The Impact of Infrastructure-Related Taxes and Fees on Airline Fares in the US and the European Union

by

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Submitted to the Department of Civil and Environmental Engineering
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Transportation
and
Master of Science in Operations Research

at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
June 2005

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Abstract

The purpose of this thesis is to estimate the impact of infrastructure-related add-on taxes and fees on the direct cost of air travel in the United States and the European Union. Its scope includes domestic travel in the United States and both domestic and intra-EU international travel within the European Union. For the United States, we work with over 4 million passenger records from the Department of Transportation 10% Ticket Samples to conclude that the effective tax rate (ETR) on the average base fare (BF) was 15.5% in the second quarter of 2002. The incidence is much heavier on the least expensive tickets because three out of the four add-on taxes and fees are based on the passenger's itinerary and are independent of the BF. Comparative analyses indicate that the ETR was 10.9% in 1993 and 16.1% in 2004, but a large portion of the ETR increase over the years is due to a significant decline in the yields achieved by the airlines. We also show that passengers traveling on low cost carriers are expected to face a higher ETR than those traveling on traditional network airliners or the "legacy carriers". Other analyses are performed to demonstrate that there was a statistically significant decrease in the number of segments per ticket from 2002 to 2004 and that the ETR would increase by 2.2% to 2.6% as a result of the new security fee policy proposed by the Bush Administration in 2005.

Turning to the European side, our preliminary estimation shows that the average ETR was 12.5% in 2004 based on an analysis of over 300,000 ticket records provided by a Global Distribution System company. However, the ETR, in fact, varies greatly among the 15 European Union countries investigated, ranging from 6.6% to 24.4%, because of the complex and diverse taxation rules in place in Europe and because of the differences in average ticket prices. Finally, a simple analysis shows that the actual European ETR may be significantly higher than the ETR in the United States if the differences in charging schemes for the cost of air transportation infrastructure are taken into consideration.

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Acknowledgements

First and foremost, I would like to thank my academic and research advisor, Professor Amedeo Odoni, for his encouragement and guidance over the past three years. His wisdom and thoughtfulness helped me in achieving much more than what I had set out to achieve at MIT. I was truly fortunate to have him as my advisor. Thank you.

I would also like to thank Professor Joakim Karlsson of the Daniel Webster College, who is another faculty advisor in this research project. Thank you for always taking the tough role of checking our direction and feeding us with fresh industry knowledge. And, thanks for always being "on-line" to answer questions when I was lost!

I would like to extend my sincere thanks and appreciation to Guglielmo Guastalla, Robert Berrez, and Hansjoerg Kuebler at Amadeus S.A. who have not only generously provided data for the European part of this research but also offered me an internship opportunity in the beautiful French Riviera. I would also like to thank Natalie Evan, Gourab Nath, Antoine Multon and last but not least, my fellow stagiaires for your friendship which made the summer enjoyable and life in France much more interesting without even being able to speak any French!

There are others who deserve recognition for their significant contribution in this thesis research. Diana Dorinson, my former MST classmate, has paved the way for using the Amadeus data for this research, and kept providing me with valuable guidance even after her graduation. Thea Graham, formerly with BTS and now with DHS, has supplied data on security fee collection. Professor Severin Borenstein of the U.C. Berkeley has provided us with the data for the U.S. part of this research.

Thanks to all my friends in ORC, CTL, ICAT, JAM, Sushis, as well as those I met in Boston and Cambridge. I would not have made it through without you, and you are the reason I stayed here for three years.

Lastly, I would like to thank my parents, Yoshimune and Shukusei Yamanaka, and my brother Koichi, for their wonderful support throughout all my endeavors. Warm and welcoming home is what really keeps one courageous outside.

This research project was funded by the Global Airline Industry Program at MIT, sponsored by the Alfred P. Sloan Foundation and by a gift to the Program from Amadeus, S.A.

TABLE OF CONTENTS

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Motivation

It is becoming common wisdom among experienced air travelers that finding a cheap airline fare does not necessarily mean one will travel inexpensively. Even with a cheap basic fare, passengers worldwide must now pay for a wide array of add-on government taxes and fees such as excise taxes, airport passenger facility charges, and security fees. Moreover, the airlines themselves may, under various circumstances, increase the price of a ticket in the form of reservation handling fees and fuel surcharges. At the end, the total amount paid by the customers may be considerably higher than the originally advertised base fare. It is also true that very few passengers seem to understand what exactly they are being charged for or how much of their total travel cost is associated with these add-on taxes and fees. To make matters worse, much of the information appearing in the public media on the subject is often anecdotal or based on biased samples and second-hand statistics.

Airlines themselves are also deeply concerned about the harmful impact that add-on government taxes and fees may have on demand and, thus, on the financial health of an industry which has already faced terrible losses in recent years, caused by such events as the September 11, 2001 terrorist attack, the war in Iraq, and SARS—let alone the truly fierce competition within the industry itself. In early 2003, the Air Transport Association (ATA) in the United States published a report, *Airlines in Crisis: the Perfect Economic Storm*, which stated that "as a result of competitive forces at work in the industry, the absence of industry pricing power results in government imposed taxes and fees directly reducing industry revenue on virtually a dollar-for-

dollar basis" (Air Transport Association, 2003a). Also in 2003, then CEO of Northwest Airlines, Richard H. Anderson, testified in a hearing before the Senate Committee on Commerce, Science, and Transportation on the state of the airline industry. In his statement, Anderson argued that "the taxes amount to 26% of the average ticket...are simply too high and they cannot be passed on to passengers in the form of higher ticket prices. This means that they are an added cost at a time when we [the airlines] are already under tremendous pressure to cut costs" (United States Senate, 2003). Since then, several more hearings have been held before this same Committee, which has become a battleground on the subject of government policy toward the airline industry. Airline executives have argued forcefully for more favorable treatment of the industry, while others, such as Senator John McCain, have been "reluctant to give additional aid, preferring to allow the airlines to survive or fail on their own" (Alexander, 2003).

In the meanwhile, the 26% figure mentioned above has become a widely accepted estimate of the cost of ticket taxes and fees in the United States and has been cited widely by influential individuals such as airline executives and politicians in connection with alerting the public to unfair taxing practices regarding the airlines. For example, in a Wall Street Journal article, a former CEO of American Airlines, Robert Crandall (2002) states that "the multitude of fees and taxes imposed now accounts for about 25% of the fare paid by the average traveler", and Lawrence Lindsey, an assistant to the President Bush for economic policy and Director of the National Economic Council at the White House, writes in another Wall Street Journal article (2003) that "taxes and fees now consume 25% of the cost of a low-priced ticket ... This tax compares with an 18% federal excise tax on cigarettes and an 11% federal excise tax on whiskey."

Across the Atlantic in Europe, similar concerns have been widely expressed, but no organized campaign on the issue has taken place, perhaps due to the far more complex and diverse taxation rules in place among the European nations, as well as the wide differences that exist among European Union nations with respect to the burden imposed by add-on taxes and fees (see Chapter 4). Only recently, in October 2004, the Association of European Airlines (AEA) issued a press release in which its chairman, Vagan Soerensen, who is also the CEO of Austrian Airlines, commented that "[of] particular concern is the continuous desire of regulators, particularly in Europe, to impose an array of cost increases through new taxes, charges and complex legislation" (AEA, 2004).

While in 2005 there are some signs of financial recovery of the industry in both the US and Europe, the frustration of airlines on the issue of taxes and fees has been mounting. In March 2005, a joint statement was issued by the ATA and the AEA stating that "the taxes and fees on an airline ticket purchased either in Europe of the U.S. are higher percentage-wise than the so called 'sin-taxes' on things like alcohol and tobacco" and that the burden "threatens the very fiber of the air transportation industry and the economies that rely on it" (Air Transport Association, 2005). A proposal by the second Bush Administration to increase the security tax on domestic tickets in connection with the 2006 taxes has also been met with very strong opposition by the airlines.

The objective of this research is to conduct empirical studies, based on large samples of actual tickets, in order to estimate the true increase in the cost of air travel, which is due to infrastructure-related taxes and fees in both the United States and the European Union. Such estimates can serve as the basis of a more realistic discussion about funding the development, operation and security of aviation infrastructures, as well as on how the cost burden should be

shared among the various stakeholders. The main index used throughout the thesis is the effective tax rate (ETR) on airfares. We define ETR as the percentage by which the base fare (BF) charged by an airline for a trip is increased as a result of the total taxes and fees (TTF). The scope of the study includes (a) domestic travel within the US and (b) domestic and intra-EU international travel within the European Union.

1.2 Literature Review

Despite the great amount of attention the topic has received in recent years, there have been few in-depth studies of the cost of taxes and fees in air travel. We are not aware of any studies that systematically estimate the impact of taxes and fees on airline fares in Europe. In the United States, there have been a few attempts. For instance, ATA has reported in several publications, including the *Perfect Economic Storm* (ATA, 2003a) and its 2004 Economic Report (Air Transport Association, 2004) (formerly the ATA Annual Report) that the taxes and fees account for 26% of the total ticket price for US domestic travels. This estimate, however, is based on what is called a "typical" $200 total fare roundtrip ticket with a connection in each direction, and thus adds the maximum amount of taxes and fees applicable. The method yields a BF of $148 and the TTF of $52 and would amount to a 35.1% ETR by our definition, i.e., (52/148) x 100%.

More recently, John Heimlich (2005) of ATA estimated the average tax rate in the US as amounting to 19.9% of the BF in 2004. This estimate is based on the average BF and average number of segments per ticket computed by the ATA, but still assumes the maximum rate for

fees with varying rates. According to this study, the average BF amounted to $230.85 and the average TTF to $45.87.

In a report submitted to the previously mentioned US Senate Committee on Commerce, Science, and Transportation in March 2004, the General Accounting Office (now General Accountability Office) reported that the total amount of air ticket taxes and fees collected in 2002 in the US was $12.6 billion (GAO, 2004). This report also presents the amount of taxes and fees as a percentage of BF for ten different US carriers. This ranged from 11.9% to 15.3% in 1998 and from 15.7% to 23.6% in 2002 depending on the carrier. The same article also cites extensively the US results presented in Chapter 2 of this thesis. Another US government publication issued by the Internal Revenue Service asserts that the total amount of aviation-related excise taxes collected in 2002 (excluding passenger fees) amounted to slightly more than $9 billion, and that it represented 13.1% of the total US excise taxes collected that year (Henry, 2004). However, this report did not estimate the increase in direct travel costs to passengers due to the aviation excise taxes.

Outside government sources and the ATA, the only other empirical study on this general subject that we are aware of was performed by Morrison and Winston (2003) for the National Business Travel Association. The study used the US Department of Transportation 10% ticket sample database (see Chapter 2) to compute average fare and tax rates for *business* travelers only in 3,200 city-pair markets in the US. It concluded that the average tax rate, as a percentage of the BF, increased from 8% in 1989 to 14% in 2002.

1.3 Outline of the Thesis

We now provide an overview of the contents of Chapters 2 though 5 of this thesis.

Our analysis and results for domestic United States travel are presented in Chapter 2 and in Chapter 3. In Chapter 2, the taxes and fees applicable to airline fares in the US are first identified and explained, followed by the description of the methodology employed in analyzing the US data. The average ETR for the second quarter of 2002 is then computed. We also examine the distributive characteristics of the tax burden with respect to how it impacts tickets in different cost ranges and how it varies as a function of the distance traveled. A comparison of the ETR applicable to legacy carriers and to low cost carriers is also presented. An alternative measure of the tax rate that, at first glance, seems more intuitive is also examined at the end of the chapter. We provide a formal proof of the bias in this measurement toward higher estimates of the tax rate.

In Chapter 3, results for the second quarter of 2004 and the second quarter of 1993 are presented, in order to provide a perspective on how the ETR has evolved over the years. The most striking finding is that the increase in the ETR over the years is due, in large part, to the decline (in constant prices) of the basic fares charged by the airlines, stemming from the inability of legacy carriers to maintain basic fares at levels consistent with inflation or with their true costs. This chapter also contains several additional analyses. These include: confidence intervals for the ETR estimates; a comparison of the number of segments per passenger itinerary in 2002 and 2004; and an analysis of the potential impact of the new security fee policy recently proposed by the Bush Administration on the average ETR.

Chapter 4 turns to Europe and examines air travel within and between the 15 original members of the European Union. The chapter begins with a brief overview of the complex taxation rules in the region, and then describes the data sources and the procedure used to analyze the European data. Subsequently, the average ETR result is presented with the distributive characteristics of both BF and TTF in our sample. Our results (and, in general, all the results) of this chapter should be treated as being of a preliminary nature, due to a relatively small ticket sample and some gaps in the database we used. A long section is devoted to discussing the differences in ETR among the fifteen European countries examined. The section not only compares domestic and intra-EU international ETRs in each country, but also compares the ETR in all O-D country pairs in the EU. Finally, plausible adjustments in data necessary for performing a fair comparison with US results are discussed. We perform a simple analysis to show that the actual European ETR may be significantly higher than the ETR in the United States if the differences in charging schemes for the cost of air transportation infrastructure are taken into consideration.

Finally, Chapter 5 provides a summary of the findings of this thesis and suggests directions for further research.

Chapter 2: Analysis of US Taxes and Fees in 2002

2.1 Identification and History of US Taxes and Fees

There are currently four types of taxes and fees levied on domestic airfares in the United States: the federal ticket tax (FTT), the federal flight segment tax (FST), the passenger facility charge (PFC), and the federal security service fee (FSSF). Since the FTT and FST are essentially two components of one tax, they are described together.

2.1.1 FTT and FST

The FTT and the FST are paid into the Airport and Airway Trust Fund. This fund finances congressional appropriations to cover "those obligations of the United States...which are attributable to planning, research and development, construction, or operation and maintenance of air traffic control, air navigation, communications, or supporting services for the airway system" (Internal Revenue Code, 1986). Together they accounted for $6.3 billion in 2002 (or 62% of the total revenue of the Airport and Airway Trust Fund)[1]. The major outlays from the trust fund in 2002 support Federal Aviation Administration (FAA) operations, facilities and equipment, and federal grants-in-aid for airports (Air Transport Association, 2003b).

The FTT is equal to 7.5% of the base fare (BF). The FST was $3 per flight segment in 2002 and 2003 (Internal Revenue Code, 1986). A built-in inflation adjustment raised the segment tax to $3.10 in 2004 and $3.20 in 2005 (Air Transport Association, 2003c).

[1] There are other taxes that also support the trust fund. These include the international arrival/departure tax and federal aviation fuel taxes. However, these taxes are not considered by this thesis, as we only consider taxes on domestic travel and those that are paid directly by travelers as an added ticket cost at the time of ticket purchase.

Several exemptions to these taxes exist. For example, designated "rural airports" are exempt from the segment tax[2] (Internal Revenue Code, 1986). Conversely, special taxes exist for Alaska/Hawaii arrivals and departures (Internal Revenue Service, 1999).

As shown in Table 2.1, the federal segment tax did not exist prior to October 1, 1997 (Air Transport Association, 2003c). Domestic air travel was taxed at a flat rate that peaked at 10% during the period 1990–1996. The federal ticket tax rate was reduced from 10% in 1990 to 7.5% in 1999, in conjunction with a gradual increase of the segment tax, from $1 in 1997 to $3.20 in 2005.

Table 2.1: History of U.S. infrastructure-related taxes and fees on domestic airline fares

Year	*FTT* (%)	*FST*	*PFC* (maximum allowable)	*FSSF*
1941	5.0	-	-	-
1942	10.0	-	-	-
1943	15.0	-	-	-
1955	10.0	-	-	-
1956	5.0	-	-	-
1970	8.0	-	-	-
1980	5.0	-	-	-
1982	8.0	-	-	-
1990	10.0	-	-	-
1992	10.0	-	$3.00	-
1997	9.0	$1.00	$3.00	-
1998	8.0	$2.00	$3.00	-
1999	7.5	$2.25	$3.00	-
2000	7.5	$2.50	$3.00	-
2001	7.5	$2.75	$4.50	-
2002	7.5	$3.00	$4.50	$2.50
2003	7.5	$3.00	$4.50	$2.50
2004	7.5	$3.10	$4.50	$2.50
2005	7.5	$3.20	$4.50	$2.50

[2] While there are 3,885 designated rural airports (Office of the Assistant Secretary for Aviation and International Affairs, 2003a), most do not receive any significant levels of air carrier traffic. In our analysis, rural airports represent only 0.17% of all passengers.

2.1.2 PFC

The PFC was instituted as a means of assisting airports with air carrier service to "finance eligible airport-related projects, including making payments for debt service" (AIR-21, 2000). When the collection of PFCs began after June 1, 1992, airports so authorized by the FAA could charge $1, $2, or $3 per enplanement. Higher PFC levels up to $4.50 were introduced for certain airports effective April 1, 2001 (AIR-21, 2000; Air Transport Association, 2003d). PFCs are only collected for up to two boardings per each one-way trip (AIR-21, 2000), resulting in a maximum collection of $18 per round-trip. Table 2.2 summarizes relevant statistics for 1993, 2002, 2003 and 2004 (FAA, 2005). PFCs are charged by airlines at the time a ticket is purchased and are then transferred directly to the appropriate airport(s).

Table 2.2: Summary of PFC collections in 1993, and 2002 – 2004

Year	Number of collecting airports	PFC Amount			
		$1	$2	$3	$4.50
1993	89	0.00%	1.10%	98.90%	N/A
2002	311	0.30%	0.00%	57.90%	41.80%
2003	313	0.30%	0.00%	44.70%	55.00%
2004	315	0.00%	0.32%	35.56%	64.13%

Note: As of June 30 in each year

2.1.3 FSSF

The FSSF is the most recently adopted tax on domestic airline tickets. It was created by the Aviation and Transportation Security Act (2001), which authorizes a $2.50 tax per enplanement, limited to a maximum of two segments per one-way trip. Consequently, the highest possible security fee paid by a passenger on a domestic round-trip ticket is $10. Collection of the security service fee began on February 1, 2002. In order to provide relief to the

ailing airline industry, Congress temporarily suspended the fee from June 1 to September 30, 2003 (Air Transport Association, 2003c). In January 2005, the second Bush administration proposed a rate hike of $3 per each way of travel. Its potential effect will be discussed briefly later in this chapter.

2.1.4 Other Taxes

A number of other federal infrastructure and security taxes and fees are assessed on air carriers. These are outside the scope of this thesis as they either apply only to international travel or are not directly added to the price of an airline ticket, or both. Table 2.3 lists these other taxes and fees (Air Transport Association, 2003e).

Table 2.3: Federal infrastructure-related air carrier taxes and fees outside the scope of this study

Tax	Rate	Basis
International arrival tax	$14.10	Per arriving international passenger
International departure tax	$14.10	Per departing international passenger
Immigration user fee	$7.00	Per arriving international passenger
Customs user fee	$5.00	Per arriving international passenger
Animal and plant health inspection service passenger fee	$4.95	Per arriving international passenger
Animal and plant health inspection service aircraft fee	$70.00	Per arriving international aircraft
Jet fuel tax	$0.043	Per gallon
Leaking underground storage tank fuel tax	$0.001	Per gallon
Air carrier security fee	Varies	Per carrier (based on actual 2000 screening costs)
Cargo waybill tax	6.25%	Domestic freight waybill
Frequent flyer tax	7.50%	Sale of the right to award frequent flyer miles to third parties

Additionally, foreign nations impose taxes and fees on U.S. carriers engaged in international operations. These can be numerous and varied, but do not apply to domestic travel. Finally, air carriers also pay non-federal charges such as landing fees and airport leases, but these are not added directly to the price of an airline ticket and also fall outside the scope of this study.

2.2 Methodology and Data Analysis

The total fare for an air trip consists of the sum of two parts: BF, which is the total fare less any applicable taxes and fees, and TTF, the sum of the four ticket taxes and fees:

$$TTF = FTT + FST + FSSF + PFC$$

For any set of air tickets, the *effective tax rate*, ETR, is defined as:

$$ETR = \frac{E(TTF)}{E(BF)} \times 100\%$$

where E(TTF) and E(BF) represent the average[3] values of TTF and BF, respectively, for that set of tickets. We are interested in estimating ETR for the entire set of U.S. domestic air passengers, except the ones originating or terminating in Alaska or Hawaii, as well as for specific subsets of passengers grouped according to fare value, type of carrier, and distance traveled.

We used the US DOT's *Origin and Destination Data Bank 1A Ticket Dollar Value* (DB1A) survey to obtain a representative sample of domestic airline tickets. This database

[3] The average is weighted by number of passengers.

provides "the full itinerary and the dollar amounts paid by each passenger" for a "continuous 10% sample of airline tickets" (Bureau of Transportation Statistics, 2003).

DB1A aggregates sampled tickets with identical fare products[4]. Thus, each record can correspond to more than one passenger (a data field in each record indicates the number of passengers associated with each record). The specific database we used is a modified version of the original DB1A (Borenstein, 2003c), referred to here as DB1A*. In DB1A*, round-trip tickets are broken into two records, each one representing a one-way trip. DB1A* also differs from DB1A by excluding (Borenstein, 2003b):

- Itineraries that include an airport outside the U.S.;
- Round-trips with more than four segments;
- One-way trips with more than two segments;
- Three- or four-segment tickets with more than two trip-break points

The DB1A is a quarterly database, as is DB1A*. We first used data for the second quarter of 2002 because they were the latest available at the time when this study began and also had two other desirable attributes: first, they were somewhat removed in time from the initial shock to air travel caused by the events of September 11, 2001; and, second, this was the first quarter in which the FSSF was assessed during all three months of a quarter. We then expanded the study by including data from the second quarter of 1993 and the second quarter of 2004. Table 2.4 shows the original data availability for each of the three quarters before processing. The remainder of this chapter deals exclusively with the second quarter of 2002 data as well as

[4] A fare product is a combination of fare and itinerary.

the tax and fee rates effective at the time in order to avoid confusion. The analyses of 1993 and 2004 will be presented in Chapter 3.

Table 2.4: DB1A* data availability

Quarter	Ticket category	No. of records	No. of passengers
1993Q2	One-Way	216,559	1,490,367
	Roundtrip	2,789,104	2,762,341
	Total	3,005,663	4,252,708
2002Q2	One-Way	342,605	965,105
	Roundtrip	3,796,366	4,325,318
	Total	4,138,971	5,290,423
2004Q2	One-Way	434,568	1,169,361
	Roundtrip	3,968,092	4,666,534
	Total	4,402,660	5,835,895

Because the DB1A database only includes the total fare paid, we had to compute the component taxes and the base fare for any given passenger itinerary and total fare. This was done through the following four-step procedure:

1. Allocate \$3 per segment for the FST.
2. Allocate \$2.50 per segment for the FSSF.
3. Allocate the appropriate PFC value (\$1, \$2, \$3, \$4.50 or \$0) for the departing and connecting (if applicable) airports in each segment.
4. Compute the base fare, BF, and the 7.5% federal ticket tax, FTT, by solving the system of equations $BF = \frac{(Total\ Fare - FST - FSSF - PFC)}{1.075}$ and $FTT = 7.5\% \times BF$.

One gap in the DB1A data is that the intermediate airport on one-stop continuing flights[5] is not recorded. For example, if a passenger travels from Boston to Los Angeles via Chicago without changing aircraft, the Chicago stop does not show up in DB1A. Thus, one-stop continuing flights look identical to nonstop flights in DB1A. Neither a FSSF, nor a PFC is collected at the intermediate airport, since the passenger is considered not to constitute an enplanement there. The FST, however, is collected for both segments of the flight. But our algorithm computes only one FST collection, since the intermediate airport is not recorded. Fortunately, such itineraries are very rare and the discrepancy is relatively small, $3 per one-way, at most. Finally, our algorithm does not identify rural airports, and therefore computes a FST when in reality none should be assessed. Flights to/from rural airports account for only 0.17% of all passengers.

