3/99	Yes	--
37. *Portugal	In Force	12/22/99	Yes	--
38. *Slovak Republic	In Force	1/7/00	Yes	--
39. Namibia	C&R	2/4/00	--	--
40. Burkina Faso	In Force	2/9/00	Yes	--
41. Ghana	In Force	3/16/00	Yes	--
42. Turkey	In Force	3/22/00	--	--
43. Gambia	In Force	5/2/00	Yes	--
44. Nigeria	Provisional	8/26/00	Yes	--
45. Morocco	In Force	10/5/00	Yes	--
46. Rwanda	N/A	10/11/00	Yes	--
47. *Malta	In Force	10/12/00	Yes	--
48. Benin	N/A	11/28/00	Yes	--
49. Senegal	C&R	12/15/00	Yes	--
50. *Poland	In Force	5/31/01	Yes	--
51. Oman	C&R	9/16/01	Yes	--
52. Qatar	Provisional	10/3/01	Yes	--
53. *France	In Force	10/19/01	Yes	--
54. Sri Lanka	In Force	11/1/01	--	--
55. Uganda	C&R	6/04/02	Yes	--
56. Cape Verde	In Force	6/21/02	Yes	--
57. Samoa	In Force	7/4/02	Yes	Yes
58. Jamaica	In Force	10/30/08	--	--
59. Tonga	In Force	9/19/03	Yes	Yes
60. Albania	In Force	9/24/03	Yes	--
61. Madagascar	Provisional	3/10/04	Yes	--
62. Gabon	In Force	5/26/04	Yes	--
63. Indonesia	C&R	7/26/04	Yes	--
64. Uruguay	Provisional	10/20/04	Yes	--
65. India	In Force	1/15/05	Yes	--
66. Paraguay	In Force	5/2/05	Yes	--
67. Maldives	In Force	5/5/05	Yes	--
68. Ethiopia	Provisional	5/17/05	Yes	--
69. Thailand	In Force	9/19/05	Yes	--
70. Mali	In Force	10/17/05	Yes	--
71. Canada	In Force	3/12/07	Yes	--
72. Bosnia and Herzegovina	In Force	11/22/05	Yes	--

Partner	Application	Date Concluded	All-cargo 7th's	MALIAT Membership
73. Cameroon	In Force	2/16/06	Yes	--
74. Chad	Provisional	5/31/06	Yes	--
75. Cook Islands	In Force	2/28/06	Yes	Yes
76. Kuwait	In Force	5/27/07	Yes	--
77. Liberia	In Force	2/15/07	Yes	--
78. *Bulgaria	Provisional 3/30/08	4/30/07	Yes	--
79. *Cyprus	Provisional 3/30/08	4/30/07	Yes	--
80. *Estonia	Provisional 3/30/08	4/30/07	Yes	--
81. *Greece	Provisional 3/30/08	4/30/07	Yes	--
82. *Hungary	Provisional 3/30/08	4/30/07	Yes	--
83. *Ireland	Provisional 3/30/08	4/30/07	Yes	--
84. *Latvia	Provisional 3/30/08	4/30/07	Yes	--
85. *Lithuania	Provisional 3/30/08	4/30/07	Yes	--
86. *Slovenia	Provisional 3/30/08	4/30/07	Yes	--
87. *Spain	Provisional 3/30/08	4/30/07	Yes	--
88. *United Kingdom	Provisional 3/30/08	4/30/07	Yes	--
89. Georgia	In Force	12/6/07	Yes	--
90. Australia	C&R	2/14/08	Yes	--
91. Croatia	N/A	3/13/08	Yes	--
92. Kenya	C&R	5/30/08	--	--
93. Laos	C&R	10/3/08	Yes	--
94. Armenia	C&R	10/7/08	Yes	--

*The U.S.-EU Air Transport Agreement, signed April 30, 2007, has been provisionally applied since March 30, 2008, for all 27 European Union member countries.

Appendix II: List of Immunized Alliances with U.S. Carriers

Source: U.S. Department of Transportation Office of Aviation Analysis

IMMUNIZED ALLIANCES

ALLIANCE	NOTE	DATE FILED	DOCKET NUMBER	FINAL ORDER
American-CAI	(Alliance Ended on 6/1/00)	11/3/95	OST-1995-792	7/15/96:Order 96-7-21
American-British Airways	(Dismissed)	8/10/01	OST-2001-10387 OST-2001-11029	4/4/02:Order 2002-4-4 *(Granted AA-BA motion to dismiss)*
American-Finnair		4/4/02	OST-2002-12063	7/30/02:Order 2002-7-39
American-LAN Chile		12/23/97	OST-1997-3285	9/13/99:Order 99-9-9
American-Sabena-Swissair	(Effective 8/6/00) (AA-SR Terminated on 11/8/01; AA-SN Terminated on 3/21/02)	11/19/99	OST-1999-6528	5/11/00:Order 2000-5-13
American-TACA Group	(Request to Dismiss filed on 3/4/02)	3/17/00	OST-2000-7088	Pending
American-Swiss Int'l Air Lines		6/28/02	OST-2002-12688	11/22/02:Order 2002-11-12
Continental-COPA		12/22/00	OST-2000-8577	5/3/01:Order 2001-5-1
Delta-Austrian-Sabena-Swissair	(Alliance Ended on 8/6/00)	9/8/95	OST-1995-618	6/14/96:Order 96-6-33
Delta-Air France-Alitalia-Czech Airlines		8/15/01	OST-2001-10429	1/18/02:Order 2002-1-6
Delta-Korean Air Lines-Air France-Alitalia-Czech Airlines		3/13/02	OST-2002-11842	6/27/02:Order 2002-6-18
Northwest-KLM		9/9/92	OST-1992-46371	1/11/93:Order 93-1-11
Northwest-KLM-Alitalia	(AZ Terminated Relationship on 10/28/01)	5/11/99	OST-1999-5674	12/3/99:Order 99-12-5
Northwest-Malaysia		1/13/00	OST-2000-6791	10/13/00:Order 2000-10-12
United-Asiana Airlines		1/3/03	OST-2003-14202	5/14/03:Order 2003-5-18
United-Lufthansa		2/29/96	OST-1996-1116	5/20/96:Order 96-5-27
United-Lufthansa-SAS		5/28/96	OST-1996-1411	11/1/96:Order 96-11-1

United-Austrian-Lauda-Lufthansa-SAS		8/18/00	OST-2000-7828	1/26/01:Order 2001-1-19
United-British Midland-Austrian-Lauda-Lufthansa-SAS		9/5/01	OST-2001-10575 OST-2001-11029	4/4/02:Order 2002-4-4 *(Subject to achieving US-UK open skies within six months of issue date of order)* 10/3/02:Order 2002-10-6 *(Subject to achieving US-UK open skies by 12/31/02)* 12/31/02:Order 2002-12-22 *(Subject to achieving US-UK open skies by 6/30/03)*
United-Air Canada		6/4/96	OST-1996-1434	9/19/97:Order 97-9-21
United-Air New Zealand		12/17/99	OST-1999-6680	4/3/01:Order 2001-4-2

Appendix III: Wilcoxon Rank Sum Table

		Lower Tail						Upper Tail					
		prob						*prob*					
n_A	n_B	.005	.01	.025	.05	.10	.20	.20	.10	.05	.025	.01	.005
4	4			10	11	13	14	22	23	25	26		
	5		10	11	12	14	15	25	26	28	29	30	
	6	10	11	12	13	15	17	27	29	31	32	33	34
	7	10	11	13	14	16	18	30	32	34	35	37	38
	8	11	12	14	15	17	20	32	35	37	38	40	41
	9	11	13	14	16	19	21	35	37	40	42	43	45
	10	12	13	15	17	20	23	37	40	43	45	47	48
	11	12	14	16	18	21	24	40	43	46	48	50	52
	12	13	15	17	19	22	26	42	46	49	51	53	55
5	5	15	16	17	19	20	22	33	35	36	38	39	40
	6	16	17	18	20	22	24	36	38	40	42	43	44
	7	16	18	20	21	23	26	39	42	44	45	47	49
	8	17	19	21	23	25	28	42	45	47	49	51	53
	9	18	20	22	24	27	30	45	48	51	53	55	57
	10	19	21	23	26	28	32	48	52	54	57	59	61
	11	20	22	24	27	30	34	51	55	58	61	63	65
	12	21	23	26	28	32	36	54	58	62	64	67	69
6	6	23	24	26	28	30	33	45	48	50	52	54	55
	7	24	25	27	29	32	35	49	52	55	57	59	60
	8	25	27	29	31	34	37	53	56	59	61	63	65
	9	26	28	31	33	36	40	56	60	63	65	68	70
	10	27	29	32	35	38	42	60	64	67	70	73	75
	11	28	30	34	37	40	44	64	68	71	74	78	80
	12	30	32	35	38	42	47	67	72	76	79	82	84
7	7	32	34	36	39	41	45	60	64	66	69	71	73
	8	34	35	38	41	44	48	64	68	71	74	77	78
	9	35	37	40	43	46	50	69	73	76	79	82	84
	10	37	39	42	45	49	53	73	77	81	84	87	89
	11	38	40	44	47	51	56	77	82	86	89	93	95
	12	40	42	46	49	54	59	81	86	91	94	98	100
8	8	43	45	49	51	55	59	77	81	85	87	91	93
	9	45	47	51	54	58	62	82	86	90	93	97	99
	10	47	49	53	56	60	65	87	92	96	99	103	105
	11	49	51	55	59	63	69	91	97	101	105	109	111
	12	51	53	58	62	66	72	96	102	106	110	115	117
9	9	56	59	62	66	70	75	96	101	105	109	112	115
	10	58	61	65	69	73	78	102	107	111	115	119	122
	11	61	63	68	72	76	82	107	113	117	121	126	128
	12	63	66	71	75	80	86	112	118	123	127	132	135
10	10	71	74	78	82	87	93	117	123	128	132	136	139
	11	73	77	81	86	91	97	123	129	134	139	143	147
	12	76	79	84	89	94	101	129	136	141	146	151	154
11	11	87	91	96	100	106	112	141	147	153	157	162	166
	12	90	94	99	104	110	117	147	154	160	165	170	174
12	12	105	109	115	120	127	134	166	173	180	185	191	195

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