In order to test the algorithm, we collected a sample of fares representing typical discretionary and business travel ticket purchases in ten large city-pair markets for the second quarter of 2002. These samples were obtained from two online travel agencies, Expedia and Orbitz. We used three traveler profiles (one for discretionary and two for business travel), which we applied to each of the two online travel web sites. Multiplied over the ten city-pairs, this resulted in a total of sixty samples. Since the travel web sites break out base fare and total tax, we were able to verify the validity of the taxes estimated by our algorithm. In 54 out of the 60

[5] A one-stop continuing flight occurs when an aircraft lands at an intermediate airport and the passenger subsequently departs on the same aircraft with the same flight number. This differs from a connecting flight, where the passenger changes aircraft at the intermediate airport

samples we predicted the taxes exactly. In the other six cases, the error, as expected, involved itineraries where at least one travel direction included a one-stop continuing flight[6].

In computing the ETR estimates given in the later sections, we began by establishing a comprehensive set of domestic city-pair markets, using as a basis the *Domestic Airline Fares Consumer Report: second quarter 2002 Passenger and Fare Information* published by the USDOT Office of the Assistant Secretary for Aviation and International Affairs (OST). This report is based on DB1A data and is issued quarterly "in response to consumer inquiries regarding domestic airline fares" (Office of the Assistant Secretary for Aviation and International Affairs, 2003b,). Specifically, we used the 6395 city-pair markets available in Table 6 (Office of the Assistant Secretary for Aviation and International Affairs, 2002) of that report, which lists "all domestic markets (48 states) with more than 10 passengers/day" (Office of the Assistant Secretary for Aviation and International Affairs, 2003b). Because the OST report only includes aggregate information on fares, we used DB1A* to obtain fare information on a passenger-by-passenger basis for these 6395 city-pair markets.

Eliminating city-pairs with less than ten daily passengers as well as all city-pairs with origins and destinations in Alaska or Hawaii left 3,628,537 records representing 4,731,202 passengers. This step filtered out 9.6% of the passengers covered by DB1A* in this quarter. Of these, 6.2% were traveling to or from markets in Alaska or Hawaii, and 3.3% were passengers in city-pair markets in the 48 contiguous states with less than ten daily passengers.

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[6] This does not mean that 10% of passengers travel on one-stop continuing flights. Such flights are scheduled almost exclusively on large, long-distance markets. Overall the percent of passengers on one-stop continuing flights is probably much smaller than 10%. Moreover, the maximum error in our tax estimates for these passengers is $3 per one-way trip.

While reviewing the DB1A* data, it became apparent that a significant number of fares were either extremely low or extremely high. For example, a number of records were found with a total fare of $0, indicating tickets that are frequent flyer awards or promotional no-cost fares. Other examples of unreasonably low or high fares are caused by data entry errors, as well as the use of "place-holders" such as "$9,999" to indicate an unknown fare or a corporate bulk purchase. After discussing this issue with the OST, a major user of DB1A data, we decided to adopt a combination of minimum acceptable yields for various distance groupings, as well as an absolute minimum and maximum reasonable fare. We initially adopted the same values used by the OST in screening DB1A data, which means eliminating total fares amounting to:[7]

- Less than 10 ¢/mile for distances less than 100 miles
- Less than 8 ¢/mile for distances in the 100-199 mile range
- Less than 6 ¢/mile for distances in the 200-299 mile range
- Less than 5 ¢/mile for distances in the 300-399 mile range
- Less than 4¢/mile for any distance

On the high fare side, we defined the high-end filter by eliminating all fares greater than $2,500 (one-way) for any distance.

The OST also eliminates one-way total fares of less than $15, irrespective of distance. We did not use this rule, since it seems to set too low a limit. Instead we selected $30 as the minimum one-way BF. Table 2.5 summarizes the four filters used for the data analysis. It also

[7] K. Bryan, personal communication, July 8, 2003.

lists the number of records and passengers that were retained after each successive application of a filter.

Table 2.5: Filters used for processing DB1A* records (2002Q2)

		All		One-Way		Roundtrip	
Filter step	Filter description	Records	Passengers	Records	Passengers	Records	Passengers
-	Original DB1A* data	4,138,971	5,290,423	342,605	965,105	3,796,366	4,325,318
1	Market filter: Retained city-market pairs within the 48 contiguous states with 10 or more daily average passengers	3,628,537	4,731,202	300,900	765,155	3,327,637	3,966,047
2	Minimum fare per distance (D) filter: For D < 100 mi, drop total fares < 10 ¢/mi For 100 mi ≤ D < 200 mi, drop total fares < 8 ¢/mi For 200 mi ≤ D < 300 mi, drop total fares < 6 ¢/mi For 300 mi ≤ D < 400 mi, drop total fares < 5 ¢/mi For any D, drop total fares < 4¢/mi	3,869,143	4,313,144	281,676	725,677	3,057,421	3,587,467
3	Minimum fare rule: Drop base fares < $30	3,316,355	4,282,151	279,509	722,077	3,036,846	3,560,074
4	Maximum fare rule: Drop base fares > $2,500	3,315,662	4,280,892	279,048	720,980	3,036,614	3,559,912

Note: All fare filter limits are based on one-way fares. Hence, the limits on roundtrip tickets are doubled.

2.3 Second Quarter 2002 Results

2.3.1 Overall ETR

The application of filters 1, 2, 3 and 4 on the second quarter 2002 DB1A* left 4,280,892 passengers whose airfares and itineraries satisfied all four filters. Of those, 720,980 had traveled with one-way tickets and 3,559,912 with roundtrip tickets. The overall ETR was 15.5% for the entire passenger samples with an average BF of $265.54 and an average TTF of $41.10. The mean ETR for the one-way passengers was lower at 13.0% with $204.81 in BF and $26.53 in TTF. On the other hand, the ETR for roundtrip passengers was 15.9% on average, with an average BF of $277.84 and an average TTF of $44.06. Table 2.6 summarizes relevant overall results, including the breakdown of the TTF into its four components, and Table 2.7 shows the passenger share by ticket type, as well as corresponding segments per ticket.

Note that the FTT is responsible, on average, for about one-half of the TTF, while the FST, FSSF, and PFC contribute to the other half in roughly similar amounts. Moreover, the lower ETR among one-way passengers was caused by both their higher BF and fewer segments per each direction of travel.

Table 2.6: Second quarter 2002 ETR results

Ticket category	Total Fare	BF	TTF	FTT	FST	PFC	FSSF	ETR
All	$306.65	$265.54	$41.10	$19.92	$7.26	$7.88	$6.05	15.5%
One-Way	$231.34	$204.81	$26.53	$15.36	$3.85	$4.12	$3.20	13.0%
Roundtrip	$321.90	$277.84	$44.06	$20.84	$7.95	$8.64	$6.63	15.9%

Table 2.7: Second quarter 2002 passenger share and segment per ticket by ticket type

Ticket category	No. passengers in sample (% share)		Segments per ticket
All	4,280,892		2.42
One-way	720,980	(16.8%)	1.28
Round-trip	3,559,912	(83.2%)	2.65

A side observation was that the average number of segments per each direction of travel was 1.28 among the one-way tickets and 1.33 among roundtrip tickets. In fact, having three or more segments in one direction of travel seems to be quite rare and only 2.9% of passengers in DB1A* records fall in this category (Borenstein, 2003a). This means that roughly two-thirds of all the trips taken consisted of a single segment each way, and one-third of two segments. The average distance between origin and destination was 982 miles overall, and 871 miles and 1005 miles among one-way and roundtrip passengers respectively.

2.3.2 Distribution of ETR as a Function of Fare and Distance

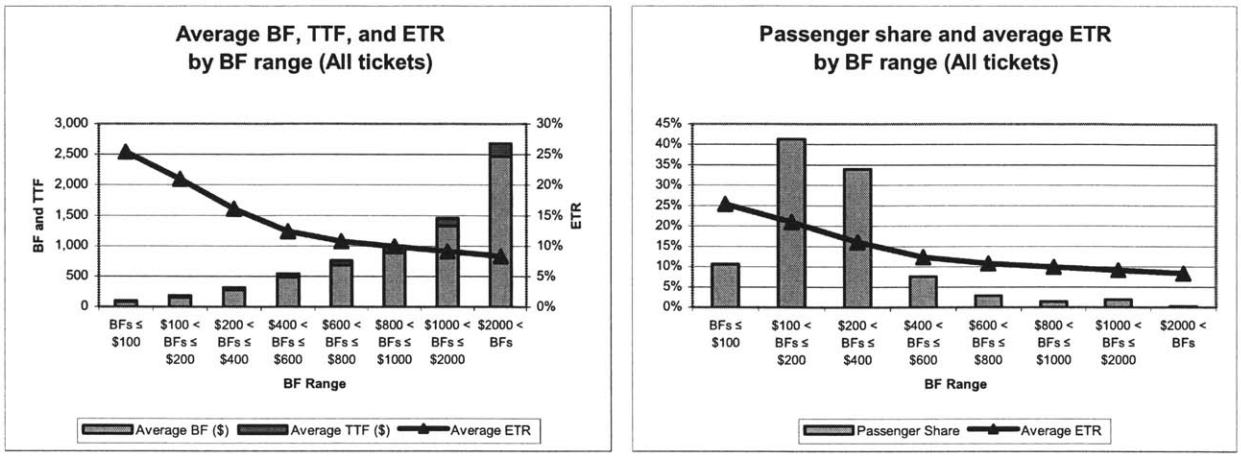
We also examined some distributive characteristics of the ETR, namely its incidence as a function of (a) the BF and (b) the trip distance. Table 2.8 shows the first of these relationships. It is not surprising that the average ETR increases as the BF declines, since three of the four

components of the TTF – namely, FST, PFC and FSSF – vary only with the passenger's itinerary and are independent of the BF. However, the steepness of the increase is quite remarkable as illustrated in Figure 2.1. Note also in Table 2.8 that 86% of passengers paid the BF of less than or equal to $400, and the average ETRs in those fare ranges were greater than the overall average of 15.5%. This, of course, does not mean that all passengers in those fare ranges experienced the ETR greater than 15.5% since there are passengers in each fare bracket who faced smaller ETRs. A detailed analysis of individual ETRs (i.e. an actual ETR as experienced by each passenger) reveals that 63.6% of passengers had ETRs greater than 15.5%. The use of individual ETRs will be further scrutinized in Section 2.4 and Section 2.5.

Table 2.8: Average ETR for eight different ranges of the BF

BF Range	Ticket category	No. of passengers		Average BF ($)	Average TTF ($)	Average ETR
BFs ≤ $100	**All**	**455,996**	**(10.7%)**	**78.86**	**20.04**	**25.4%**
	One-way	252,160		75.01	15.35	20.5%
	Roundtrip	203,836		83.62	25.84	30.9%
$100 < BFs ≤ $200	**All**	**1,768,821**	**(41.3%)**	**153.69**	**32.23**	**21.0%**
	One-way	255,060		144.55	22.33	15.4%
	Roundtrip	1,513,761		155.24	33.90	21.8%
$200 < BFs ≤ $400	**All**	**1,453,683**	**(34.0%)**	**271.60**	**43.67**	**16.1%**
	One-way	134,923		273.22	33.05	12.1%
	Roundtrip	1,318,760		271.43	44.76	16.5%
$400 < BFs ≤ $600	**All**	**325,415**	**(7.6%)**	**482.65**	**59.75**	**12.4%**
	One-way	40,299		487.96	49.06	10.1%
	Roundtrip	285,116		481.90	61.27	12.7%
$600 < BFs ≤ $800	**All**	**120,628**	**(2.8%)**	**688.72**	**74.10**	**10.8%**
	One-way	17,675		688.95	64.20	9.3%
	Roundtrip	102,953		688.68	75.81	11.0%
$800 < BFs ≤ $1000	**All**	**62,351**	**(1.5%)**	**891.46**	**88.66**	**9.9%**
	One-way	9,692		894.24	79.62	8.9%
	Roundtrip	52,659		890.95	90.32	10.1%
$1000 < BFs ≤ $2000	**All**	**82,345**	**(1.9%)**	**1,331.14**	**121.69**	**9.1%**
	One-way	10,821		1,271.33	107.28	8.4%
	Roundtrip	71,524		1,340.20	123.87	9.2%
$2000 < BFs	**All**	**11,655**	**(0.3%)**	**2,470.40**	**206.57**	**8.4%**
	One-way	350		2,140.63	173.45	8.1%
	Roundtrip	11,305		2,480.61	207.60	8.4%

Figure 2.1: Average ETR and passenger share by BF range (All tickets)



It is also noteworthy that for base fares greater than $600, the average ETR is 11% or smaller. For base fares greater than $800, typically corresponding to full-economy, business, or first-class travel, the ETR is less than 10%. As indicated in Table 2.1, the federal ticket tax, FTT, was set at 10% between 1990 and 1996. It follows that the ETR on all tickets was at least 10% during those years. Thus, the ETR for high-priced tickets in 2002 was less than in the mid-1990s and, probably, during the late 1990s, as well (cf. Chapter 3). One can then safely conclude that add-on taxes and fees were *not* among the principal causes of the dramatic decline in demand for high-priced tickets that so-called "legacy" (or "traditional") major carriers have experienced since 2000. The blame must be placed elsewhere.

Perhaps surprisingly, ETR varies little with the distance between the origin and destination in each itinerary. Table 2.9 indicates that overall ETR varies from 13.8% to 16.5% for the entire range of distance groups. One of the reasons is that the average base fare increases less than linearly with the origin-destination distance, as indicated in Table 2.9. For example, the average BF for a distance of between 1,000 and 2,000 miles is only about 78% greater than for a distance of less than 200 miles. A second reason is that longer distances are more likely to be

associated with itineraries that include a connection at an intermediate airport. This, in turn, means a greater likelihood of a high FST, FSSF, and PFC.

Table 2.9: Relationship between the average ETR and the origin-destination distance

Origin-destinaton distance, D (miles)	Ticket category	Average BF ($)	Average TTF ($)	ETR	No. segments per ticket	No. passengers
D ≤ 200	**All**	**171.23**	**27.10**	**15.8%**	**1.67**	**88,300**
	One-way	119.78	17.59	14.7%	1.01	30,041
	Roundtrip	197.76	32.01	16.2%	2.02	58,259
200 < D ≤ 500	**All**	**186.22**	**30.81**	**16.5%**	**1.96**	**1,041,986**
	One-way	126.44	18.80	14.9%	1.09	229,388
	Roundtrip	203.09	34.21	16.8%	2.21	812,598
500 < D ≤ 1000	**All**	**252.89**	**40.26**	**15.9%**	**2.40**	**1,473,342**
	One-way	199.61	26.64	13.3%	1.31	229,821
	Roundtrip	262.74	42.77	16.3%	2.60	1,243,521
1000 < D ≤ 2000	**All**	**305.05**	**46.58**	**15.3%**	**2.71**	**1,251,844**
	One-way	262.73	32.42	12.3%	1.46	169,414
	Roundtrip	311.67	48.80	15.7%	2.91	1,082,430
2000 < D	**All**	**406.98**	**56.04**	**13.8%**	**2.89**	**425,421**
	One-way	395.99	42.95	10.8%	1.52	62,316
	Roundtrip	408.87	58.28	14.3%	3.13	363,105

2.3.3 Legacy Carriers vs. Low Cost Carriers

In view of Table 2.8, it is also interesting to compare the incidence of the add-on taxes and fees on low-cost carrier tickets vs. those of legacy carriers. Table 2.10 summarizes this comparison. The legacy carriers in the sample are American, Continental, Delta, Northwest, United, and US Airways; the low-cost carriers are ATA, jetBlue, and Southwest.

Table 2.10: Legacy vs. low-cost carriers

Carrier type	Ticket category	No. of passengers	BF ($)	TTF ($)	FTT ($)	FST ($)	PFC ($)	FSSF ($)	ETR	No. segments per ticket	O-D distance (miles)
Legacy	**All**	**2,137,220**	**315.62**	**45.96**	**23.67**	**7.49**	**8.55**	**6.24**	**14.6%**	**2.50**	**1,117**
	One-Way	255,307	298.91	34.02	22.42	3.87	4.50	3.23	11.4%	1.29	1,008
	Roundtrip	1,881,913	317.89	47.58	23.84	7.98	9.10	6.65	15.0%	2.66	1,132
LCC	**All**	**964,339**	**172.13**	**29.48**	**12.91**	**5.91**	**5.73**	**4.93**	**17.1%**	**1.97**	**739**
	One-Way	253,451	120.38	18.79	9.03	3.49	3.36	2.91	15.6%	1.16	746
	Roundtrip	710,888	190.58	33.29	14.29	6.77	6.58	5.64	17.5%	2.26	736

As suggested by Table 2.10, the overall ETR for low-cost carriers is about 2.5% higher than for legacy carriers. Apparently this has not been sufficient to slow down the dramatic

increase in the market share of low-cost carriers, which has been one of the hallmarks of the airline industry in recent years. At the same time, the 2.5% difference is smaller than one would probably expect (cf. Table 2.8) from the fact that the average BF for low-cost carriers is less than $200, compared to about $315 for legacy carriers. One of the reasons is the fact that the average number of segments in an itinerary on a low-cost carrier is 1.97, as opposed to 2.50 for legacy carriers.[8] This means that both the FST and the FSSF are smaller, on average, for low-cost carrier passengers than those of legacy carriers. A second reason is that low-cost carrier routes often bypass the most congested airports in favor of secondary ones. As the most congested airports are also the ones that tend to impose passenger facility charges, the average PFC paid by low-cost carrier passengers is considerably smaller (as shown in Table 2.10).

2.3.4 Sensitivity to Fare and Market Filters

Finally, we tested the sensitivity of the overall results to the various filters that were applied (see Section 2.2). These tests, summarized in Table 2.11, indicate that the 15.5% estimate for the average ETR is very robust. Depending on what combination of filters is applied, the average overall ETR takes values in the narrow range between 15.4% and 16.3%.

[8] This reflects two aspects of low-cost vs. legacy carrier operations: first, the average origin-destination distance flown by low-cost carrier passengers is 739 miles vs. 1,117 miles for legacy carrier passengers; second, the route networks of legacy carriers rely more heavily on connections at hub airports.

Table 2.11: Sensitivity of the estimated average ETR to the filters applied

Filters applied	Ticket category	No. of passengers remaining	Average BF ($)	Average TTF ($)	Average ETR
None	**All**	**5,290,423**	**245.78**	**39.72**	**16.2%**
	One-way	965,105	190.45	24.86	13.1%
	Roundtrip	4,325,318	258.12	43.04	16.7%
1 only	**All**	**4,731,202**	**242.99**	**39.58**	**16.3%**
	One-way	765,155	206.37	26.65	12.9%
	Roundtrip	3,966,047	250.06	42.07	16.8%
1 and 2	**All**	**4,313,144**	**266.47**	**41.16**	**15.4%**
	One-way	725,677	217.00	27.45	12.6%
	Roundtrip	3,587,467	276.47	43.94	15.9%
1, 2, and 3	**All**	**4,282,151**	**268.09**	**41.29**	**15.4%**
	One-way	722,077	217.98	27.52	12.6%
	Roundtrip	3,560,074	278.25	44.09	15.8%
*** 1, 2, 3, and 4**	**All**	**4,280,892**	**265.54**	**41.10**	**15.5%**
	One-way	720,980	204.81	26.53	13.0%
	Roundtrip	3,559,912	277.84	44.06	15.9%

2.4 An Alternative Measure of the ETR

As defined earlier, we computed the ETR by dividing the overall average TTF by the overall average BF of the entire ticket samples. An alternative method that might seem more intuitive is to compute the individual ETR of each ticket first and then take the average of all individual ETRs. Calling this second measurement ETR2, the two measurements can be expressed as following:

$$ETR = \frac{E[TTF]}{E[BF]} \times 100\%$$

$$ETR2 = E\left[\frac{TTF}{BF}\right] \times 100\%$$

Although their definitions appear very similar to each other, ETR2, in fact, leads to a different estimate. For example, consider an example with three passengers who paid a BF of $100, $200, and $400 respectively, and a TTF of $25, $35, and $50 respectively. The corresponding ETR and ETR2 are:

$$ETR = \frac{(25+35+50)/3}{(100+200+400)/3} \times 100\% = 15.7\%$$

$$ETR2 = (\frac{25}{100} + \frac{35}{300} + \frac{50}{400})/3 \times 100\% = 18.3\%$$

We computed ETR2 for the second quarter of 2002, and obtained ETR2 = 18.7%. Note that this is greater than the ETR of 15.5% we computed earlier in this chapter. At first glance, ETR2 seems to be as reasonable a measure as ETR, but it is, in fact, a measure that is biased. It is so because it gives more weight to passengers with a small BF than those with a large BF due to the nonlinear nature of the function 1/BF. This systematic bias of ETR2 toward higher values is proved rigorously in the next section.

2.5 Proof that ETR2 ≥ ETR

2.5.1 Proof

We re-write TTF as shown below using some additional notation:

TTF = 0.075(BF) + LEGS [A + B + PF] (1)

where

LEGS is the number of segments per trip (a random variable)

A is the FST per segment (a constant at $3.00 in 2002)

B is the FSSF per segment (a constant at $2.50 in 2002)

PF is the passenger facility charge *per segment*, i.e., *per airport visited* (a random variable)

Using this notation, we can rewrite ETR and ETR2 as following:

$$ETR = \frac{E[TTF]}{E[BF]} = \frac{0.075E[BF] + E[LEGS](A+B) + E[LEGS \cdot PF]}{E[BF]}$$

$$= 0.075 + \frac{E[LEGS](A+B)}{E[BF]} + \frac{E[LEGS]E[PF]}{E[BF]} \tag{2}$$

$$E\left[\frac{TTF}{BF}\right] = E\left[\frac{0.075BF + LEGS(A+B+PF)}{BF}\right]$$

$$= 0.075 + (A+B)E[LEGS]E\left[\frac{1}{BF}\right] + E[LEGS]E[PF]E\left[\frac{1}{BF}\right] \tag{3}$$

In (2), we have made only one assumption, namely that LEGS and PF are independent random variables. This assumption is clearly approximately true to a very high level of accuracy. It seems logical that the number of segments traveled would give us information about how much we pay in PFC at each of the airports visited. Any deviation from that logic would be due to the observation that, since connecting itineraries often connect at major hubs where higher PFC rates are frequently collected, there may be a slight bias toward higher PFC per airport on two-legged (one-way) trips. In (3), we have made two further assumptions:

(i) PF is independent of BF. This assumption should be true with very high accuracy as there is no reason to expect that the amount of PFC per segment should be linked to BF.

(ii) LEGS is independent of BF. This should also be true with high accuracy, as indicated by Table 3.8, which shows that the average number of segments per trip is essentially independent of BF for all BF greater than $100. Tickets with BF less than $100 represent only about 10% of the entire passenger base.

Subtracting (2) from (3), we then have (4):

$$E\left[\frac{TTF}{BF}\right]-\frac{E[TTF]}{E[BF]}=$$

$$(A+B)E[LEGS]E\left[\frac{1}{BF}\right]+E[LEGS]E[PF]E\left[\frac{1}{BF}\right]-\frac{E[LEGS](A+B)}{E[BF]}-\frac{E[LEGS]E[PF]}{E[BF]}$$

$$=(A+B)E[LEGS]\left(E\left[\frac{1}{BF}\right]-\frac{1}{E[BF]}\right)+E[LEGS]E[PF]\left(E\left[\frac{1}{BF}\right]-\frac{1}{E[BF]}\right)$$

$$=\left((A+B)E[LEGS]+E[LEGS]E[PF]\right)\left(E\left[\frac{1}{BF}\right]-\frac{1}{E[BF]}\right)$$

$$\left(E[LEGS]((A+B)+E[PF])\right)\left(E\left[\frac{1}{BF}\right]-\frac{1}{E[BF]}\right)\geq 0$$

with the inequality following directly from Jensen's inequality by setting f(x)= 1/x.

2.5.2 Testing of Assumptions

We tested the reasonableness of the three assumptions made in the previous section by comparing the ETR and ETR2 estimates obtained by (2) and (3) respectively to actual ETR and ETR2 computed from the second quarter 2002 samples[9].

$$ETR = 0.075 + \frac{E[LEGS](A+B)}{E[BF]} + \frac{E[LEGS]E[PF]}{E[BF]}$$

$$= 0.075 + \frac{(2.42)(3+2.5)}{265.54} + \frac{(2.42)(7.88/2.42)}{265.54} = 0.1548 = 15.5\%$$

$$ETR2 = 0.075 + (A+B)E[LEGS]E\left[\frac{1}{BF}\right] + E[LEGS]E[PF]E\left[\frac{1}{BF}\right]$$

$$= 0.075 + (3+2.5)(2.42)(0.005727) + (2.42)(7.88/2.42)(0.005727) = 0.1964 = 19.6\%$$

Note that the ETR estimate of 15.5% is exactly equal to the true value presented in Section 2.3. The ETR2 estimate of 19.6% is also close to the true value of 18.7% but slightly higher. In fact, Table 2.12 shows that the ETR2 estimate provided by (3) was constantly a little higher than the true ETR2 for all ticket categories. One cause of the discrepancy is that the sensitivity of E[1/BF] to small values of BF makes the ETR2 estimate less accurate than the ETR estimate provided by (2) which depends on more robust E[BF]. We also suspect that the constant overestimation of ETR2 is due to the fact assumption (ii) is not true for BF less than $100. In other words, although (ii) assumes the independence between BF and LEGS, LEGS is almost always equal to 1 for extremely inexpensive tickets of BF < $100. Clearly, E[LEGS] in

[9] E[PF] was estimated as E[PFC]/E[LEGS]. E[PFC], E[LEGS] and E[BF] are found in Table 2.6 and Table 2.7. E[1/BF] was calculated from the data to be 0.005727.

(3) needs to be adjusted to a smaller value to account for this fact, and a smaller E[LEGS] will improve, if not eliminate entirely, the overestimation problem.

Table 2.12: ETR2 estimates for different ticket categories

Ticket category	ETR2 estimate from (3)	True ETR2
All	19.6%	18.7%
One-way	16.8%	16.3%
Roundtrip	19.6%	19.2%

Finally, Table 2.13 shows that E[1/BF] is larger than 1/E[BF] for all ticket categories. This observation supports the claim that E[TTF/BF] - E[TTF]/E[BF] $\geq$ 0 as shown in the relationship (4) in Section 2.5.1.

Table 2.13: E[1/BF] and 1/E[BF] for different ticket categories

Ticket category	E[1/BF]	1/E[BF]
All	0.005727	0.003766
One-way	0.008376	0.004883
Roundtrip	0.005191	0.003599

Chapter 3 Comparison with 1993 and 2004

As mentioned previously, US domestic ETRs during the second quarter 1993 and second quarter 2004 were also analyzed and compared with the 2002 results. Tax and fee rates as well as the markets of interest evolved, but the same basic methodology outlined in Section 2.2. was used for analysis. In this chapter, results from 2004 are presented first, followed by 1993 findings.

3.1 Second Quarter 2004 Results

In early 2005, we updated the study of the 2002 data using the second quarter 2004 DB1A* data. Fare filtering rules for eliminating extraordinarily low or high fares were unchanged (see Section 2.2.). The O-D market list was updated according to the First Quarter 2004 version of the USDOT OST *Airline Fares Consumer Report*, which was the latest issue of the report available at the time of analysis (Office of the Assistant Secretary for Aviation and International Affairs, 2004). As with the 2002 O-D market list, we used city-pairs within 48 contiguous states with ten or more average daily passengers, and the new list contained 5,929 city pairs compared to 6,395 in the previous list. The filters left 4,852,779 passengers, of whom 958,996 passengers traveled on one-way tickets and 3,893,783 passengers on roundtrip tickets.

There were two changes in tax and fee rules between 2002 and 2004. First, the FST rate was raised from $3.00 per segment to $3.10 per segment due to the built-in inflation adjustment clause (Air Transport Association, 2003c). Second, a PFC was being collected at more airports

in 2004 and the average rate also increased. As illustrated in Table 2.2, there were 311 airports collecting PFCs in 2002, and 41.8% of them were approved to levy the maximum rate of $4.50 per enplanement. In 2004, 315 airports collected PFCs and 64.1% of them levied the maximum $4.50 per enplanement, resulting in a significant increase in the average PFC rate.

3.1.1 Overall ETR

The overall average ETR in the second quarter of 2004 increased to 16.1%, with $251.43 average BF and $40.57 average TTF, from 15.5% in the second quarter of 2002. More specifically, the average ETRs for one-way and roundtrip passengers were 14.0% and 16.5% respectively. These results are summarized in Table 3.1 together with the comparison with 2002 figures, while Table 3.2 shows the breakdown of one-way and roundtrip passengers, as well as their corresponding average number of segments per ticket.

Table 3.1: Overall 2004Q2 ETR results and comparison with 2002Q2

Quarter	Category	Total Fare	BF	TTF	FTT	FST	PFC	FSSF	ETR
2Q 2004	All	$292.00	$251.43	$40.57	$18.86	$7.25	$8.62	$5.84	16.1%
	One-way	$208.58	$182.97	$25.60	$13.72	$3.96	$4.72	$3.20	14.0%
	Round-trip	$312.54	$268.29	$44.25	$20.12	$8.06	$9.58	$6.50	16.5%
2Q 2002	All	$321.99 ($306.65)	$278.83 ($265.54)	$43.16 ($41.10)	$20.91 ($19.92)	$7.62 ($7.26)	$8.27 ($7.88)	$6.35 ($6.05)	15.5%
	One-way	$242.91 ($231.34)	$215.05 ($204.81)	$27.86 ($26.53)	$16.13 ($15.36)	$4.04 ($3.85)	$4.33 ($4.12)	$3.36 ($3.20)	13.0%
	Round-trip	$338.00 ($321.90)	$291.74 ($277.84)	$46.26 ($44.06)	$21.88 ($20.84)	$8.35 ($7.95)	$9.07 ($8.64)	$6.96 ($6.63)	15.9%

Note: All values for the second quarter of 2002 are shown in 2004 dollars, except for figures in parentheses which are in 2002 dollars.

Table 3.2: Passenger share and segments per ticket by ticket category

Quarter	Category	No. Passengers in Sample (% share)		Segments per Ticket
2Q 2004	All	4,852,779		2.34
	One-way	958,996	(19.8%)	1.28
	Round-trip	3,893,783	(80.2%)	2.60
2Q 2002	All	4,280,892		2.42
	One-way	720,980	(16.8%)	1.28
	Round-trip	3,559,912	(83.2%)	2.65

Surprisingly, the average TTF declined in 2004 despite the tax and fee rate hikes described above. Part of the decline can be attributed to the lower average BF since FTT is a

fixed percentage of the BF, and it was unchanged at 7.5% both in 2002 and in 2004. The FSSF rate also remained constant at $2.50 per enplanement, but the average FSSF amount for the roundtrip passengers was lower in 2004, even on a current dollar basis, because the average number of segments per roundtrip ticket dropped from 2.65 in 2002 to 2.60 in 2004. The average amount of FSSF for the one-way passengers was the same in both years on a current dollar basis because the average number of segments per ticket did not change. The FST showed more mixed results. While its rate increased from $3.00 per segment to $3.10 per segment, the average FST amount per ticket decreased from $7.62 to $7.25, both in 2004 dollars. This surprising decline was caused by both lower average number of segments per trip among roundtrip passengers and significantly higher share of one-way passengers, which increased from 16.8% to 19.8%.

Comparing to 2002, the average ETR increased in all three ticket categories, namely, the overall average, one-way only, and round-trip only. However, the change is almost entirely due to the decline in BF because the amount of TTF per ticket declined at the same time for all ticket types, when measured in constant dollars. In other words, passengers paid less taxes and fees per ticket on average in 2004, but the relative tax rate increased because of the decline in the average ticket prices.

3.1.2 Confidence Intervals and Extreme ETR Estimates

In order to test the robustness of the ETR estimates, 95% confidence intervals were constructed for the BF, FTT, FST, PFC, and FSSF. Then, the lowest and highest ETR estimates were computed as follows using the lower bounds (LB) and upper bounds (UB) of the confidence intervals:

Lowest ETR estimate: $$\frac{LB(FTT)+LB(FST)+LB(PFC)+LB(FSSF)}{UB(BF)}$$

Highest ETR estimate: $$\frac{UB(FTT)+UB(FST)+UB(PFC)+UB(FSSF)}{LB(BF)}$$

Results are shown in Table 3.3 and Table 3.4 for one-way passengers and roundtrip passengers respectively. Neither the highest nor the lowest estimates of the ETR ever deviated by more than 0.1% from the average ETRs, showing that the estimates are highly robust. Obviously, the large sample sizes contributed to these tight bounds.[10]

Table 3.3: 95% confidence intervals and ETR limits for one-way tickets

Fare Component	Sample Mean	Sample Std Dev	Sample Size	Finite Pop Correction	Std Dev of Sample Mean	95% CI Lower Bound	95% CI Upper Bound
BF	$182.97	178.26	958,996	0.9487	0.1727	$182.63	$183.31
FTT	$13.72	13.37	958,996	0.9487	0.0130	$13.70	$13.75
FST	$3.96	1.39	958,996	0.9487	0.0013	$3.96	$3.97
PFC	$4.72	2.20	958,996	0.9487	0.0021	$4.72	$4.73
FSSF	$3.20	1.12	958,996	0.9487	0.0011	$3.19	$3.20
Sum of Taxes and Fees	$25.60					$25.57	$25.64
Average ETR	14.0%						
Lowest ETR	13.9%						
Highest ETR	14.0%						

[10] Since DB1A contains 10% of all tickets, the finite population correction term was $\sqrt{1-\frac{1}{10}}$ or 0.9487. The same analysis was conducted for all three quarters (1993, 2002 and 2004) analyzed in this study, and the extreme ETR estimates never deviated by more than 0.1% in all cases owing to the large sample sizes.

Table 3.4: 95% confidence intervals and ETR limits for roundtrip tickets

Fare Component	Sample Mean	Sample Std Dev	Sample Size	Finite Pop Correction	Std Dev of Sample Mean	95% CI Lower Bound	95% CI Upper Bound
BF	$268.29	198.09	3,893,783	0.9487	0.0952	$268.10	$268.48
FTT	$20.12	14.86	3,893,783	0.9487	0.0071	$20.11	$20.14
FST	$8.06	2.84	3,893,783	0.9487	0.0014	$8.05	$8.06
PFC	$9.58	4.47	3,893,783	0.9487	0.0022	$9.57	$9.58
FSSF	$6.50	2.29	3,893,783	0.9487	0.0011	$6.49	$6.50
Sum of Taxes and Fees	$44.25					$44.23	$44.27
Average ETR	16.5%						
Lowest ETR	16.5%						
Highest ETR	16.5%						

3.1.3 Distribution of ETR as a Function of Base Fare

We also examined the distribution of ETR as a function of BF and compared with 2002. The results are shown in Table 3.5 through Table 3.8. As seen in the tables, the average ETR increased in all BF ranges for all three ticket categories, except for the highest range of more than $2,000 in BF. The ETRs increased because of the higher FST and PFC rates and lower average BFs. On the other hand, the average ETR declined in the highest one-way fare bracket due to a significant decline in the average number of segments per ticket. The ETR in the highest roundtrip fare range remained constant because the FTT, which is definitely the dominating factor of TTF in this fare range, remained relatively constant with a mere 1.4% change.

Table 3.5: Average ETR by BF range in 2004Q2 (All tickets)

	Passenger Share		Average BF ($)		Average TTF ($)		Average ETR	
BF Range	2004Q2	2002Q2	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2
BFs ≤ $100	10.8%	10.7%	77.72	82.81	19.65	21.04	25.3%	25.4%
$100 < BFs ≤ $200	38.6%	41.3%	156.49	161.38	32.79	33.84	21.0%	21.0%
$200 < BFs ≤ $400	38.7%	34.0%	271.30	285.18	44.29	45.85	16.3%	16.1%
$400 < BFs ≤ $600	7.1%	7.6%	480.95	506.80	60.34	62.74	12.5%	12.4%
$600 < BFs ≤ $800	2.5%	2.8%	689.88	723.17	75.29	77.81	10.9%	10.8%
$800 < BFs ≤ $1000	1.2%	1.5%	889.81	936.06	89.18	93.09	10.0%	9.9%
$1000 < BFs ≤ $2000	1.1%	1.9%	1,294.38	1,397.74	119.37	127.78	9.2%	9.1%
$2000 < BFs	0.1%	0.3%	2,517.17	2,593.99	210.54	216.91	8.4%	8.4%
All	100.0%	100.0%	251.43	278.83	40.57	43.16	16.1%	15.5%

Table 3.6: Average ETR by BF range in 2004Q2 (One-way tickets only)

	Passenger Share		Average BF ($)		Average TTF ($)		Average ETR	
BF Range	2004Q2	2002Q2	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2
BFs ≤ $100	36.5%	35.0%	75.88	78.77	16.18	16.12	21.3%	20.5%
$100 < BFs ≤ $200	36.4%	35.4%	142.53	151.78	23.17	23.45	16.3%	15.4%
$200 < BFs ≤ $400	19.2%	18.7%	270.05	286.89	33.22	34.70	12.3%	12.1%
$400 < BFs ≤ $600	4.6%	5.6%	483.27	512.37	49.35	51.51	10.2%	10.1%
$600 < BFs ≤ $800	1.6%	2.5%	682.14	723.42	64.21	67.41	9.4%	9.3%
$800 < BFs ≤ $1000	0.8%	1.3%	901.57	938.97	79.99	83.60	8.9%	8.9%
$1000 < BFs ≤ $2000	0.8%	1.5%	1,310.01	1,334.93	110.30	112.65	8.4%	8.4%
$2000 < BFs	0.0%	0.0%	2,108.93	2,247.72	169.33	182.13	8.0%	8.1%
All	100.0%	100.0%	182.97	215.05	25.60	27.86	14.0%	13.0%

Table 3.7: Average ETR by BF range in 2004Q2 (roundtrip tickets only)

	Passenger Share		Average BF ($)		Average TTF ($)		Average ETR	
BF Range	2004Q2	2002Q2	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2 (2004 Dollars)	2004Q2	2002Q2
BFs ≤ $100	4.5%	5.7%	81.39	87.81	26.59	27.13	32.7%	30.9%
$100 < BFs ≤ $200	39.1%	42.5%	159.69	163.00	35.00	35.59	21.9%	21.8%
$200 < BFs ≤ $400	43.5%	37.0%	271.44	285.01	45.49	46.99	16.8%	16.5%
$400 < BFs ≤ $600	7.7%	8.0%	480.61	506.01	61.97	64.33	12.9%	12.7%
$600 < BFs ≤ $800	2.7%	2.9%	691.00	723.13	76.89	79.60	11.1%	11.0%
$800 < BFs ≤ $1000	1.3%	1.5%	888.01	935.52	90.58	94.84	10.2%	10.1%
$1000 < BFs ≤ $2000	1.2%	2.0%	1,291.77	1,407.24	120.89	130.07	9.4%	9.2%
$2000 < BFs	0.1%	0.3%	2,567.67	2,604.71	215.64	217.99	8.4%	8.4%
All	100.0%	100.0%	268.29	291.74	44.25	46.26	16.5%	15.9%

Table 3.8: Segments per ticket by BF range

	Overall		One-Way		Roundtrip	
	2004Q2	2002Q2	2004Q2	2002Q2	2004Q2	2002Q2
BFs ≤ $100	1.49	1.64	1.14	1.13	2.21	2.27
$100 < BFs ≤ $200	2.27	2.37	1.34	1.31	2.48	2.55
$200 < BFs ≤ $400	2.58	2.66	1.39	1.44	2.71	2.78
$400 < BFs ≤ $600	2.60	2.68	1.41	1.41	2.78	2.86
$600 < BFs ≤ $800	2.53	2.53	1.40	1.41	2.69	2.72
$800 < BFs ≤ $1000	2.42	2.46	1.34	1.42	2.59	2.65
$1000 < BFs ≤ $2000	2.40	2.45	1.28	1.33	2.58	2.62
$2000 < BFs	2.30	2.37	1.17	1.41	2.44	2.40

Scrutinizing the actual amount of taxes and fees paid, we notice that it actually declined in all BF brackets, despite the higher FST and PFC rates in 2004. The only exception occurred in the cheapest BF range of the one-way tickets, where the average TTF increased from $16.12 to $16.18 on a constant dollar basis while the average BF fell by $2.89. Therefore, the TTF increase must be due to the higher average number of segments per ticket, as well as the higher FST and PFC rates.

Other than the few exceptions mentioned, we conclude that the decline in BFs was the main culprit for the increase in the average ETR across all fare ranges since the average TTF per ticket was observed to be decreasing at the same time. An interesting side observation here is that regardless of the decrease in the average BF, airlines managed to improve to some extent the passenger composition in terms of the paid fare range. In Table 3.5, one can observe that the BF range between $100 and $200 contained the largest share of passengers in 2002, but in 2004, the next higher range of between $200 and $400 had the largest share. However, it may also be true that the improvement was brought about not only by bumping up passengers from the lower fare ranges, but also at the expense of losing some high yield passengers. In fact, on a current dollar basis, while the share of passengers paying less than $200 in BF declined from 52.0% in 2002 to 49.4% in 2004, the share of passengers paying more than $400 also declined from 14.1% to 11.9%.

3.1.4 Legacy Carriers vs. Low Cost Carriers

Interestingly, exactly one-third of both legacy carriers and low-cost carriers investigated in our 2002 study went bankrupt between 2002 and 2004. In nearly three years between the First Quarter 2002 and the Third Quarter 2004, the six legacy carriers, namely, American, Continental,

Delta, Northwest, United, and US Airways, combined faced a massive loss of $19.8 billions, while the three low-cost carriers, namely, ATA, jebBlue, and Southwest came out with almost $860 millions in profit, despite the fact that ATA filed for Chapter 11 protection in October 2004 (Bureau of Transportation Statistics, 2005). The continuing presence of financially distressed legacy airlines and of some thriving low-cost airlines stimulated our interest in comparing the two groups again with the new data. The results are shown in Table 3.9 and Table 3.10. The average ETR increased for both legacy carriers and low-cost carriers, but the increase was steeper for the latter group, resulting in an increase in the ETR gap from 2.5% in the second quarter of 2002 to 3.2% in the second quarter of 2004 (cf. Section 2.3). There are some other findings that are even more striking. First, while the average PFC charge among legacy carriers dropped by 0.6%, it increased by a large amount of 12.5% for the low-cost carriers. To speculate on the causes, low-cost carriers are increasingly flying to major airports where PFCs are heavily levied, while, at the same time, many secondary airports they serve began to collect higher PFCs in order to fund the infrastructure developments necessary to accommodate increased traffic volume. Second, the average distance between origin and destination increased for both types of airlines, but the increase was far greater for the low-costs. Third, while the average number of segments per ticket declined for both groups, the reduction was larger for the legacy carriers. This is consistent with the widely advertised trend among legacy carriers of providing more point-to-point flights that bypass hubs. Finally, as seen in Table 3.10, it is remarkable that the number of low-cost carrier passengers in our samples increased by almost 30% in two years, while the number of legacy carrier passengers dropped by over 1%. In summary, while legacy carriers still have the majority market share, low-cost carriers continue to grow fast and expand more and more into long-distance markets that were previously dominated by the legacy carriers.

And this is happening despite the considerably higher ETR rates faced by low-cost carrier passengers.

Table 3.9: Legacy vs. low-cost carriers (2004Q2)

Carrier type	Ticket category	No. of pax	BF ($)	TTF ($)	FTT ($)	FST ($)	PFC ($)	FSSF ($)	ETR	No. segments per ticket	O-D Distance
Legacy	All	2,110,520	297.92	44.62	22.34	7.39	8.93	5.96	15.0%	2.38	1,186
	One-Way	315,599	255.75	31.07	19.18	3.93	4.80	3.17	12.1%	1.27	1,102
	Roundtrip	1,794,921	305.33	47.00	22.90	7.99	9.66	6.45	15.4%	2.58	1,200
LCC	All	1,251,888	165.73	30.14	12.43	6.06	6.77	4.88	18.2%	1.95	844
	One-Way	345,282	112.74	19.02	8.46	3.62	4.04	2.92	16.9%	1.17	845
	Roundtrip	906,606	185.91	34.37	13.94	6.99	7.81	5.63	18.5%	2.25	843

Table 3.10: Legacy vs. low-cost carriers--percentage change from 2002Q2

Carrier type	Ticket category	No. of pax	BF	TTF	FTT	FST	PFC	FSSF	ETR	No. segments per ticket	O-D Distance
Legacy	All	-1.2%	-10.1%	-7.5%	-10.1%	-6.1%	-0.6%	-9.1%	0.4%	-4.6%	6.2%
	One-Way	23.6%	-18.5%	-13.0%	-18.5%	-3.4%	1.5%	-6.6%	0.8%	-1.9%	9.3%
	Roundtrip	-4.6%	-8.5%	-5.9%	-8.5%	-4.6%	1.0%	-7.7%	0.4%	-3.1%	6.1%
LCC	All	29.8%	-8.3%	-2.6%	-8.3%	-2.4%	12.5%	-5.6%	1.1%	-0.8%	14.2%
	One-Way	36.2%	-10.8%	-3.6%	-10.8%	-1.5%	14.6%	-4.6%	1.3%	0.1%	13.2%
	Roundtrip	27.5%	-7.1%	-1.7%	-7.1%	-1.8%	13.0%	-4.9%	1.0%	-0.2%	14.5%

The 2002Q2 fares and tax and fee amounts are inflated with the US Dept. of Labor Consumer Price Index. A positive change indicates an increase in 2004 and a negative change indicates a decrease in 2004.

3.1.5 Change in Segments per Ticket

Another effect we hoped to determine by comparing the second quarter of 2004 and the second quarter of 2002 was whether the continuing proliferation of low-cost carriers, many of which do not offer connecting flights, and the increasing use of point-to-point flights as opposed to hub connections among the legacy carriers have had an impact on the average number of segments per ticket (see for example, Maynard, 2005). In order to test this, the difference of means test was performed on the data in Table 3.11 with the following hypothesis.

$H_0 : \mu_{2004} = \mu_{2002}$

$H_1 : \mu_{2004} < \mu_{2002}$

where μ is the mean number of segments per ticket in each year.

Table 3.11: Data for the difference in means test

Ticket category	Quarter	No. of directonal passengers	Mean of no. of segments in each direction	Std Dev
One-way	2002Q2	720,980	1.282	0.450
	2004Q2	958,996	1.278	0.448
Roundtrip	2002Q2	7,119,824	1.325	0.468
	2004Q2	7,787,566	1.299	0.458

Note: Each roundtrip itinerary is broken into two directional records in DB1A*.

The resulting t value was -107.12 for roundtrip tickets and -5.20 for one-way tickets. (See Appendix A for the details.) Thus, the difference in means test rejects the null hypothesis of equal average number of segments in preference of the fewer number of segments per ticket in 2004 for both ticket types.

The decline in the number of segments seems to affect roundtrip tickets more. There was a nearly 2% reduction in the number of segments on average for roundtrip itineraries, but only of about 0.3% for the one-way tickets. The results are too preliminary to explain precisely what kind of change is taking place in the domestic route structure. In other words, while there is a statistically significant reduction in the average number of segments per ticket, we have not examined the details of the change.

3.1.6 Impact of New FSSF Rate Proposal

In February 2005, the Bush administration presented its 2006 budget plan which proposes to increase FSSF from $2.5 to $5.5 per enplanement, with a cap of $8 for each way of travel, in

the hope of generating an additional $1.5 billion for meeting increased funding requirements at the TSA. Under the proposal, FSSF will effectively increase by $3 per direction of travel for the same itinerary regardless of the number of segments involved. This has generated a heated debate about the potential damage to the airline industry's profitability, which has been hurt in recent years by falling ticket prices and increasing fuel costs (see, for example, Alexander, 2005). We used the second quarter 2004 DB1A* ticket samples with increased FSSF rates to estimate the impact of the new policy on the average ETRs.

The ETRs with new FSSF rates were estimated under two scenarios. One scenario assumed that passengers would absorb all of the cost increase; thus, airlines would be able to maintain the same BF for every ticket and the Total Fare would rise by the amount of the FSSF increase. We called this the Constant BF scenario. The other scenario, the Constant Total Fare scenario, assumed that the additional cost would be fully absorbed by the airlines, making the Total Fare constant compared to the original amount without the FSSF rate increase and the BF would decline by the amount of the change in FSSF. As seen in Table 3.12, overall ETRs were estimated to rise from 16.1% to 18.3% and 18.7% for the Constant BF scenario and Constant Total Fare scenario respectively. The latter ETR was higher due to a decline in the corresponding BF. In reality, the higher travel cost will most likely be partially absorbed by both passengers and airlines, hence the true impact to the average ETR will be somewhere between the two outcomes depending on the price elasticity of the passenger demand. Furthermore, the first scenario should also result in a decrease in the number of passengers because of the higher ticket prices, but this effect was neglected for simplicity.

Table 3.12: Impact of new FSSF rate on average ETRs

FSSF adjustment scenario	Ticket Category	No. passengers in sample	Total Fare	BF	TTF	FTT	FST	PFC	FSSF	ETR
Original	**All**	**4,852,779**	**$292.00**	**$251.43**	**$40.57**	**$18.86**	**$7.25**	**$8.62**	**$5.84**	**16.1%**
	One-Way	958,996	$208.58	$182.97	$25.60	$13.72	$3.96	$4.72	$3.20	14.0%
	Roundtrip	3,893,783	$312.54	$268.29	$44.25	$20.12	$8.06	$9.58	$6.50	16.5%
Constant BF	**All**	**4,852,779**	**$297.40**	**$251.43**	**$45.97**	**$18.86**	**$7.25**	**$8.62**	**$11.25**	**18.3%**
FSSF increase absorbed	One-Way	958,996	$211.58	$182.97	$28.60	$13.72	$3.96	$4.72	$6.20	15.6%
by passengers	Roundtrip	3,893,783	$318.54	$268.29	$50.25	$20.12	$8.06	$9.58	$12.50	18.7%
Constant Total Fare	**All**	**4,852,779**	**$292.00**	**$246.02**	**$45.97**	**$18.86**	**$7.25**	**$8.62**	**$11.25**	**18.7%**
FSSF increase absorbed	One-Way	958,996	$208.58	$179.97	$28.60	$13.72	$3.96	$4.72	$6.20	15.9%
by airlines	Roundtrip	3,893,783	$312.54	$262.29	$50.25	$20.12	$8.06	$9.58	$12.50	19.2%

Regarding the feasibility of generating an additional $1.5 billion in FSSF revenue in 2006, a simple calculation showed that the new policy would generate only about $1.3 billion in additional income for the TSA. Therefore, we conclude that the number of passengers must increase by at least 15% from the second quarter 2004 level in order to achieve its advertised goal.

3.2 Second Quarter 1993 Results

An analysis of data for the second quarter of 1993 was also performed in order to obtain a perspective on changes in the ETR over a decade. The only add-on taxes and fees that were applied to domestic air tickets at the time were a federal ticket tax (FTT) at the rate of 10% of BF and any applicable passenger facility charges, whose use was not yet as common as in the later years as seen in Table 2.2[11]. Given the average ETR of 15.5% of BF in 2002 and 16.1% in 2004, one would expect a lower overall ETR in 1993. Furthermore, since almost the entire total taxes and fees (TTF) in 1993 consisted of a fixed percentage of the BF, a flatter incidence of the ETR

[11] PFCs were first authorized in 1992; we selected 1993, instead of 1992, as the year for our analysis to allow time for the adoption of the PFC by a significant number of airports.

across the spectrum of BF ranges would also be expected. These expectations are borne out by the results shown in Table 3.13 and Table 3.14. Table 3.13, which also includes overall results for 2002 and 2004 for convenience, indicates that the overall ETR in 1993 was equal to 10.9%, significantly less than the 2002 and 2004 figures.

Table 3.13: Comparison of 1993, 2002, and 2004 average fares, taxes, fees, and ETR

Quarter	Ticket Category	Total Fare	BF	TTF	FTT	FST	PFC	FSSF	ETR	Segments per ticket	O-D Distance (miles)
2Q 1993	**All**	**$373.99**	**$337.25**	**$36.74**	**$33.72**	–	**$3.02**	–	**10.9%**	**2.17**	**858**
	One-way	$153.49	$138.29	$15.20	$13.83	–	$1.37	–	11.0%	1.18	579
	Roundtrip	$493.29	$444.89	$48.40	$44.49	–	$3.91	–	10.9%	2.71	1009
2Q 2002	**All**	**$321.99**	**$278.83**	**$43.16**	**$20.91**	**$7.62**	**$8.27**	**$6.35**	**15.5%**	**2.42**	**982**
	One-way	$242.91	$215.05	$27.86	$16.13	$4.04	$4.33	$3.36	13.0%	1.28	871
	Roundtrip	$338.00	$291.74	$46.26	$21.88	$8.35	$9.07	$6.96	15.9%	2.65	1005
2Q 2004	**All**	**$292.00**	**$251.43**	**$40.57**	**$18.86**	**$7.25**	**$8.62**	**$5.84**	**16.1%**	**2.34**	**1030**
	One-way	$208.58	$182.97	$25.60	$13.72	$3.96	$4.72	$3.20	14.0%	1.28	959
	Roundtrip	$312.54	$268.29	$44.25	$20.12	$8.06	$9.58	$6.50	16.5%	2.60	1048

Note: All fares and taxes and fees are shown in 2004 dollars.

We are not aware of any other study that has attempted to estimate either the current or historical ETR levels for a representative sample of all domestic tickets sold in the U.S. A report by Morrison and Winston (2003) for the National Business Travel Association uses DB1A data to compute average fare and tax rates for business travelers in 3,200 markets. Their results compare well with those presented in Table 10, indicating a tax rate of 8% in 1989 and 14% in 2002 (Morrison & Winston, 2003).

Possibly the most striking aspect of Table 3.13 is the fact that the average roundtrip BF for domestic air travel declined by 39.7% from $444.89 to $268.29, in 2004 prices, over an eleven-year period from 1993 to 2004. On the other hand, the average one-way BF increased from $138.29 to $182.97 and somewhat mitigated the fall in the overall BF that includes both roundtrip and one-way ticket types, which declined by 25.4% from $337.25 to $251.43. The overall TTF increased by a smaller margin from $36.74 to $43.16 during the first nine years, but

then declined slightly to $40.57 in 2004, making the overall increase from 1993 to 2004 equal to10.4%. This suggests that the 25.4% decline in BF is largely responsible for the increase in ETR from 10.9% to 16.1% during the eleven-year period. In any event, in real terms, the *total cost of domestic air travel* (i.e., BF + TTF) declined by 21.9% between 1993 and 2004.

Table 3.14: Average ETR for eight different ranges of the BF in 1993

BF Range	Ticket category	No. of passengers		Average BF ($)	Average TTF ($)	Average ETR
BFs ≤ $100	**All**	**885,337**	**(26.5%)**	**56.82**	**6.68**	**11.8%**
	One-way	821,919		54.55	6.35	11.6%
	Roundtrip	63,418		86.17	10.88	12.6%
$100 < BFs ≤ $200	**All**	**713,962**	**(21.4%)**	**150.95**	**17.67**	**11.7%**
	One-way	205,605		131.45	14.43	11.0%
	Roundtrip	508,357		158.84	18.98	11.9%
$200 < BFs ≤ $400	**All**	**1,168,086**	**(35.0%)**	**279.48**	**30.91**	**11.1%**
	One-way	101,040		283.66	29.95	10.6%
	Roundtrip	1,067,046		279.09	31.00	11.1%
$400 < BFs ≤ $600	**All**	**308,839**	**(9.3%)**	**492.64**	**51.95**	**10.5%**
	One-way	33,441		486.06	50.12	10.3%
	Roundtrip	275,398		493.44	52.17	10.6%
$600 < BFs ≤ $800	**All**	**133,039**	**(4.0%)**	**695.62**	**72.20**	**10.4%**
	One-way	5,734		666.81	68.22	10.2%
	Roundtrip	127,305		696.92	72.38	10.4%
$800 < BFs ≤ $1000	**All**	**64,624**	**(1.9%)**	**881.43**	**90.93**	**10.3%**
	One-way	1,882		885.96	90.21	10.2%
	Roundtrip	62,742		881.29	90.95	10.3%
$1000 < BFs ≤ $2000	**All**	**59,974**	**(1.8%)**	**1,190.22**	**121.72**	**10.2%**
	One-way	1,245		1,217.98	123.13	10.1%
	Roundtrip	58,729		1,189.63	121.69	10.2%
$2000 < BFs	**All**	**1,205**	**(0.04%)**	**2,329.51**	**235.62**	**10.1%**
	One-way	36		2,168.06	218.22	10.1%
	Roundtrip	1,169		2,334.48	236.15	10.1%

Table 3.14 shows that the ETR did not increase in any significant way for round-trip tickets with base fares of $600 (in current dollars) or more between 1993 and 2004 (cf. Table 3.5) and, in fact, has declined for BF higher than $800. While the associated fraction of passengers is small (only 4.8% of passengers in the second quarter of 2004 paid more than a $600 BF and only 7.8% in 1993), these are also the passengers who are by far the most

important to the revenues of the airlines. This finding underlines the point made earlier: add-on taxes and fees cannot be considered a significant contributor to the decline of high-end ticket sales that the airline industry has experienced in recent years. At the opposite end of the price spectrum, the ETR has essentially doubled or more for base fares up to $200 and increased by roughly 50% for base fares between $200 and $400. These two categories comprised around 83% and 88% of passengers in 1993 and 2004, respectively.

Chapter 4: Analysis of European Effective Tax Rate

This chapter presents the result of our analysis on the European effective tax rate (ETR). By "Europe", we refer to the original 15 European Union (EU) member countries, namely, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom. The scope of the study covers both domestic and intra-EU flights among these states, making the analysis far more complex than what was previously done for the US.

4.1 Brief Overview of European Taxes and Fees

The EU does not have integrated tax rules in place for the taxation of air travel. As a result, there are 43 different kinds of ticket taxes and fees in the 15 countries investigated. Moreover, many of these have rates that vary depending on itinerary detail such as the boarding point, destination country, and even the choice of airline (IATA, Quarterly). It was therefore necessary to devote a lot of time to the task of understanding the wide variety of taxation practices in Europe and how they affect the cost of travel.

Another important characteristic of the ticket taxes and fees related to air travel in the EU is that carriers make separate payments to both Eurocontrol and local governments for the usage of en route and terminal Air Navigation Services (ANS). That is unlike in the US, where the cost of ANS is mostly funded by ticket taxes levied directly on airline passengers and partly by general government tax revenue. Because of this, as well as other less significant differences in

funding practices of air transportation infrastructures, careful calibrations are necessary to make meaningful comparison of ETRs between the EU and US. Although they are still preliminary, some reconciliation attempts are discussed in Section 3.4.

4.2 Methodology and Data Analysis

Due to the lack of a central ticket database in Europe similar to DB1A in the US, we relied on the ticketing data provided by an MIT Global Airline Industry Program partner, Amadeus Global Travel Distribution S.A. ("Amadeus"), for the empirical analysis. Amadeus is one of a few predominant Global Distribution System (GDS) companies with access to the seat inventory at well over 400 airlines. It processed approximately 450 million bookings worldwide in 2004 (Amadeus, 2005). Furthermore, Amadeus is a leading GDS in Europe with a market share of 55% in the region (Moores, 2004).

Amadeus' booking system connects tens of thousands of travel agent terminals with airline reservation systems, and millions of structured messages are exchanged through the system each day supporting commercial transactions selling airline seats. These messages are created according to the industry's standard communication protocol between computer systems, and can contain various transactional details. Furthermore, specific message formats with relevant details are used at different stages of a transaction. In order to provide empirical data for this study as well as for other previous and on-going research at MIT, Amadeus engineers selected one message type called AIRRQT among many available formats, and created a filtering software to capture only this type of message from all the messages going through the

company's central system. The AIRRQT was selected due to its following desirable characteristics:

1. It contains adequate ticket details including the itinerary, fare and tax breakdown, and distribution channel information. Furthermore, the ticket tax section shows the individual taxes and fees that have been applied with the two-letter identifier (tax code) and corresponding value for up to fifteen tax and fee types. This feature allowed us to use the actual amount of taxes and fees levied, instead of estimating it from the passenger's itinerary as done in our US study.

2. It is transmitted only after a ticket is actually purchased. Thus, the estimated ETR will most accurately reflect the ETR experienced by actual passengers, since "temporary" bookings that do not result in purchases are rejected by the filter.

3. The transmission of the AIRRQT message is one of the few occasions during a ticketing transaction when all ticket details are synchronized and recorded simultaneously. Therefore, the message contains all of the final ticket details at the time of purchase.

The actual data collection was performed at Amadeus during a two-day period from January 13th to January 14th in 2004, and a total of 1,120,507 tickets with 2,626,580 flight segments were captured.

Each record of AIRRQT contains information for a single flight segment. One or more records are then grouped under the same Passenger Name Record Number (PNR) and Ticket Number to represent the whole itinerary of a ticket. Of the 79 fields available in each AIRRQT

record[12], we mostly relied on the fields listed in Table 4.1 for our analysis. Other fields are there to identify the distribution channel and other transactional details that are used in the filtering steps described next. Also note that fare and tax amounts are not prorated for individual segments within a ticket, but instead the same fares and tax breakdown are repeated in all segment records of a ticket. All monetary values were converted to US dollars using currency exchange rates provided by the OANDA Corporation (OANDA, 2005).

Table 4.1: Relevant AIRRQT fields

Purpose	Relevant Field	Note
Identification of unique ticket	PNR	
	Ticket Number	
Identification of itinerary	Roundtrip Identifier	Identifies one-way or roundtrip ticket type
	Origin Airport	
	Destination Airport	
	Segment Number	Used to sequence flights to construct the ticket itinerary
	Stop Over Indicator	Used to identify the trip destination in multi-segment roundtrip ticket
Fare and tax detail	Base Fare	
	Total Fare	
	Tax Breakdown	Up to 15 tax and fee types stored in AIRRQT
	Total Taxes and Fees	Derived field. Sum of all tax and fee amounts.

In order to prepare the raw AIRQRT ticket data for our analysis, six filtering steps were performed sequentially in the following order. The remaining number of flight records and number of tickets after each step are summarized in Table 4.2.

1. Eliminated bad records missing key identification and routing information such as the PNR number, ticket number, and origin and destination airports, and irrelevant records representing cancellations and refund.

2. Preserved only tickets for which the complete itinerary is contained within the EU[13].

[12] There are many more fields in the AIRRQT massage format, but only 79 fields that were deemed useful for research in airline economics have been captured in order to reduce the data size.

[13] A list of airports in the fifteen EU countries was obtained from a web site which lists IATA airport codes by country (Krenn, 2005). Accordingly, there are 773 airports within the region with IATA airport code assigned.

3. Eliminated tickets without fare and tax information.

4. Eliminated tickets with a discrepancy between the recorded number of segments and the estimated number of segments. The latter was computed for each ticket as [Highest Segment Number] - [Lowest Segment Number] + 1. The segment numbering practice seems to vary among airlines, so this type of discrepancy does not necessarily indicate a data error. However, the filter was implemented to standardize the segment numbering and make the data set more tractable.

5. Removed tickets with a discrepancy between the recorded Base Fare (BF) and estimated BF. The latter was computed as the difference between the Total Fare and Total Taxes and Fees (TTF). Since BF must be equal to the difference, a discrepancy suggests errors in recorded fares or taxes or both.

6. Eliminated one-way tickets with more than two flight segments and roundtrip tickets with more than four flight segments. In essence, we restricted our study to only those itineraries with at most two segments per each direction of travel for ease of analysis. This filter eliminated just 1.9% of all remaining tickets after Step 5. Therefore, any distortion caused by this restriction should not have a significant impact on the overall results.

Table 4.2: Filters used for preparing AIRRQT records

Filter step	Filter description	Records remaining	Tickets remaining	Remaining ticket %
	Original AIRRQT data	2,626,580	1,120,507	100.0%
1	Bad and irrelevant records elimination	2,218,776	970,853	86.6%
2	EU market filter	864,341	423,556	37.8%
3	Fare and tax detail availability filter	799,365	393,426	35.1%
4	Segment numbering filter	729,746	362,809	32.4%
5	Base fare discrepancy filter	688,471	341,093	30.4%
6	Number of segments filter	663,825	334,782	29.9%

Similarly to the US study, we defined the ETR as the percentage by which the BF charged by an airline for a trip is increased as a result of the TTF paid directly by air travelers. However, we noticed that in the European AIRRQT data two tax codes, YQ and YR, reserved for airline surcharges appeared frequently in the ticket tax section. Based on discussions with both Amadeus and airline experts from two member airlines of the MIT Global Airline Industry Program, we decided to consider these charges as part of BF as they are part of airline revenue. Therefore, the ETR for our European study is defined as:

$$ETR = \frac{E(TTF) - E(YQYR)}{E(BF) + E(YQYR)} \times 100\%,$$

where E(TTF), E(BF), and E(YQYR) represent the average values of TTF, BF, and the total amount of YQs and YRs per ticket respectively.

4.3 Results

4.3.1 Overall ETR

In the 334,782 ticket records remaining after all filters, the average ETR was 12.5% with the average BF amounting to $264.84, TTF of $43.57 and YQYR of $9.40. Results are summarized in Table 4.3. As noted earlier, we add YQYR to BF when computing the ETR.

Table 4.3: Average ETR

Ticket Category	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	Segments per Ticket
All	334,782	264.84	43.57	9.40	12.5%	1.98
One-way	63,688	166.43	18.18	3.21	8.8%	1.12
Roundtrip	271,094	287.96	49.54	10.86	12.9%	2.18

Comparing to the second quarter 2004 US results (c.f. Chapter 3), the average European BF plus YQYR was more than $20 higher, while the European TTF minus YQYR was about $4 lower, resulting in a European ETR which appears to be 3.6% lower than in the United States. However, the ETRs shown in Table 4.3 are simply the arithmetic means of the fifteen EU-15 nations. In truth, the ETR varies greatly from country to country. ETRs by country are presented in Section 3.3.2. Moreover, the ETRs computed here are not really comparable to those for the United States for the reasons discussed in the previous section. Some important adjustments that may lead to more accurate comparisons with the US are discussed in Section 3.4.

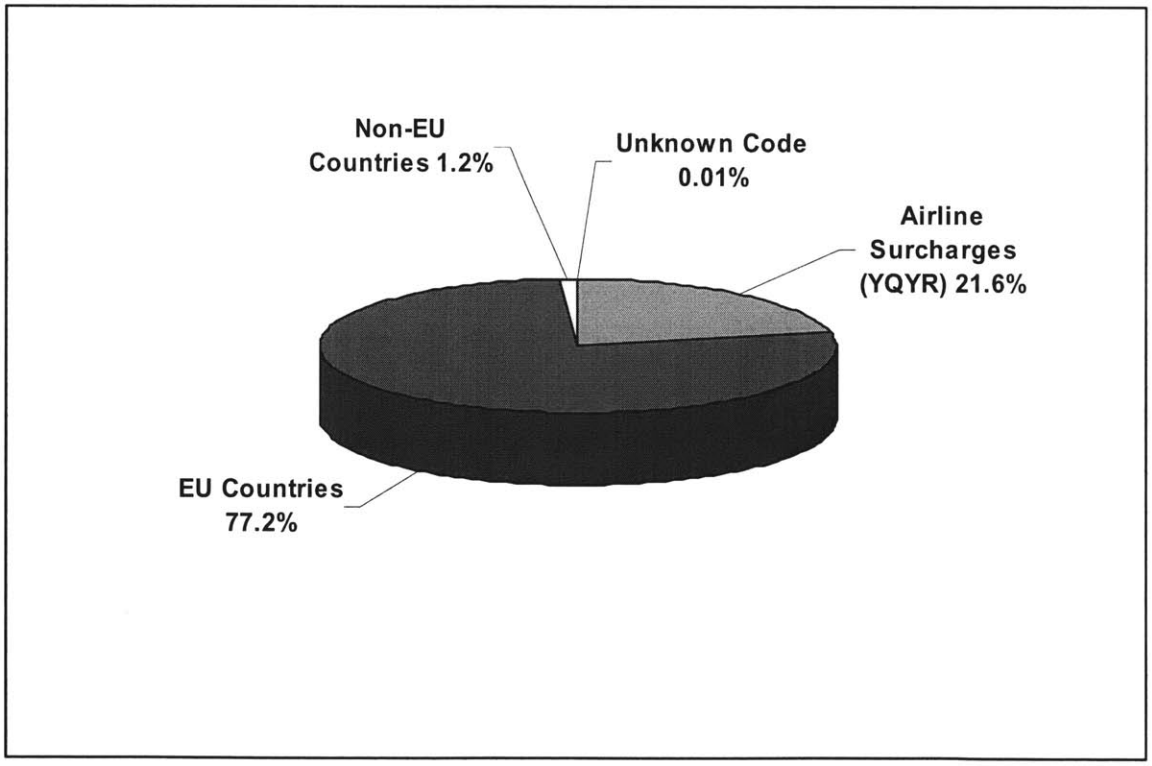
Eighty two different tax and fee codes appeared in our 334,782 ticket samples, including 43 EU tax codes, 37 non-EU tax codes, and 2 tax codes representing airline surcharges. Table 4.4 shows the 20 most frequently used codes with the number of occurrence and total amount for each code, while the entire list of 82 codes is included as Appendix B. As seen in Table 4.4, the YQ code, which is one of two codes reserved for airline surcharges, was by far the most commonly used. In fact, together with the other airline surcharge code, YR, airline surcharges accounted for nearly 22% of the entire amount of taxes and fees levied in our sample, while all European taxes and fees accounted for about 77% (Figure 4.1). The average amount of airline surcharges per ticket was $9.40, as already indicated in Table 4.3.

Table 4.4: Twenty most frequently used tax and fee codes

Occurrence Rank	Tax and Fee Code	Occurrence	Total Amount (US$)	Country	Description
1	YQ	254,878	2,733,720	Airline	Airline own use only
2	FR	170,649	2,161,279	France	Aviation Civile Tax, Corsica Fiscal Tax, Airport Tax
3	RS	105,323	778,123	Spain	Departure Charge
4	QV	105,178	246,729	Spain	Security Tax
5	DE	86,166	1,091,832	Germany	Airport Security Charge
6	UB	66,275	1,238,310	United Kingdom	Passenger Service Charge
7	RD	64,185	1,042,373	Germany	Passenger Service Charge
8	GB	63,327	747,220	United Kingdom	Air Passengers Duty
9	QW	52,621	420,822	France	Passenger Service Charge
10	RA	46,434	567,921	Germany	Passenger Service Charge
11	UI	46,076	96,465	France	VAT Adjustment Tax
12	YR	32,384	414,831	Airline	Airline own use only
13	QX	31,714	256,200	France	Passenger Service Charge
14	IT	27,853	245,507	Italy	Domestic or International Embarkation Tax
15	VT	26,535	73,808	Italy	Security Charge
16	EX	26,389	73,934	Italy	Security Bag Charge
17	YA	16,062	428,193	Sweden	Passenger Charge
18	DQ	12,368	61,769	Finland	Security Charge
19	ZO	11,023	222,267	Denmark	Passenger Charge
20	DK	9,130	140,145	Denmark	Transportation Tax

Note: Sorted by the number of occurrences.

Figure 4.1: Share of tax and fee values by recipient



Due to the large amount of airline surcharges, the estimated ETR changes substantially, depending on whether these surcharges are considered as part of BF or part of TTF. Our practice,

as explained in Section 4.2, is to treat YQYR as part of BF instead of TTF. On the other hand, if they were considered to be a part of the TTF rather than the BF, the average ETR computed in Table 1 would jump to 16.5% from 12.5%. We believe that most observers would see this higher estimate as having little logical justification, because it simply splits the airline revenue into two parts and treats one of them as an add-on ticket tax. However, even from this point of view, the estimate may be important as an indicator of how most passengers may perceive the size of the ETR. It is a safe guess that the great majority of them assume that YQYR is just another one of the many taxes and fees that appear on their tickets and not a surcharge that represents airline revenue.

It may also be valid to argue that these airline surcharges should be treated differently than the BF, as they are there to offset temporary external costs and thus may be rescinded at some future time. Rapidly rising fuel costs and costs associated with meeting increased security requirements are two examples of such possibly temporary or extraordinary expenditures requiring special funding. In this sense, some may view the YQYR airline surcharges as part of the TTF, based on the rationale that these external costs are not caused by the airlines. According to this argument, the true ETR, which is supposed to measure the increase in the travel cost to passengers caused by costs other than the airlines' own, lies somewhere between 12.5%, when airline surcharges are counted as airlines' revenue, and 16.5%, when the surcharges are considered to be costs not caused or imposed by airlines, similar to government taxes. It is not the purpose of this study to argue which perspective is correct. Moreover, the total travel costs to passengers do not change regardless of how the surcharges are allocated. Therefore, we simply report both rates here.

Another interesting observation is that, as mentioned earlier, 37 of the 82 tax codes appearing in the EU ticket samples are either non-EU codes or unknown codes. Non-EU tax codes are those assigned by IATA for use in countries outside of the EU and unknown codes are those not defined in the IATA Tax Book at all. Together they represent about 0.6% of all taxes and fees applied by frequency and about 1.2% by value. Although we have not been able to solve this mystery, we have been able to ascertain that users of a ticket reservation system have the capability to override the taxes and fees that are normally assessed by the automated fare quoting system and add any arbitrary fees in any amount desired. It is also plausible that these errors are caused by the automated system itself. In any event, there seems to be a lack of a reliable and global auditing mechanism that could prevent the occurrence of these two types of mishaps.

In the European ticket samples, we also noticed that the average number of segments per ticket is lower than for the US, suggesting significantly higher use of non-stop flights in Europe. As seen in Table 4.5, the number of segments per ticket is about 15% less in Europe for all three ticket categories. This may be due largely to (a) shorter distances between the major origin-destination pairs in Europe that make these pairs suitable only for non-stop flights and (b) the larger concentration of European passengers in these large markets. The overall average O-D distance in the European samples is merely 439.0 miles[14] compared with 1030.4 miles for the US in 2004. Table 4.6 also compares the distances between the airport origin-destination pairs of the ten largest air travel markets in our European and US data sets. Note that the arithmetic average distance for the 10 European markets is 312.0 miles, compared to 875.5 miles for the US, and the

[14] This estimate is based on 317,988 tickets (95.0% of all available for this study) whose O-D distances were listed in the October 2004 issue of the OAG (OAG 2004).

former covers 12.7% of all European ticket samples while the latter covers 4.1% of the US samples.

Table 4.5: Comparison between European and US segments per ticket

	EU		US	
Ticket Category	No. of tickets in sample (% share)	Segments per Ticket	No. of tickets in sample (% share)	Segments per Ticket
All	334,782	1.98	4,852,779	2.34
One-way	63,688 (19.0%)	1.12	958,996 (19.8%)	1.28
Roundtrip	271,094 (81.0%)	2.18	3,893,783 (80.2%)	2.60

Table 4.6: Ten largest air travel markets in the EU and US

EU		US	
Origin-Dest Pair	Distance (miles)	Origin-Dest Pair	Distance (miles)
BCN - MAD	300	FLL - JFK	1,072
TLS - ORY	355	LAX - JFK	2,473
ORY - NCE	418	FLL - LGA	1,079
MUC - TXL	299	ATL - LGA	762
MRS - ORY	389	DCA - LGA	214
HAM - MUC	373	BOS - LGA	185
DUS - MUC	302	OAK - LAX	338
PMI - BCN	126	LGA - ORD	732
FRA - TXL	270	JFK - MCO	947
CGN - TXL	288	MCO - LGA	953

Note: European O-D distances obtained from the OAG (OAG 2004).

Finally, a sensitivity analysis using the same minimum and maximum BF filters used in the US study (c.f. Section 2.2.) was conducted. With the filters of $30 minimum and $2,500 maximum BF per each direction of travel, the average ETR decreased from 12.5% to 12.3% as shown in Table 4.7.

Table 4.7: Average ETR with fare filters ($30 ≤ BFs ≤ $2500 per direction)

Ticket Category	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	Segments per Ticket
All	301,769	290.42	44.06	9.52	12.3%	1.99
One-way	58,006	180.52	18.85	3.36	8.7%	1.13
Roundtrip	243,763	316.57	50.06	10.99	12.8%	2.19

4.3.2 ETR by Country

In this section, we look more carefully at how the ETRs vary among the fifteen EU countries, as well as how domestic and intra-EU ETRs differ from each other within a nation. Overall results are summarized in Table 4.8, while the ETR by country are displayed in Figure 4.2 in increasing order. Figure 4.3 also compares domestic and intra-EU ETRs within each country. In order to simplify the presentation, all results are inclusive of both one-way and roundtrip tickets. The detailed breakdown of one-way and roundtrip results is shown in Appendix C.

Table 4.8: ETR by the origin country

Origin Country	O-D Type	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR in TTF (US$)	ETR	Segments per Ticket
Austria	**All**	**4,437**	**375.47**	**68.21**	**19.39**	**12.4%**	**2.27**
	Domestic	384	248.23	53.59	15.87	14.3%	1.86
	Intra-EU	4,053	387.53	69.60	19.73	12.2%	2.30
Belgium	**All**	**3,289**	**362.19**	**52.38**	**6.00**	**12.6%**	**2.18**
	Domestic	0					
	Intra-EU	3,289	362.19	52.38	6.00	12.6%	2.18
Denmark	**All**	**6,624**	**357.75**	**65.19**	**12.48**	**14.2%**	**2.11**
	Domestic	2,339	214.57	58.97	9.38	22.1%	1.87
	Intra-EU	4,285	435.91	68.58	14.17	12.1%	2.24
Finland	**All**	**10,240**	**269.72**	**58.70**	**11.46**	**16.8%**	**2.26**
	Domestic	6,137	186.79	57.96	10.23	24.2%	2.02
	Intra-EU	4,103	393.76	59.81	13.30	11.4%	2.62
France	**All**	**67,935**	**344.50**	**51.24**	**9.77**	**11.7%**	**1.97**
	Domestic	51,479	279.84	50.23	9.38	14.1%	1.89
	Intra-EU	16,456	546.77	54.38	10.99	7.8%	2.21
Germany	**All**	**71,609**	**306.03**	**56.74**	**17.02**	**12.3%**	**2.06**
	Domestic	44,998	254.77	54.09	15.94	14.1%	1.89
	Intra-EU	26,611	392.72	61.24	18.83	10.3%	2.35
Greece	**All**	**2,073**	**203.27**	**47.95**	**8.09**	**18.9%**	**1.79**
	Domestic	1,159	121.24	37.98	4.57	26.6%	1.53
	Intra-EU	914	307.29	60.59	12.56	15.0%	2.12
Ireland	**All**	**1,829**	**165.54**	**42.29**	**9.07**	**19.0%**	**2.10**
	Domestic	45	132.47	20.85	2.82	13.3%	1.78
	Intra-EU	1,784	166.38	42.83	9.23	19.1%	2.11
Italy	**All**	**12,942**	**291.70**	**39.69**	**14.17**	**8.3%**	**1.94**
	Domestic	8,024	201.45	32.91	12.71	9.4%	1.69
	Intra-EU	4,918	438.93	50.75	16.54	7.5%	2.35
Luxembourg	**All**	**1,189**	**350.80**	**37.36**	**13.28**	**6.6%**	**2.13**
	Domestic	0					
	Intra-EU	1,189	350.80	37.36	13.28	6.6%	2.13
Portugal	**All**	**1,597**	**293.31**	**32.54**	**4.49**	**9.4%**	**2.10**
	Domestic	491	170.87	22.94	0.00	13.4%	1.98
	Intra-EU	1,106	347.66	36.81	6.48	8.6%	2.15
Spain	**All**	**85,797**	**195.56**	**14.94**	**1.02**	**7.1%**	**1.81**
	Domestic	69,957	159.33	10.90	0.02	6.8%	1.72
	Intra-EU	15,840	355.54	32.77	5.41	7.6%	2.24
Sweden	**All**	**13,169**	**310.73**	**58.88**	**12.49**	**14.4%**	**2.21**
	Domestic	8,397	231.82	55.35	10.49	18.5%	1.99
	Intra-EU	4,772	449.58	65.10	16.01	10.5%	2.59
The Netherlands	**All**	**3,231**	**351.77**	**58.17**	**7.00**	**14.3%**	**2.22**
	Domestic	9	170.42	56.11	6.82	27.8%	1.78
	Intra-EU	3,222	352.28	58.18	7.00	14.2%	2.22
United Kingdom	**All**	**48,821**	**163.15**	**51.26**	**9.14**	**24.4%**	**2.01**
	Domestic	19,282	130.48	49.44	8.47	29.5%	1.89
	Intra-EU	29,539	184.47	52.45	9.58	22.1%	2.09

Figure 4.2: Average ETRs by origin country (sorted in increasing order)

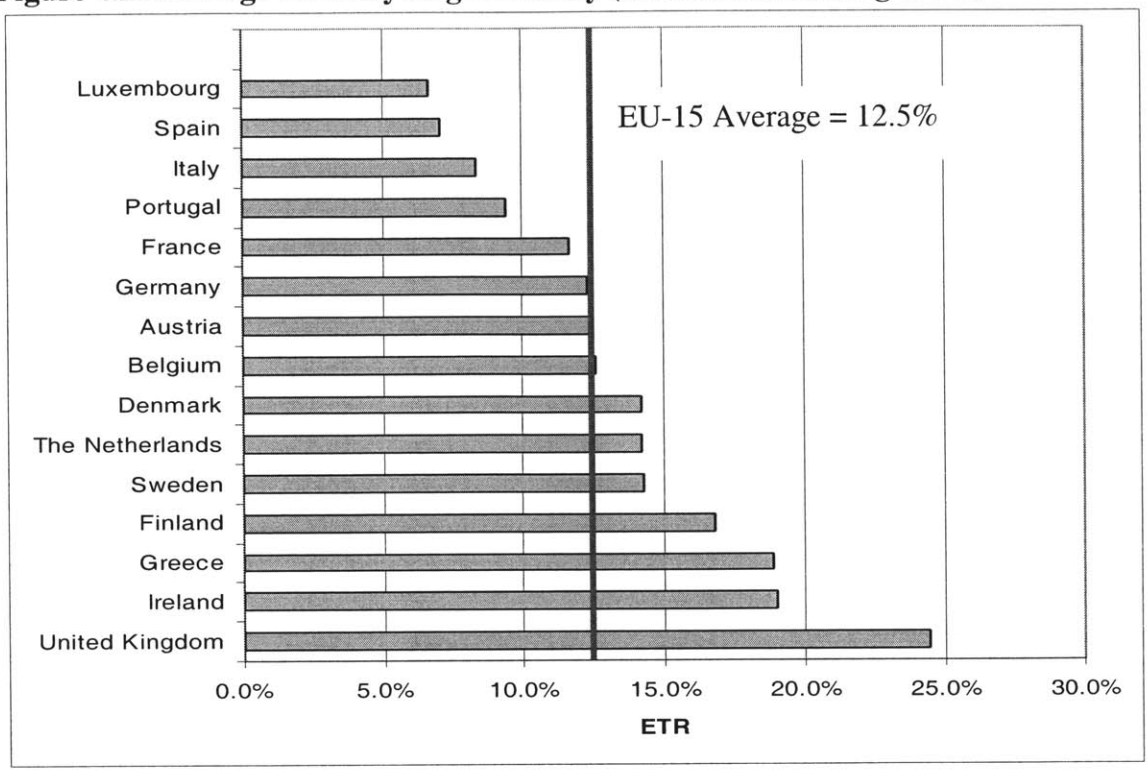
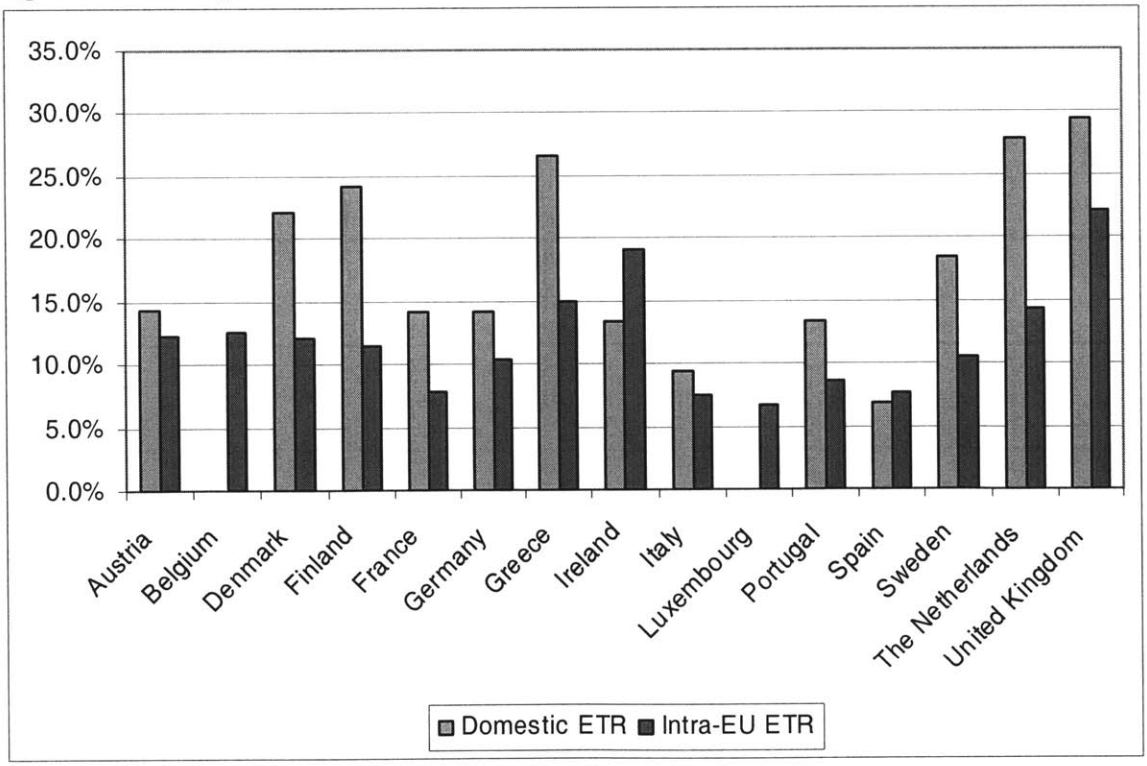


Figure 4.3: Comparison between domestic and intra-EU ETRs



In all countries except Ireland and Spain, the domestic ETR is considerably higher than the intra-EU ETR as shown in Figure 4.3. However, this is not because higher taxes and fees are levied on domestic tickets. It is rather due to the fact that intra-EU BFs are significantly higher than domestic BFs, while the TTFs are only slightly higher for intra-EU itineraries in most countries. These points are further illustrated in Figure 4.4 and Figure 4.5.

Figure 4.4: Average BF+YQYR by origin country

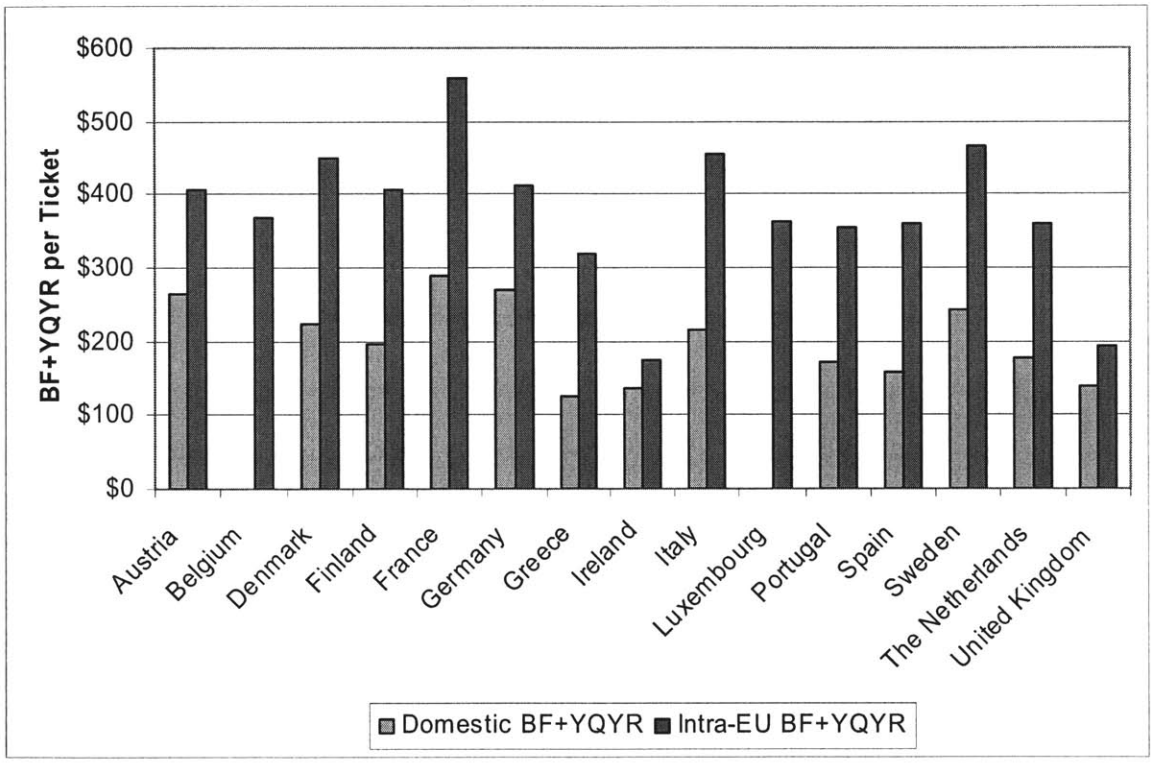
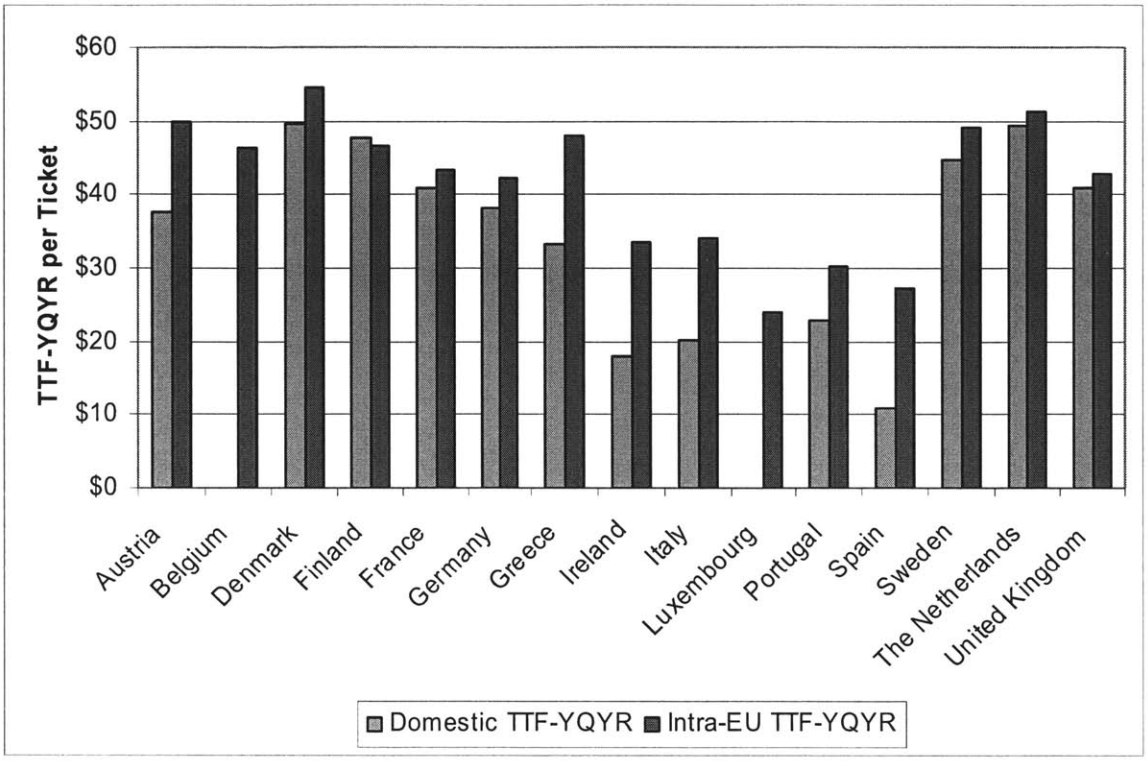


Figure 4.5: Average TTF-YQYR by origin country



One may also notice in Figure 4.3 that intra-EU ETRs fluctuate less than domestic ETRs. This is simply because differences in tax rates among the EU-15 countries can be mitigated when two or more countries are involved in an itinerary instead of just one. This observation prompts a comparison between ETRs by origin country and ETRs by destination country and the results are presented in Table 4.9. There are countries like the United Kingdom and Luxembourg where trips originating from the country cost significantly less than trips going there, resulting in higher ETRs for the passengers originating in the country. On the other hand, in places like France, passengers pay much more to travel out of the country than traveling into it, causing the ETRs to be higher for the people going to the country.

Table 4.9: Intra-EU ETR, BF, and TTF by origin country and destination country

	ETR			Base Fare + YQYR (US$)			Total Taxes and Fees - YQYR (US$)		
	Origin	Dest	Diff	Origin	Dest	Diff	Origin	Dest	Diff
Austria	12.2%	10.7%	1.5%	407.26	426.73	-19.48	49.87	45.87	4.00
Belgium	12.6%	10.4%	2.2%	368.19	446.21	-78.02	46.37	46.48	-0.11
Denmark	12.1%	11.8%	0.3%	450.08	450.65	-0.57	54.42	53.06	1.36
Finland	11.4%	9.2%	2.2%	407.06	463.19	-56.13	46.51	42.65	3.86
France	7.8%	12.7%	-4.9%	557.77	347.24	210.53	43.39	44.14	-0.75
Germany	10.3%	9.4%	0.9%	411.55	442.70	-31.15	42.40	41.42	0.99
Greece	15.0%	14.0%	1.0%	319.85	379.42	-59.57	48.03	53.25	-5.22
Ireland	19.1%	18.6%	0.5%	175.61	203.76	-28.15	33.60	37.89	-4.30
Italy	7.5%	9.6%	-2.1%	455.47	384.98	70.49	34.21	37.09	-2.87
Luxembourg	6.6%	5.3%	1.3%	364.08	530.24	-166.16	24.08	28.02	-3.94
Portugal	8.6%	9.9%	-1.3%	354.14	354.20	-0.06	30.33	34.95	-4.62
Spain	7.6%	10.4%	-2.8%	360.94	309.69	51.25	27.36	32.13	-4.77
Sweden	10.5%	10.3%	0.2%	465.58	469.05	-3.47	49.09	48.47	0.62
The Netherlands	14.2%	15.9%	-1.6%	359.27	321.27	38.00	51.18	51.05	0.14
United Kingdom	22.1%	13.8%	8.3%	194.06	338.16	-144.11	42.87	46.67	-3.80

Note: The difference is computed as the origin value minus the destination value.

Given the wide range of average ETRs among the fifteen countries, it is important to point out that high ETRs can be the result of either high taxes or low fares. In Table 4.10, note that ETRs in the United Kingdom are the highest in all itinerary categories (overall, domestic, and intra-EU), but clearly low fares are the main cause. In Spain, where the ETR is consistently one of the lowest, the low tax rate keeps the ETR low despite the relatively inexpensive fares. Finally, the total amount of taxes and fees is the highest in Denmark in all three itinerary categories, but relatively high fares keep the ETR lower than what it would otherwise be.

Table 4.10: ETR, BF, and TTF ranking by the origin country

		Overall			Domestic			Intra-EU		
	No. tickets		BF+YQYR	TTF-YQYR		BF+YQYR	TTF-YQYR		BF+YQYR	TTF-YQYR
Country	in sample	ETR Rank	Rank	Rank	ETR Rank	Rank	Rank	ETR Rank	Rank	Rank
Austria	4,437	9	1	3	7	3	8	6	6	3
Belgium	3,289	8	3	6	n/a	n/a	n/a	5	8	7
Denmark	6,624	7	2	1	5	5	1	7	4	1
Finland	10,240	4	11	4	4	7	3	8	7	6
France	67,935	11	6	8	8	1	6	12	1	8
Germany	71,609	10	8	10	9	2	7	10	5	10
Greece	2,073	3	12	9	3	13	9	3	13	5
Ireland	1,829	2	14	11	11	12	12	2	15	12
Italy	12,942	13	9	13	12	6	11	14	3	11
Luxembourg	1,189	15	4	14	n/a	n/a	n/a	15	9	15
Portugal	1,597	12	10	12	10	9	10	11	12	13
Spain	85,797	14	13	15	13	10	13	13	10	14
Sweden	13,169	5	7	5	6	4	4	9	2	4
The Netherlands	3,231	6	5	2	2	8	2	4	11	2
United Kingdom	48,821	1	15	7	1	11	5	1	14	9

Note: Ranked from the highest to the lowest in all categories.

We also compared ETRs in all 224 country pairs, including domestic markets, appearing in our ticket sample. Table 4.11 and Table 4.12 show the ten highest country pair ETRs and the ten lowest country pair ETRs, respectively, with a sample of at least 500 tickets. The ETRs for all 224 markets are listed in Appendix D. Not surprisingly, the United Kingdom is involved in eight out of the ten highest ETR country pairs, but these are the result of cheap tickets available for traveling to and from the country. In fact, all ten highest ETR markets have lower average BFs than all ten of the lowest ETR markets, except for the domestic Spanish market.

Table 4.11: Ten highest ETRs (markets with at least 500 tickets)

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR
United Kingdom	The Netherlands	2,063	106.65	62.03	9.00	45.9%
United Kingdom	France	5,365	153.58	60.79	9.59	31.4%
United Kingdom	Ireland	2,121	101.68	43.10	8.57	31.3%
Ireland	United Kingdom	1,124	97.71	38.81	7.45	29.8%
United Kingdom	United Kingdom	19,294	130.55	49.44	8.47	29.5%
Greece	Greece	1,162	121.70	38.00	4.57	26.5%
United Kingdom	Austria	595	186.45	62.40	11.83	25.5%
Finland	Finland	6,142	187.00	57.95	10.23	24.2%
United Kingdom	Belgium	837	216.55	59.61	8.35	22.8%
United Kingdom	Greece	557	252.66	69.87	10.11	22.7%

Table 4.12: Ten lowest ETRs (markets with at least 500 tickets)

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR
Spain	Portugal	1,256	394.15	20.18	0.29	5.0%
Italy	Spain	1,211	375.20	38.26	15.83	5.7%
France	Italy	2,703	614.15	51.18	11.77	6.3%
Germany	Sweden	529	751.33	72.74	23.21	6.4%
Sweden	Germany	714	745.38	70.24	20.56	6.5%
France	Spain	3,536	489.83	42.77	9.79	6.6%
Spain	France	3,247	423.26	37.98	8.88	6.7%
Spain	Spain	70,043	159.89	10.93	0.03	6.8%
France	Germany	3,522	656.70	59.46	13.67	6.8%
Spain	Italy	2,528	333.98	26.30	3.16	6.9%

4.3.3 ETR by BF Range

As in the earlier US study, we also examined the distributive behavior of the European ETR as a function of the BF. Table 4.13 shows the results and Figure 4.6 shows the passenger share of each BF range. The average ETR varies greatly among BF ranges, and takes values from 2.0% to 42.3%. This is because the TTF, which also includes YQYR, does not even double between the lowest and highest BF ranges, while the range of the BF is about 40 times wider. Also note that 62.3% of passengers (those with a BF under $100 and those with BF between $100 and $250) face significantly higher average ETRs than the overall mean of 12.5%. This is because of the distribution of BF, which is highly skewed toward the lower fares with a very long and thin tail into the high fare range as seen in the histogram in Figure 4.7.

Table 4.13: The average ETR for six different ranges of the BF

BF Range (US$)	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	Segments per ticket
BF ≤ 100	90,628	56.76	33.73	6.81	42.3%	1.74
100 < BF ≤ 250	117,760	165.21	42.10	8.74	19.2%	1.98
250 < BF ≤ 500	84,419	360.33	48.74	10.74	10.2%	2.13
500 < BF ≤ 1000	32,333	657.09	57.71	13.75	6.6%	2.18
1000 < BF ≤ 2000	9,407	1,260.64	61.33	15.53	3.6%	2.45
2000 < BF	235	2,305.16	65.28	18.35	2.0%	3.07
All	334,782	264.84	43.57	9.40	12.5%	1.98

Figure 4.6: Passenger share by BF range

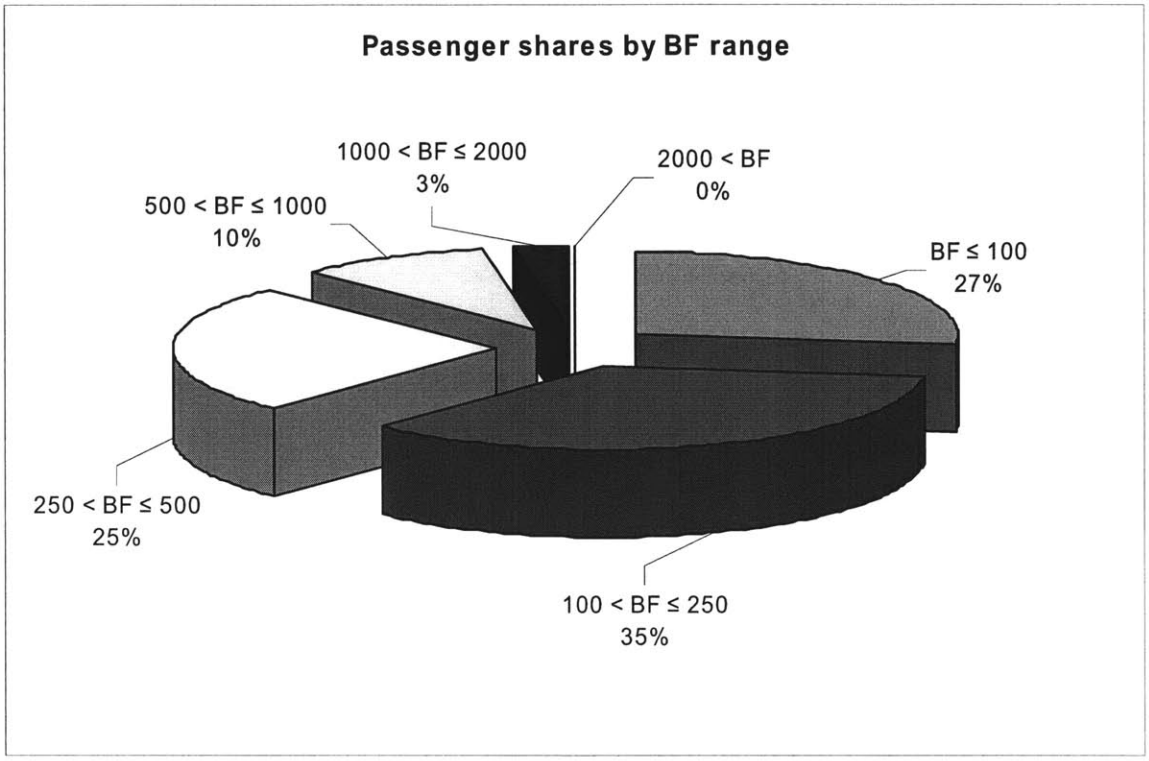
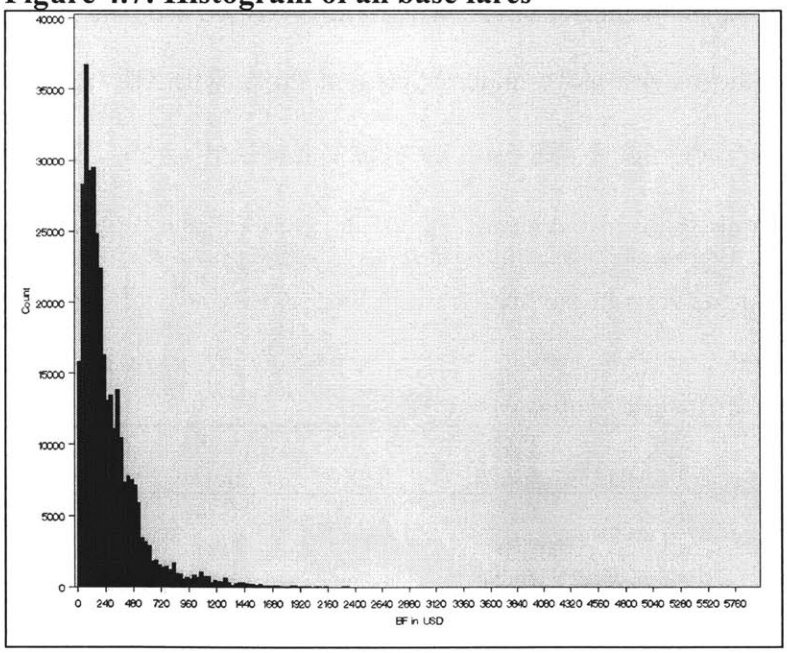


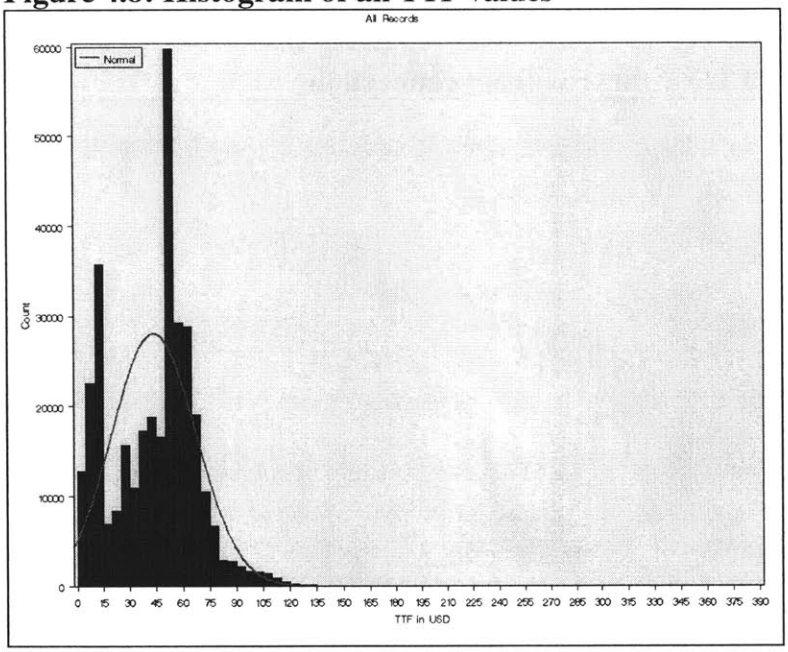
Figure 4.7: Histogram of all base fares



4.3.4 Distributions of TTF

Given the distribution of BF shown in Figure 4.7, we also plotted the distribution of TTF to see if similar characteristics could be observed. Figure 4.8 is a histogram of all TTF values. A Gaussian distribution curve based on the Maximum Likelihood Estimators of μ and σ is added to Figure 4-15 and to subsequent Figures, only for the purpose of emphasizing the strongly multi-modal nature of the TTF histogram.

Figure 4.8: Histogram of all TTF values



Notice that two "peaks" exist in the distribution of TTF. We first hypothesized that the two peaks are present either (1) because the sample includes both one-way and roundtrip tickets or (2) because it includes both connecting and non-connecting itineraries. These effects were explored in three sets of histograms: Figure 4.9 separates one-way and roundtrip tickets, Figure 4.10 separates one-way connecting and non-connecting itineraries, and Figure 4.11 separates roundtrip connecting and non-connecting itineraries. However, two or, in some cases, three peaks continued to appear in all plots.

Figure 4.9: Histograms of one-way and roundtrip TTFs

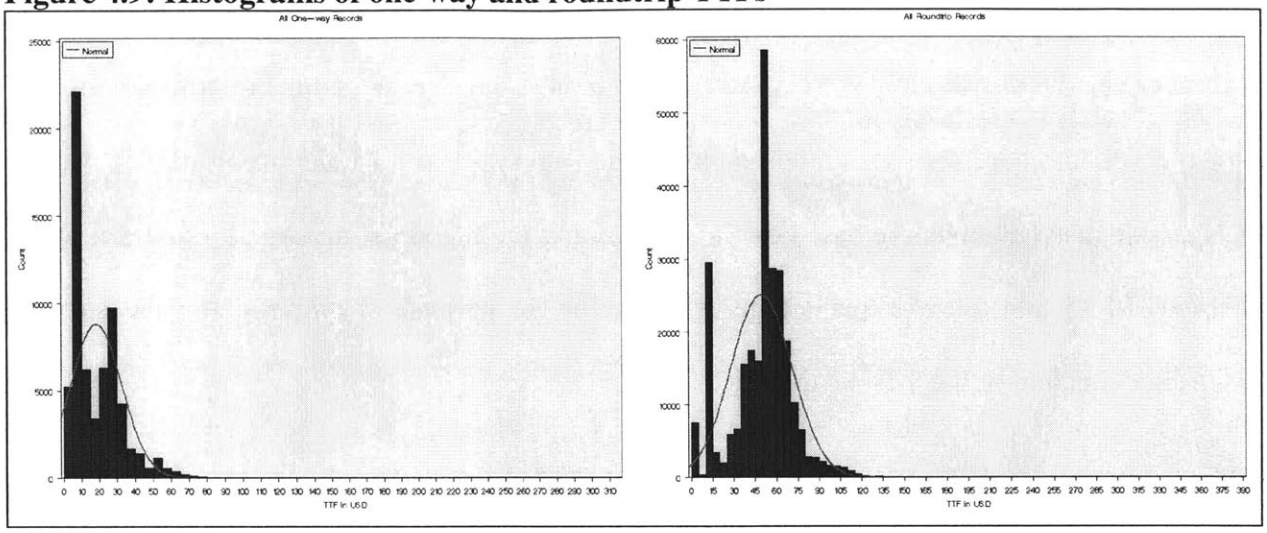


Figure 4.10: Histograms of one-way TTFs with or without connection

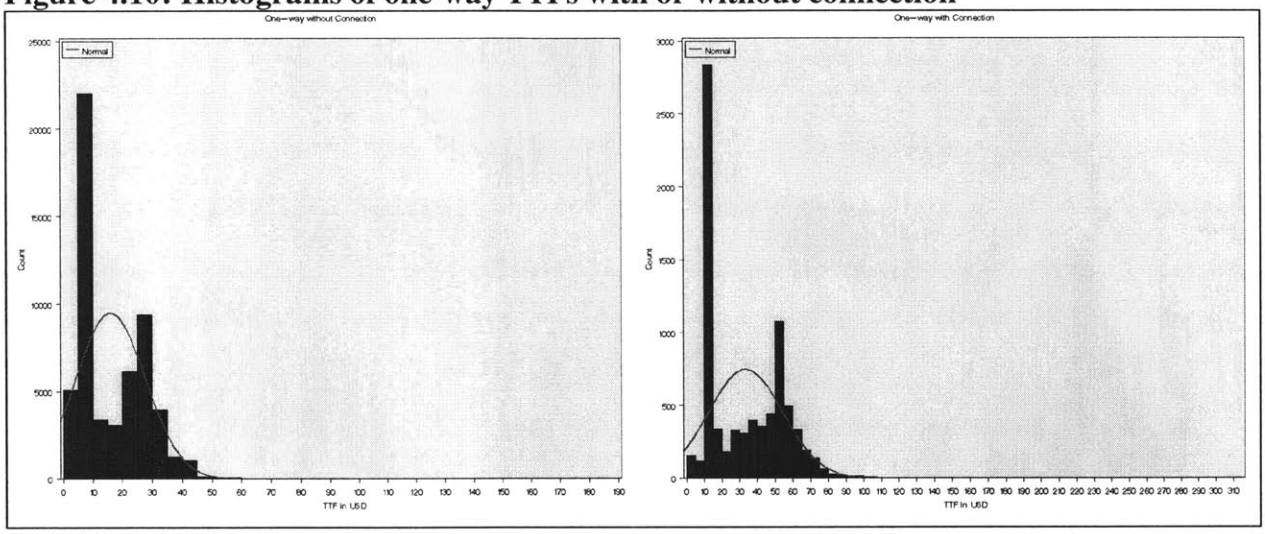
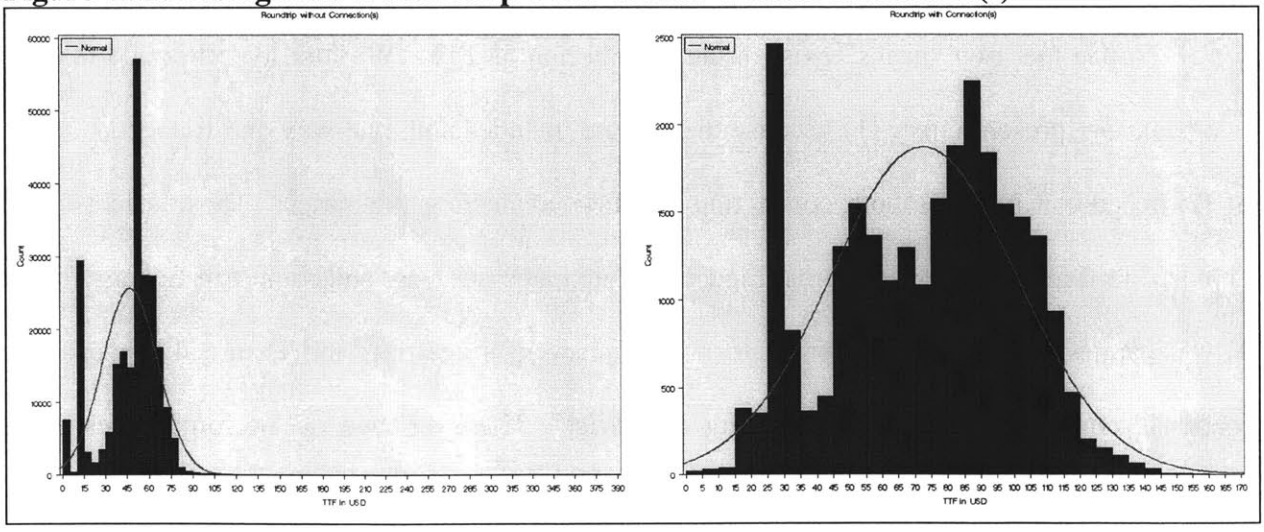
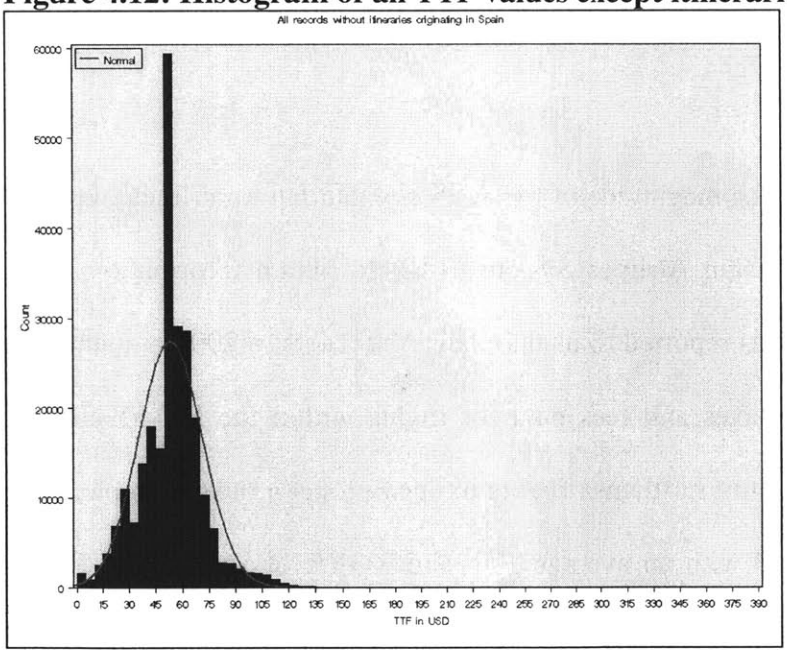


Figure 4.11: Histograms of roundtrip TTFs with or without connection(s)



It seems that the true culprit for the gaps in the distribution of TTF is the great variability in the amount of TTF collected by different countries. Since most taxes and fees levied in the EU only depend on the itinerary and do not depend of the amount of BF, the amount of TTF per ticket falls in a relatively narrow range for each country of origin. The peaks then represent the likely TTF ranges of countries with a large number of tickets in our sample such as Spain, Germany, and France. For instance, Figure 4.12 is a histogram of all TTF values just like Figure 4.8, except that itineraries originating in Spain have been removed. Note how the first peak has been successfully removed.

Figure 4.12: Histogram of all TTF values except itineraries originating in Spain



4.4 Comparison with the US Results

As pointed out in Section 3.2, one major difference between the US and European taxes and fees is that the former covers the cost of Air Navigation Services (ANS) almost entirely through passenger ticket taxes while the latter collects fees from user airlines directly. Since our purpose is to measure the increase in travel cost due to additional charges related to infra-structural costs, this difference in practices must be taken into account. The comparison between US and Europe would be highly inaccurate if it were solely based on the amount paid directly by passengers for ticket taxes and fees. Unfortunately, the lack of a database in Europe similar to Form 41 in the US makes it difficult for us to estimate the amounts paid for European ANS fees by airlines.

In order to get some sense of the magnitude of the ANS cost burden to airlines, we have worked with Lufthansa and Scandinavian Airlines System (SAS) to obtain information about their ANS fee payments. Lufthansa has reported to us that their ANS costs in 2004 amounted to approximately 52.5% of total ticket taxes and fees paid for flights within the EU-15 nations. There were 55,560 tickets involving only Lufthansa flights in our European ticket sample. The average BF among them was $328.33 with an average TTF and YQYR of $63.18 and $21.15 respectively, resulting in a 12.0% ETR. Assuming the same "ANS fee" to "total taxes and fees" ratio as reported by the airline, the estimated ANS payment per ticket is $22.06, computed as 52.5% of the difference between the TTF and the YQYR. For purposes of comparing the ETR for Lufthansa tickets with the ETR on domestic US tickets, this amount of $22.06 has to be subtracted from the BF and added to the TTF, effectively moving the ANS cost burden from the airline to the passengers. As a result, the BF decreases to $306.28 and the TTF increases to

$64.08. The YQ/YR amount is unchanged at $21.15 making the total airline revenue $327.43. Hence, the ETR computed in this manner is 19.6%, which is a sharp increase from the 12.0% ETR that would be obtained without considering the ANS charges.

In view of this considerable increase in the ETR as a result of transferring an infrastructure cost burden from airlines to passengers in Europe, we also tested shifting the Air Carrier Security Fee (ACSF) cost burden in the US from airlines to passengers. ACSF is the fee that airlines pay to the US Department of Homeland Security (DHS) for maintaining the national aviation security infrastructure (Air Transport Association, 2003c). Although the specific amounts paid by individual airlines are considered confidential, the DHS has supplied us with the aggregate figures for 2002 and 2004 as shown in Table 4.14 (Graham, 2005).

Table 4.14: FSSF and ACSF comparison

	Year	
Fee	**2002**	**2004**
Air Carrier Security Fee (airline)	$226,814,975.92	$310,847,685.83
Fdedral Security Service Fee (passenger)	$1,439,503,718.72	$1,818,336,975.20
Total	$1,666,318,694.64	$2,129,184,661.03

Source: DHS, Transportation Security Agency, Office of Revenue

The ACSF represented 13.6% and 14.6% of total air security fees revenue at DHS in 2002 and 2004 respectively. Furthermore, the total amount of ACSF was approximately 15.8% of total FSSF in 2002 and 17.1% in 2004. Applying the 2004 ratio to the second quarter 2004 US results presented in Chapter 3 (c.f. Table 3.5), the estimated ACSF amount is approximately $1.00 per ticket. This amount should be subtracted from the average BF and added to the average TTF in order to estimate the adjusted ETR. The adjusted BF and TTF are $250.43 and $41.57 respectively, leading to a 16.6% ETR. This is approximately 0.5% higher than the original ETR without considering ACSF.

The results obtained through both the ANS fee adjustment for Europe and the ACSF adjustment for the US should be considered preliminary at this point because of the scarce data availability. Moreover, these are not the only types of infrastructure-related costs paid by the airlines. Landing fees and terminal lease or usage fees are just a few examples of the costs not included here for either the US or Europe. According to the Air Transport Association, the amount of landing fees paid by its member airlines in the US averaged at about 2.3% of their total operating cost during the First Quarter of 2004. This percentage might be even higher in EU-15 as the landing fees at major European airports are generally higher than those in the US (ICAO, annual). The purpose of presenting the ANS and ACSF adjustments is to demonstrate that there are different ways to fund air transport infrastructures, and that appropriate adjustments in ETRs are necessary to compare them.

Chapter 5: Conclusion

5.1 Summary of Conclusions

In Chapter 2, we first identified and explained the four types of taxes and fees applicable to airline fares related to domestic travels within the United States. We also introduced the US Department of Transportation 10% ticket sample database (DB1A) which was used to access the actual ticket records of the second quarter 2002, followed by an algorithm for computing the base fare (BF) and total taxes and fees (TTF) from the total fare and itinerary information in the DB1A records. The size of the database which originally contained 4,138,971 records representing 5,290,423 passengers was reduced to 3,315,662 records and 4,280,892 passengers by a four-step filtering process that eliminated tickets with itineraries falling outside of the geographical scope of the study and fares that were deemed either too high or too low. The average effective tax rate (ETR) for the second quarter of 2002 was estimated to be 15.5% with an average BF of $265.54 and an average TTF of $41.10. We also investigated the distributive characteristics of the ETRs as a function of the BF and O-D distance. The former varied from 8.4% in the high fare range to 25.4% in the low fare range. Since the excise tax on airline tickets alone was higher than 8.4% between 1990 and 1997, we concluded that add-on taxes and fees were not among the principal causes of the decline that has been observed in recent years in the demand for high yield tickets. On the other hand, we showed that the ETR varied much less by distance traveled. It ranged only between 13.8% and 16.5% across the various distance ranges and the relationship was not one in which the ETR declined or increased monotonically with distance. The average ETR experienced by travelers on six legacy carriers were compared with those for three low cost carriers (LCC) and were estimated to be 14.6% and 17.1%, respectively.

Finally, an alternative method of measuring the cost increase due to add-on taxes and fees defined as $E\left[\frac{TTF}{BF}\right]$, instead of $\frac{E[TTF]}{E[BF]}$, was examined. We showed that the alternative measurement was systematically biased toward estimating a higher tax rate, due to the non-linear nature of the (1/BF) function.

In Chapter 3, results for the second quarter of 2004 and the second quarter of 1993 were presented to provide a perspective on how the ETR has evolved over the years. Applying the methodology described in Chapter 2, the average ETR in 2004 was estimated to be 16.1% with a BF of $251.43 and a TTF of $40.57. In 1993, the ETR was estimated to be 10.9% with a BF of $337.25 and a TTF of $36.74 in 2004 dollars. (In 2004 dollars, the 2002 BF and TTF would be $278.83 and $43.16 respectively for the same 15.5% ETR.) A striking observation here is that the ETR has been increasing, while the actual average amount of taxes and fees collected per ticket has been declining over the years (in constant prices). This indicates that the increase in ETR is due, in large part, to the decline of the basic fares charged by the airlines. The distribution of the tax rate as a function of BF was also examined for both 2004 and 1993. In 2004, the distribution very much resembled that in 2002, ranging between 8.4% for high fare tickets and 25.3% for low fare tickets. On the other hand, the distribution was much flatter in 1993, ranging just between 10.1% and 11.8%. This is because most of TTF at the time was associated with the Federal Ticket Tax at a rate of 10% of BF, unlike 2002 and 2004 when about half of the TTF did not depend on BF. It was also shown that the ETR gap between the legacy carriers and the LCCs has widened from 14.6% vs. 17.1% in 2002 to 15.0% vs. 18.2% in 2004. Using the 2004 results, we conducted two statistical analyses observing that (a) there was a statistically significant decline in the number of segments per ticket from 2002 to 2004 and (b)

the 95% confidence intervals of the ETRs were so tight due to the large number of samples that the bounds never deviated by more than 0.1% from the mean value for all ticket categories. Finally, the impact of the security fee increase proposed by the Bush Administration in 2005 on the average ETR was estimated to be between +2.2% to +2.6% depending on how the BF would be affected by the security fee increase.

In Chapter 4, preliminary ETR results for the original 15 European Union member countries were presented. For the empirical analysis, we utilized actual ticket records which were collected during a two day period in January 2004 by a Global Distribution System company, Amadeus, S.A. An extensive filtering procedure had to be developed in order to make the data usable for our purpose. For the 334,782 domestic and intra-EU ticket records remaining after applying the filters, the average ETR was estimated to be 12.5% with a BF of $254.84 and a TTF of $43.57. However, the ETR varied greatly among the 15 EU nations. In fact, while several nations had an average ETR in the 12% ~ 16% range, there are countries such as Italy, Luxembourg, Portugal and Spain where the ETR was less than 10% and countries such as Greece, Ireland, and the United Kingdom where the ETR was over 18%. We also discussed possible adjustments in the European ETR in order to make the results more comparable with the average ETR in the United States by accounting for differences in the funding practice for costs related to air transportation infrastructures. A simple analysis showed that the average European ETR might be of the order of 19-20% if the costs of Air Navigation Services, currently charged directly to the airlines, are included.

5.2 Directions for Further Research

For our European study, there is a need for further data analysis involving a larger sample of tickets in order to obtain more conclusive results. In fact, we have been working with Amadeus to collect 15 more days of ticket records. This expanded database is mostly ready for analysis at the moment.

A future critical area for research involves investigating how much of the total ticket cost increases associated with add-on taxes and fees is being absorbed by the airlines. In other words, we are interested in seeing whether the BF level is indeed kept lower because of the carriers' inability to charge their customers fully for the cost of taxes and fees due to the competitive environment. Along similar lines, it is important to examine how passenger demand is affected by the price increases due to the add-on taxes and fees. Specifically, it would be interesting to see if passengers differentiate between increases in the base fare and increases in taxes and fees, or perceive both in the same way.

Finally, this research has the potential to evolve toward policy questions related to efficient charging schemes for covering the costs associated to air transportation infrastructure. This would address, for example, the question of the optimal mix between taxes and fees which are set proportionally to the base fare vs. those which depend on the itinerary or the number of segments or other factors. Questions related to differences in practices across regions (e.g., whether it is best to charge airlines directly for the cost of Air Navigation Services as is done in Europe or charge passengers in the form of taxes and fees, as in the United States) would also be included in this category.

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Appendix A: Difference of Means Test for the Change in Segments per Ticket

The objective here is to compare the average number of segments per ticket in the second quarter 2004 (μ_X) and second quarter 2002 (μ_Y) given $X_1 \ldots Xn$ and $Y_1 \ldots Ym$, each representing segments per ticket data among 2004 and 2002 ticket samples respectively, in order to evaluate whether the decline in the average number of segments is statistically significant.

Relevant statistics for the roundtrip tickets are (see Table 3.11):

$\overline{X} = 1.299$	$\overline{Y} = 1.325$
$S_X^2 = 0.2098$	$S_Y^2 = 0.2194$
n = 7,787,566	m = 7,119,824

For comparing the means, we construct a *t* test with the following hypothesis.

$$H_0 : \mu_X = \mu_Y$$
$$H_1 : \mu_X < \mu_Y$$

The rejection region for such hypothesis is:

$$t < -t_{df}(\alpha) \text{ where } t = \frac{\overline{X} - \overline{Y}}{S_{\overline{X}-\overline{Y}}}$$

Assuming $\sigma_X \neq \sigma_Y$,

$$Var(\overline{X} - \overline{Y}) = \frac{S_X^2}{n} + \frac{S_Y^2}{m} \text{ and } df = \frac{[(S_X^2/n) + (S_Y^2/m)]^2}{\frac{(S_X^2/n)^2}{n-1} + \frac{(S_Y^2/m)^2}{m-1}}.$$

$$S_{\overline{X}-\overline{Y}} = \sqrt{\frac{S_X^2}{n} + \frac{S_Y^2}{m}} = 0.0002403$$

$$df = 14{,}722{,}223$$

$$t = \frac{1.299 - 1.325}{0.0002403} = -107.12$$

$-t_{df}(\alpha) = -1.96$ at $\alpha = 0.05$ and with the above specified *df*

Since $-107.12 < -1.96$, we reject the null hypothesis of equal average number of segments in preference of the fewer number of segments per ticket in 2004. Likewise, the *t* statistic for the one-way tickets is -5.20, and we again reject the null hypothesis.

Appendix B: List of All Tax Codes Appearing in the European Ticket Samples

Occurrence Rank	Tax and Fee Code	Occurrence	Total Amount (US$)	Country	Description
1	YQ	254,878	2,733,720	Airline	Airline own use only
2	FR	170,649	2,161,279	France	Aviation Civile Tax, Corsica Fiscal Tax, Airport Tax
3	RS	105,323	778,123	Spain	Departure Charge
4	QV	105,178	246,729	Spain	Security Tax
5	DE	86,166	1,091,832	Germany	Airport Security Charge
6	UB	66,275	1,238,310	United Kingdom	Passenger Service Charge
7	RD	64,185	1,042,373	Germany	Passenger Service Charge
8	GB	63,327	747,220	United Kingdom	Air Passengers Duty
9	QW	52,621	420,822	France	Passenger Service Charge
10	RA	46,434	567,921	Germany	Passenger Service Charge
11	UI	46,076	96,465	France	VAT Adjustment Tax
12	YR	32,384	414,831	Airline	Airline own use only
13	QX	31,714	256,200	France	Passenger Service Charge
14	IT	27,853	245,507	Italy	Domestic or International Embarkation Tax
15	VT	26,535	73,808	Italy	Security Charge
16	EX	26,389	73,934	Italy	Security Bag Charge
17	YA	16,062	428,193	Sweden	Passenger Charge
18	DQ	12,368	61,769	Finland	Security Charge
19	ZO	11,023	222,267	Denmark	Passenger Charge
20	DK	9,130	140,145	Denmark	Transportation Tax
21	AT	9,097	55,515.95	Austria	Passenger Security Charge
22	ZY	9,066	155,325.39	Austria	Passenger Service Charge
23	CJ	8,602	113,423.55	The Netherlands	Airport Security Charge
24	RN	8,601	126,596.34	The Netherlands	Passenger Service Charge
25	XS	8,374	134,212.67	Sweden	Value Added Tax
26	FN	7,992	14,718.90	Italy	Value Added Tax (Domestic)
27	YF	7,597	111,640.14	Finland	Value Added Tax
28	BE	6,861	180,035.58	Belgium	Embarkation Tax
29	QU	6,783	93,676.43	Finland	Domestic Passenger Fee
30	PT	6,468	23,899.47	Portugal	Security Tax

Occurrence Rank	Tax and Fee Code	Occurrence	Total Amount (US$)	Country	Description
31	YP	6,461	67,526.92	Portugal	Passenger Service Charge
32	VV	5,981	8,748.79	The Netherlands	Noise Isolation Charge
33	FI	5,598	69,728.82	Finland	International Passenger Fee
34	UP	5,028	45,744.91	Ireland	Passenger Charge
35	GR	4,328	75,065.91	Greece	Airport Development Charge
36	WQ	3,616	11,863.44	Greece	Security Charge
37	WP	3,609	47,311.49	Greece	Passenger Terminal Facilities Charge
38	DV	3,347	71,704.56	Reserved	Not to be assigned for industry use.
39	BC	2,910	15,659.90	Ireland	Airport Security Charge
40	DU	2,758	46,681.72	Reserved	Not to be assigned for industry use.
41	XP	2,146	36,389.54	Reserved	PTA (prepaid ticket advice) Service Charge
42	YJ	1,702	1,090.68	Luxembourg	Security Tax
43	LU	1,699	5,367.85	Luxembourg	Departure Tax
44	YO	918	8,493.46	United Kingdom	Isle of Man Passenger Duty
45	XX	737	12,745.01	Poland	Value Added Tax
46	ZX	694	4,526.17	Finland	Transfer Fee
47	FO	189	3,885.24	Faroe Islands	Departure Tax
48	XU	92	849.83	Unknown Tax Code	
49	NL	27	828.33	The Netherlands	Security Tax
50	ES	21	241.82	Spain	Value Added Tax (IVA)
51	XD	18	416.19	Mexico	International Airport Departure Tax
52	WL	10	131.35	Finland	International Transit Passenger Fee
53	XQ	10	68.00	Canada	Quebec Sales Tax
54	TZ	8	104.59	Tanzania	Airport Departure Tax
55	XN	6	391.14	Unknown Tax Code	
56	PK	5	114.87	Pakistan	Domestic Excise Tax
57	SN	5	33.03	Senegal	Fiscal Tax
58	VC	5	24.93	St. Vincent and the Grenadines	Government Tax
59	WD	4	55.39	Jamaica	Travel Tax (International)
60	XA	3	38.61	USA	APHIS User Fee

Occurrence Rank	Tax and Fee Code	Occurrence	Total Amount (US$)	Country	Description
61	BA	2	36.47	Bosnia and Herzegovina	Airport Tax
62	RF	2	18.02	Unknown Tax Code	
63	TS	2	11.13	Thailand	Passenger Service Charge (Domestic)
64	VB	2	6.93	Dominican Rep.	Airport Infrastructure Fee
65	MA	2	4.71	Morocco	Equipment Tax, Passenger Service Charge, Security Tax, Stamp Tax
66	TI	2	3.89	Cote d'Ivoire	Fiscal Stamp Tax
67	XC	1	46.81	Guatemala	Departure Tax (International)
68	AA	1	19.12	Dominican Rep.	International Airport Tax
69	PA	1	16.00	Panama	Tourism Tax
70	US	1	11.75	USA	International or Domestic Transportation Tax
71	RB	1	10.61	Martinique	Passenger Service Charge (International)
72	CO	1	10.19	Colombia	Airport Tax
73	YB	1	8.31	Algeria	Value Added Tax
74	AP	1	6.38	Israel	Security Charge
75	ZL	1	5.70	Angola	Stamp Tax
76	RX	1	5.04	Mali	Tourism Tax
77	RQ	1	4.99	Cote d'Ivoire	Passenger Service Charge (International)
78	QP	1	3.11	Unknown Tax Code	
79	WX	1	2.77	New Zealand	Passenger Levy (Domestic)
80	TN	1	1.69	Tunisia	Fiscal Stamp Tax
81	SE	1	0.00	Unknown Tax Code	
82	UK	1	0.00	Mexico	Tourist Tax

Appendix C: European ETR by Country with One-Way and Roundtrip Breakdown

All Origin-Destination Pairs

Origin Country	Ticket Category	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Austria	**All**	**4,437**	**375.47**	**68.21**	**19.39**	**12.4%**	**2.27**
	One-way	362	337.09	33.88	8.17	7.4%	1.17
	Roundtrip	4,075	378.88	71.26	20.39	12.7%	2.36
Belgium	**All**	**3,289**	**362.19**	**52.38**	**6.00**	**12.6%**	**2.18**
	One-way	383	335.47	33.68	3.97	8.8%	1.16
	Roundtrip	2,906	365.71	54.84	6.27	13.1%	2.32
Denmark	**All**	**6,624**	**357.75**	**65.19**	**12.48**	**14.2%**	**2.11**
	One-way	721	248.27	36.15	5.70	12.0%	1.12
	Roundtrip	5,903	371.13	68.74	13.31	14.4%	2.23
Finland	**All**	**10,240**	**269.72**	**58.70**	**11.46**	**16.8%**	**2.26**
	One-way	974	194.62	33.64	5.86	13.9%	1.18
	Roundtrip	9,266	277.61	61.33	12.05	17.0%	2.38
France	**All**	**67,935**	**344.50**	**51.24**	**9.77**	**11.7%**	**1.97**
	One-way	10,309	211.69	29.82	5.48	11.2%	1.13
	Roundtrip	57,626	368.25	55.07	10.54	11.8%	2.12
Germany	**All**	**71,609**	**306.03**	**56.74**	**17.02**	**12.3%**	**2.06**
	One-way	8,239	256.04	28.28	6.83	8.2%	1.18
	Roundtrip	63,370	312.54	60.44	18.34	12.7%	2.17
Greece	**All**	**2,073**	**203.27**	**47.95**	**8.09**	**18.9%**	**1.79**
	One-way	863	140.64	29.57	4.48	17.3%	1.10
	Roundtrip	1,210	247.93	61.05	10.67	19.5%	2.28
Ireland	**All**	**1,829**	**165.54**	**42.29**	**9.07**	**19.0%**	**2.10**
	One-way	277	127.16	15.79	4.27	8.8%	1.08
	Roundtrip	1,552	172.39	47.01	9.93	20.3%	2.28
Italy	**All**	**12,942**	**291.70**	**39.69**	**14.17**	**8.3%**	**1.94**
	One-way	3,613	168.54	21.53	8.39	7.4%	1.09
	Roundtrip	9,329	339.39	46.72	16.40	8.5%	2.27
Luxembourg	**All**	**1,189**	**350.80**	**37.36**	**13.28**	**6.6%**	**2.13**
	One-way	115	351.10	15.47	7.66	2.2%	1.16
	Roundtrip	1,074	350.77	39.70	13.88	7.1%	2.24
Portugal	**All**	**1,597**	**293.31**	**32.54**	**4.49**	**9.4%**	**2.10**
	One-way	414	281.34	16.83	1.74	5.3%	1.24
	Roundtrip	1,183	297.50	38.04	5.45	10.8%	2.40
Spain	**All**	**85,797**	**195.56**	**14.94**	**1.02**	**7.1%**	**1.81**
	One-way	31,553	122.80	7.89	0.41	6.1%	1.12
	Roundtrip	54,244	237.88	19.04	1.37	7.4%	2.22
Sweden	**All**	**13,169**	**310.73**	**58.88**	**12.49**	**14.4%**	**2.21**
	One-way	1,700	192.19	31.43	5.23	13.3%	1.16
	Roundtrip	11,469	328.30	62.95	13.57	14.4%	2.36
The Netherlands	**All**	**3,231**	**351.77**	**58.17**	**7.00**	**14.3%**	**2.22**
	One-way	343	308.99	34.56	3.32	10.0%	1.13
	Roundtrip	2,888	356.85	60.98	7.43	14.7%	2.35
United Kingdom	**All**	**48,821**	**163.15**	**51.26**	**9.14**	**24.4%**	**2.01**
	One-way	3,822	120.07	26.92	4.48	18.0%	1.04
	Roundtrip	44,999	166.81	53.33	9.54	24.8%	2.09

Domestic Origin-Destination Pairs

Origin Country	Ticket Category	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Austria	**All**	**384**	**248.23**	**53.59**	**15.87**	**14.3%**	**1.86**
	One-Way	60	177.11	30.00	7.75	12.0%	1.05
	Roundtrip	324	261.39	57.96	17.38	14.6%	2.01
Denmark	**All**	**2,339**	**214.57**	**58.97**	**9.38**	**22.1%**	**1.87**
	One-Way	402	159.31	32.02	4.96	16.5%	1.04
	Roundtrip	1,937	226.03	64.56	10.30	23.0%	2.04
Finland	**All**	**6,137**	**186.79**	**57.96**	**10.23**	**24.2%**	**2.02**
	One-Way	686	150.81	36.47	5.70	19.7%	1.15
	Roundtrip	5,451	191.32	60.66	10.80	24.7%	2.13
France	**All**	**51,479**	**279.84**	**50.23**	**9.38**	**14.1%**	**1.89**
	One-Way	8,769	178.12	29.00	5.31	12.9%	1.10
	Roundtrip	42,710	300.72	54.59	10.22	14.3%	2.05
Germany	**All**	**44,998**	**254.77**	**54.09**	**15.94**	**14.1%**	**1.89**
	One-Way	5,869	207.80	26.25	6.04	9.5%	1.10
	Roundtrip	39,129	261.82	58.26	17.43	14.6%	2.01
Greece	**All**	**1,159**	**121.24**	**37.98**	**4.57**	**26.6%**	**1.53**
	One-Way	572	78.07	24.96	3.07	27.0%	1.02
	Roundtrip	587	163.30	50.66	6.04	26.4%	2.01
Ireland	**All**	**45**	**132.47**	**20.85**	**2.82**	**13.3%**	**1.78**
	One-Way	10	61.59	12.68	2.20	16.4%	1.00
	Roundtrip	35	152.73	23.19	3.00	13.0%	2.00
Italy	**All**	**8,024**	**201.45**	**32.91**	**12.71**	**9.4%**	**1.69**
	One-Way	3,087	127.59	20.67	8.25	9.1%	1.06
	Roundtrip	4,937	247.64	40.56	15.50	9.5%	2.08
Portugal	**All**	**491**	**170.87**	**22.94**	**0.00**	**13.4%**	**1.98**
	One-Way	116	123.69	14.05	0.00	11.4%	1.20
	Roundtrip	375	185.47	25.69	0.00	13.9%	2.22
Spain	**All**	**69,957**	**159.33**	**10.90**	**0.02**	**6.8%**	**1.72**
	One-Way	28,706	110.20	7.23	0.03	6.5%	1.10
	Roundtrip	41,251	193.53	13.46	0.01	6.9%	2.14
Sweden	**All**	**8,397**	**231.82**	**55.35**	**10.49**	**18.5%**	**1.99**
	One-Way	1,371	149.91	30.51	4.29	17.0%	1.12
	Roundtrip	7,026	247.80	60.20	11.70	18.7%	2.16
The Netherlands	**All**	**9**	**170.42**	**56.11**	**6.82**	**27.8%**	**1.78**
	One-Way	2	103.42	30.83	3.83	25.2%	1.00
	Roundtrip	7	189.57	63.33	7.67	28.2%	2.00
United Kingdom	**All**	**19,282**	**130.48**	**49.44**	**8.47**	**29.5%**	**1.89**
	One-Way	2,522	113.33	24.74	4.40	17.3%	1.02
	Roundtrip	16,760	133.07	53.15	9.09	31.0%	2.02

Note: No domestic records were found for Belgium and Luxembourg.

Intra-EU Origin-Destination Pairs

Origin Country	Ticket Category	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Austria	**All**	**4,053**	**387.53**	**69.60**	**19.73**	**12.2%**	**2.30**
	One-way	302	368.87	34.65	8.25	7.0%	1.20
	Roundtrip	3,751	389.03	72.41	20.65	12.6%	2.39
Belgium	**All**	**3,289**	**362.19**	**52.38**	**6.00**	**12.6%**	**2.18**
	One-way	383	335.47	33.68	3.97	8.8%	1.16
	Roundtrip	2,906	365.71	54.84	6.27	13.1%	2.32
Denmark	**All**	**4,285**	**435.91**	**68.58**	**14.17**	**12.1%**	**2.24**
	One-way	319	360.37	41.34	6.62	9.5%	1.23
	Roundtrip	3,966	441.99	70.78	14.78	12.3%	2.33
Finland	**All**	**4,103**	**393.76**	**59.81**	**13.30**	**11.4%**	**2.62**
	One-way	288	298.96	26.88	6.23	6.8%	1.24
	Roundtrip	3,815	400.92	62.29	13.83	11.7%	2.73
France	**All**	**16,456**	**546.77**	**54.38**	**10.99**	**7.8%**	**2.21**
	One-way	1,540	402.85	34.49	6.45	6.9%	1.29
	Roundtrip	14,916	561.63	56.43	11.46	7.8%	2.31
Germany	**All**	**26,611**	**392.72**	**61.24**	**18.83**	**10.3%**	**2.35**
	One-way	2,370	375.50	33.32	8.79	6.4%	1.36
	Roundtrip	24,241	394.40	63.96	19.81	10.7%	2.44
Greece	**All**	**914**	**307.29**	**60.59**	**12.56**	**15.0%**	**2.12**
	One-way	291	263.65	38.64	7.25	11.6%	1.26
	Roundtrip	623	327.67	70.84	15.04	16.3%	2.52
Ireland	**All**	**1,784**	**166.38**	**42.83**	**9.23**	**19.1%**	**2.11**
	One-way	267	129.62	15.91	4.35	8.6%	1.08
	Roundtrip	1,517	172.85	47.56	10.09	20.5%	2.29
Italy	**All**	**4,918**	**438.93**	**50.75**	**16.54**	**7.5%**	**2.35**
	One-way	526	408.86	26.57	9.22	4.1%	1.28
	Roundtrip	4,392	442.53	53.65	17.42	7.9%	2.47
Luxembourg	**All**	**1,189**	**350.80**	**37.36**	**13.28**	**6.6%**	**2.13**
	One-way	115	351.10	15.47	7.66	2.2%	1.16
	Roundtrip	1,074	350.77	39.70	13.88	7.1%	2.24
Portugal	**All**	**1,106**	**347.66**	**36.81**	**6.48**	**8.6%**	**2.15**
	One-way	298	342.71	17.91	2.41	4.5%	1.26
	Roundtrip	808	349.49	43.78	7.98	10.0%	2.48
Spain	**All**	**15,840**	**355.54**	**32.77**	**5.41**	**7.6%**	**2.24**
	One-way	2,847	249.78	14.54	4.24	4.1%	1.31
	Roundtrip	12,993	378.71	36.76	5.66	8.1%	2.44
Sweden	**All**	**4,772**	**449.58**	**65.10**	**16.01**	**10.5%**	**2.59**
	One-way	329	368.37	35.26	9.13	6.9%	1.31
	Roundtrip	4,443	455.59	67.31	16.52	10.8%	2.68
The Netherlands	**All**	**3,222**	**352.28**	**58.18**	**7.00**	**14.2%**	**2.22**
	One-way	341	310.20	34.58	3.32	10.0%	1.13
	Roundtrip	2,881	357.26	60.97	7.43	14.7%	2.35
United Kingdom	**All**	**29,539**	**184.47**	**52.45**	**9.58**	**22.1%**	**2.09**
	One-way	1,300	133.15	31.15	4.65	19.2%	1.07
	Roundtrip	28,239	186.84	53.44	9.81	22.2%	2.14

Appendix D: Average ETR in All European Domestic and Intra-EU O-D Pairs

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Austria	Austria	392	253.14	54.11	15.96	14.2%	1.86
Austria	Belgium	253	389.82	70.69	16.92	13.2%	2.09
Austria	Denmark	58	554.06	87.34	22.57	11.2%	2.69
Austria	Finland	49	364.21	65.82	18.50	12.4%	2.37
Austria	France	340	435.66	80.57	22.86	12.6%	2.54
Austria	Germany	1,774	417.67	64.12	18.04	10.6%	2.02
Austria	Greece	94	371.79	79.36	20.89	14.9%	2.18
Austria	Ireland	28	269.59	71.48	19.97	17.8%	2.57
Austria	Italy	296	357.12	63.16	21.75	10.9%	2.28
Austria	Luxembourg	35	648.53	67.62	23.50	6.6%	2.60
Austria	Portugal	56	362.56	86.31	33.64	13.3%	3.32
Austria	Spain	425	291.31	66.11	20.88	14.5%	3.02
Austria	Sweden	51	574.81	84.19	22.38	10.3%	2.75
Austria	The Netherlands	123	382.78	78.91	19.64	14.7%	2.33
Austria	United Kingdom	463	297.32	79.22	20.35	18.5%	2.47
Belgium	Austria	213	329.44	68.78	17.24	14.9%	2.29
Belgium	Belgium	6	338.57	60.09	11.69	13.8%	2.00
Belgium	Denmark	125	342.13	56.91	2.94	15.6%	1.95
Belgium	Finland	88	443.12	50.37	6.93	9.7%	2.40
Belgium	France	276	446.50	50.27	3.06	10.5%	1.89
Belgium	Germany	578	490.46	60.17	14.83	9.0%	1.92
Belgium	Greece	53	282.77	65.07	8.23	19.5%	2.45
Belgium	Ireland	56	241.68	49.02	8.26	16.3%	2.02
Belgium	Italy	386	330.46	47.19	6.26	12.2%	2.29
Belgium	Luxembourg	2	929.93	47.61	11.49	3.8%	2.00
Belgium	Portugal	92	390.98	42.98	0.00	11.0%	2.41
Belgium	Spain	537	302.01	39.25	0.36	12.9%	2.84
Belgium	Sweden	77	542.18	53.54	2.44	9.4%	2.22
Belgium	The Netherlands	12	358.96	67.24	15.33	13.9%	1.92
Belgium	United Kingdom	788	289.87	54.05	2.16	17.8%	1.93
Denmark	Austria	76	551.46	95.60	22.88	12.7%	3.20
Denmark	Belgium	269	395.82	65.19	8.28	14.1%	2.09
Denmark	Denmark	2,339	214.57	58.97	9.38	22.1%	1.87
Denmark	Finland	187	545.83	64.90	13.56	9.2%	2.44
Denmark	France	531	368.92	71.42	13.81	15.1%	2.28
Denmark	Germany	640	585.93	67.99	14.38	8.9%	2.15
Denmark	Greece	139	337.78	83.15	18.10	18.3%	2.14
Denmark	Ireland	80	678.70	61.03	13.63	6.8%	2.33
Denmark	Italy	282	430.49	67.30	19.21	10.7%	2.43
Denmark	Luxembourg	28	458.27	46.63	11.97	7.4%	1.86
Denmark	Portugal	85	403.11	72.14	23.47	11.4%	2.54
Denmark	Spain	345	374.13	61.95	18.03	11.2%	2.52
Denmark	Sweden	698	347.30	62.58	11.07	14.4%	2.05
Denmark	The Netherlands	249	462.58	74.02	14.80	12.4%	2.11
Denmark	United Kingdom	676	429.19	72.73	12.84	13.5%	2.22

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Finland	Austria	173	382.33	70.89	15.90	13.8%	2.96
Finland	Belgium	227	615.02	59.80	11.35	7.7%	2.53
Finland	Denmark	399	427.67	66.14	11.79	12.4%	2.55
Finland	Finland	6,142	187.00	57.95	10.23	24.2%	2.02
Finland	France	391	390.73	62.40	14.36	11.9%	2.75
Finland	Germany	953	379.05	56.20	13.95	10.8%	2.58
Finland	Greece	15	562.00	87.88	19.62	11.7%	3.87
Finland	Ireland	52	358.99	65.84	15.07	13.6%	3.35
Finland	Italy	263	387.43	65.22	18.69	11.5%	3.19
Finland	Luxembourg	10	1,265.38	73.34	32.74	3.1%	3.80
Finland	Portugal	18	575.21	59.43	15.76	7.4%	3.61
Finland	Spain	172	414.04	58.58	19.47	9.0%	3.16
Finland	Sweden	940	322.72	52.04	9.91	12.7%	2.21
Finland	The Netherlands	121	419.10	70.86	13.55	13.2%	2.59
Finland	United Kingdom	364	400.22	65.08	12.78	12.7%	2.75
France	Austria	364	649.78	66.34	14.91	7.7%	2.35
France	Belgium	287	558.64	53.35	5.48	8.5%	1.95
France	Denmark	248	718.11	69.46	12.15	7.8%	2.44
France	Finland	244	446.16	55.59	15.94	8.6%	2.39
France	France	51,612	280.92	50.24	9.38	14.1%	1.89
France	Germany	3,522	656.70	59.46	13.67	6.8%	2.17
France	Greece	295	594.44	71.80	12.11	9.8%	2.47
France	Ireland	267	292.52	54.62	10.76	14.5%	2.26
France	Italy	2,703	614.15	51.18	11.77	6.3%	2.26
France	Luxembourg	146	597.66	39.08	10.34	4.7%	2.03
France	Portugal	1,035	366.88	44.99	6.79	10.2%	2.21
France	Spain	3,536	489.83	42.77	9.79	6.6%	2.32
France	Sweden	202	845.08	63.71	12.86	5.9%	2.50
France	The Netherlands	643	583.39	64.70	10.58	9.1%	2.15
France	United Kingdom	2,831	441.42	62.22	9.49	11.7%	2.04
Germany	Austria	2,684	425.28	63.25	20.14	9.7%	2.13
Germany	Belgium	832	560.49	58.12	14.14	7.7%	1.97
Germany	Denmark	435	665.59	67.83	16.95	7.5%	2.13
Germany	Finland	604	558.48	56.75	16.34	7.0%	2.80
Germany	France	4,014	416.09	62.00	17.28	10.3%	2.23
Germany	Germany	45,459	258.23	54.15	15.95	13.9%	1.89
Germany	Greece	994	330.65	63.80	16.57	13.6%	2.31
Germany	Ireland	490	318.26	66.17	14.76	15.4%	2.57
Germany	Italy	3,600	384.95	66.66	26.47	9.8%	2.80
Germany	Luxembourg	112	574.66	52.10	20.64	5.3%	2.46
Germany	Portugal	795	399.23	64.09	22.13	10.0%	2.76
Germany	Spain	5,035	287.58	48.02	17.72	9.9%	2.43
Germany	Sweden	529	751.33	72.74	23.21	6.4%	2.84
Germany	The Netherlands	570	527.13	70.69	21.40	9.0%	2.01
Germany	United Kingdom	5,456	343.29	65.61	16.16	13.8%	2.13

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Greece	Austria	26	287.10	71.10	17.32	17.7%	2.08
Greece	Belgium	40	281.02	56.41	7.19	17.1%	1.78
Greece	Denmark	7	468.08	88.00	20.19	13.9%	2.57
Greece	Finland	5	335.03	90.65	42.53	12.7%	3.60
Greece	France	142	375.43	72.22	13.22	15.2%	2.40
Greece	Germany	308	247.32	52.97	11.62	16.0%	1.91
Greece	Greece	1,162	121.70	38.00	4.57	26.5%	1.53
Greece	Ireland	3	211.55	113.02	34.08	32.1%	4.00
Greece	Italy	155	292.76	53.56	10.59	14.2%	2.06
Greece	Luxembourg	12	391.34	56.77	16.90	9.8%	2.25
Greece	Portugal	6	729.15	80.10	23.82	7.5%	3.33
Greece	Spain	82	376.31	55.69	11.48	11.4%	2.29
Greece	Sweden	7	338.90	70.33	21.94	13.4%	2.57
Greece	The Netherlands	33	290.78	62.22	14.21	15.7%	1.70
Greece	United Kingdom	85	340.05	77.43	14.84	17.6%	2.38
Ireland	Austria	1	448.58	58.70	11.99	10.1%	3.00
Ireland	Belgium	15	267.07	41.92	6.94	12.8%	1.73
Ireland	Denmark	12	366.83	48.54	11.82	9.7%	2.08
Ireland	Finland	20	365.79	63.00	18.08	11.7%	3.15
Ireland	France	271	206.69	45.53	9.84	16.5%	2.13
Ireland	Germany	62	425.68	64.32	17.54	10.6%	2.47
Ireland	Greece	7	411.35	93.60	16.16	18.1%	4.00
Ireland	Ireland	46	133.83	21.46	2.94	13.5%	1.78
Ireland	Italy	39	280.94	59.32	12.12	16.1%	3.38
Ireland	Luxembourg	5	225.44	30.27	11.47	7.9%	1.80
Ireland	Portugal	5	473.07	56.02	10.49	9.4%	2.80
Ireland	Spain	188	318.80	44.02	13.37	9.2%	3.05
Ireland	Sweden	19	381.56	65.41	18.32	11.8%	3.42
Ireland	The Netherlands	15	246.75	63.89	10.15	20.9%	2.53
Ireland	United Kingdom	1,124	97.71	38.81	7.45	29.8%	1.83
Italy	Austria	158	400.64	60.33	21.63	9.2%	2.25
Italy	Belgium	185	539.56	51.70	12.46	7.1%	2.17
Italy	Denmark	57	591.01	67.57	14.75	8.7%	2.88
Italy	Finland	28	681.97	58.87	21.24	5.4%	3.18
Italy	France	1,019	490.66	49.26	13.21	7.2%	2.10
Italy	Germany	1,078	496.45	62.05	23.78	7.4%	2.55
Italy	Greece	116	422.00	67.14	20.06	10.7%	2.93
Italy	Ireland	33	261.24	51.29	15.54	12.9%	2.73
Italy	Italy	8,063	203.57	32.97	12.71	9.4%	1.69
Italy	Luxembourg	43	548.77	40.48	16.26	4.3%	2.35
Italy	Portugal	84	342.82	48.01	17.83	8.4%	2.65
Italy	Spain	1,211	375.20	38.26	15.83	5.7%	2.41
Italy	Sweden	39	694.68	66.20	15.69	7.1%	3.46
Italy	The Netherlands	163	435.35	59.94	17.52	9.4%	2.09
Italy	United Kingdom	665	331.22	48.41	10.39	11.1%	2.13

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Luxembourg	Austria	65	423.77	49.54	18.82	6.9%	2.32
Luxembourg	Belgium	1	1,363.58	25.32	14.02	0.8%	2.00
Luxembourg	Denmark	31	350.77	43.03	11.93	8.6%	1.87
Luxembourg	Finland	5	1,137.74	74.19	31.41	3.7%	4.00
Luxembourg	France	140	396.23	36.10	10.24	6.4%	1.96
Luxembourg	Germany	197	421.40	43.56	17.20	6.0%	2.23
Luxembourg	Greece	39	233.15	51.32	14.86	14.7%	2.15
Luxembourg	Ireland	28	232.98	32.45	12.98	7.9%	2.07
Luxembourg	Italy	109	407.70	32.68	15.21	4.1%	2.15
Luxembourg	Portugal	205	276.40	27.66	10.88	5.8%	2.15
Luxembourg	Spain	156	339.64	23.91	11.92	3.4%	2.11
Luxembourg	Sweden	20	492.92	55.83	20.17	7.0%	2.70
Luxembourg	The Netherlands	17	506.11	52.31	15.09	7.1%	1.88
Luxembourg	United Kingdom	176	255.56	45.21	10.51	13.0%	2.05
Portugal	Austria	45	352.32	62.21	23.12	10.4%	2.31
Portugal	Belgium	14	592.07	35.20	0.00	5.9%	1.93
Portugal	Denmark	5	293.74	61.44	17.10	14.3%	2.00
Portugal	Finland	2	1,058.74	69.91	30.60	3.6%	3.00
Portugal	France	156	282.04	40.14	4.15	12.6%	2.04
Portugal	Germany	175	403.95	62.30	21.59	9.6%	2.70
Portugal	Greece	5	484.14	55.82	4.09	10.6%	3.20
Portugal	Ireland	2	229.39	38.72	8.00	12.9%	2.00
Portugal	Italy	29	377.65	58.54	15.40	11.0%	3.62
Portugal	Luxembourg	19	228.76	27.14	8.19	8.0%	2.00
Portugal	Portugal	499	171.88	23.17	0.02	13.5%	1.98
Portugal	Spain	461	353.84	18.87	0.29	5.2%	1.84
Portugal	Sweden	2	575.53	45.82	7.96	6.5%	2.00
Portugal	The Netherlands	26	609.18	34.13	1.09	5.4%	1.77
Portugal	United Kingdom	157	267.13	46.23	4.62	15.3%	2.31
Spain	Austria	238	416.74	43.86	5.36	9.1%	3.05
Spain	Belgium	524	470.33	35.14	0.46	7.4%	2.43
Spain	Denmark	115	450.62	58.75	11.02	10.3%	2.97
Spain	Finland	76	491.00	46.74	14.23	6.4%	2.87
Spain	France	3,247	423.26	37.98	8.88	6.7%	2.09
Spain	Germany	3,937	327.15	33.65	9.23	7.3%	2.12
Spain	Greece	149	536.07	42.15	3.13	7.2%	2.48
Spain	Ireland	301	305.61	33.17	8.58	7.8%	2.35
Spain	Italy	2,528	333.98	26.30	3.16	6.9%	2.53
Spain	Luxembourg	100	483.62	22.15	8.94	2.7%	2.10
Spain	Portugal	1,256	394.15	20.18	0.29	5.0%	2.22
Spain	Spain	70,043	159.89	10.93	0.03	6.8%	1.72
Spain	Sweden	106	370.38	42.24	11.85	7.9%	2.49
Spain	The Netherlands	716	303.38	42.82	1.81	13.4%	2.56
Spain	United Kingdom	2,461	270.63	30.85	0.53	11.2%	2.03

Origin Country	Destination Country	No. of tickets in sample	BF (US$)	TTF (US$)	YQYR (US$)	ETR	No. of segments per ticket
Sweden	Austria	73	504.26	82.42	24.43	11.0%	3.34
Sweden	Belgium	234	434.74	56.01	8.07	10.8%	2.08
Sweden	Denmark	753	316.95	62.99	12.14	15.4%	2.07
Sweden	Finland	784	368.70	55.66	13.22	11.1%	2.21
Sweden	France	413	456.28	71.65	17.69	11.4%	2.79
Sweden	Germany	714	745.38	70.24	20.56	6.5%	2.81
Sweden	Greece	46	418.28	100.05	27.39	16.3%	3.87
Sweden	Ireland	44	513.51	58.41	18.97	7.4%	2.77
Sweden	Italy	260	554.50	75.68	24.48	8.8%	3.53
Sweden	Luxembourg	16	484.07	50.08	18.23	6.3%	2.69
Sweden	Portugal	65	517.12	72.37	17.30	10.3%	3.35
Sweden	Spain	486	323.67	60.60	17.99	12.5%	3.41
Sweden	Sweden	8,413	232.70	55.35	10.50	18.4%	1.99
Sweden	The Netherlands	190	494.99	70.44	16.72	10.5%	2.38
Sweden	United Kingdom	678	396.15	65.87	13.61	12.8%	2.31
The Netherlands	Austria	99	496.93	64.74	11.31	10.5%	2.23
The Netherlands	Belgium	1	277.07	64.62	7.66	20.0%	2.00
The Netherlands	Denmark	121	501.59	68.87	8.34	11.9%	2.13
The Netherlands	Finland	78	547.74	63.18	14.30	8.7%	3.08
The Netherlands	France	334	426.69	61.20	8.86	12.0%	1.96
The Netherlands	Germany	426	463.79	60.23	10.58	10.5%	1.97
The Netherlands	Greece	63	435.11	67.11	7.64	13.4%	2.33
The Netherlands	Ireland	95	238.37	59.70	7.50	21.2%	2.11
The Netherlands	Italy	139	544.22	52.38	6.73	8.3%	2.25
The Netherlands	Luxembourg	7	511.48	46.31	6.56	7.7%	1.71
The Netherlands	Portugal	87	373.31	50.68	3.49	12.5%	2.38
The Netherlands	Spain	620	261.65	50.15	7.63	15.8%	2.78
The Netherlands	Sweden	148	467.02	72.62	10.14	13.1%	3.01
The Netherlands	The Netherlands	13	278.30	55.10	7.47	16.7%	1.85
The Netherlands	United Kingdom	1,000	246.87	57.66	3.08	21.8%	1.88
United Kingdom	Austria	595	186.45	62.40	11.83	25.5%	2.23
United Kingdom	Belgium	837	216.55	59.61	8.35	22.8%	1.96
United Kingdom	Denmark	438	252.95	66.30	11.42	20.8%	2.09
United Kingdom	Finland	245	300.99	58.04	12.45	14.5%	2.51
United Kingdom	France	5,365	153.58	60.79	9.59	31.4%	2.09
United Kingdom	Germany	3,938	227.64	58.89	10.22	20.5%	2.07
United Kingdom	Greece	557	252.66	69.87	10.11	22.7%	2.20
United Kingdom	Ireland	2,121	101.68	43.10	8.57	31.3%	1.93
United Kingdom	Italy	3,744	188.49	47.82	9.29	19.5%	2.16
United Kingdom	Luxembourg	72	253.94	41.52	10.78	11.6%	1.96
United Kingdom	Portugal	1,426	246.55	48.41	7.50	16.1%	2.17
United Kingdom	Spain	7,738	190.14	42.07	9.80	16.1%	2.10
United Kingdom	Sweden	388	324.47	66.13	12.30	16.0%	2.39
United Kingdom	The Netherlands	2,063	106.65	62.03	9.00	45.9%	1.94
United Kingdom	United Kingdom	19,294	130.55	49.44	8.47	29.5%	1.89

498-95