ABSTRACT

Title of Document: The Impact of Airline and Customer Characteristics on Airline and Airport Choice

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The customer choice of a particular air flight is composed of two choice decisions in a multi airport region. The customer chooses the airline and the airport that best meets their needs. This dissertation is composed of two essays. The first essay examines the airline choice decision and the second essay investigates the airport choice decision.

In the first essay the focus is the impact of airline operational quality among airline characteristics. This may include nonstop flight services, service frequency, on-time operations, etc. These factors contribute to the overall utility of airline service. Improvements in operational quality can lead to increases in reliability and convenience. As a result customers will choose airlines that offer higher levels of operational quality.

Particularly, some customers are more sensitive to operational quality based on their unique characteristics and tend to have stronger preference for the airlines that provide higher levels of operational quality.

This essay examines the following three issues; (1) the impact of operational quality on customer's choice of airline, (2) the moderating role of operations exposure (i.e., the extent to which customers are exposed to service operations) on customer choice, and (3) the moderating effect of customer characteristics on operational quality.

The second essay looks at the impact of Low Cost Carrier (LCC) presence at airports and focuses on the following issues: (1) the impact of LCC presence on a route (after controlling for the impact of fares and service frequencies) on a customer's choice of airport, (2) the moderating effect of customer demographic characteristics on airline characteristics, and (3) the moderating role of the customer's geographical location on a customer's choice of airport.

Both of these essays will utilize survey data collected from the customers departing from the three airports in the Washington Metropolitan Area. This data includes customers' choice of airline and airport along with extensive information on each customer including trip related information and demographic information.

The Impact of Airline and Customer Characteristics on Airline and Airport Choice

By

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Dedication

To God: Without the strength, wisdom, and grace bestowed upon me by God, this dissertation would not have been possible.

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Chapter 1 Overall Introduction

1.1 Introduction

The customer choice of a particular air flight is composed of two choice decisions in a multi airport region. The customer chooses the airline and the airport that best meets their needs. In this dissertation I investigate the impact of airline characteristics on a customer's choice. Among airline characteristics, the first essay focuses on airline operational quality and its impact on the airline choice decision. The second essay focuses on the impact of Low Cost Carrier (LCC) presence on the airport choice decision.

1.1.1 Airline Choice

1.1.1.1 Airline Operational Quality

The operational quality of airlines significantly impacts the customer's choice of airline. Operational quality refers to service providers' performance that contributes to the utilities of the service such as time and place (Schlesinger and Heskett, 1991; Stank et al., 1999). Airline operational quality may include flight frequency, nonstop flight services and on-time operations. Improvements in operational quality lead to increases in reliability and convenience. As a result customers will choose airlines that offer higher levels of operational quality. In addition to the level of operational quality provided, another factor that influences the overall customer experience is the extent to which they are exposed to operations. The greater the degree of exposure to operations is, the greater the chance that a customer will have a bad experience when the operational quality of the service is unreliable and inconvenient. The first part of this dissertation will examine the impact of *operational quality and operations exposure* in the customer's airline choice.

1.1.1.2 Operations Exposure

The impact of operational quality may be moderated by the extent to which customers are exposed to the service provider's operations. In the air transportation industry, not all customers are exposed to all aspects of the airline's operations. For instance, customers who check bags are exposed to the operations of the airline related to baggage handling, while those with only carry-on luggage will not experience this part of the airline's operation. It is also the case that customers traveling with more companions (i.e. young children, senior parents or business partners) are exposed to airline operations with more service users, resulting in experience of a higher cost in the event of a service failure. As a result these customers might either seek to minimize their exposure with potentially costly airline operations or might view operational quality as a more critical determinant in choosing an airline.

1.1.2 Airport Choice

1.1.2.1 LCC Presence Impact at Airports

Further, past research has shown that airport choice is heavily dependent on the following factors: airline characteristics (i.e., fare, flight frequency) and airport characteristics (i.e., accessibility). However, the customer's airport choice may also be impacted by additional airline characteristic. This dissertation will examine the role of airlines (in particular *Low Cost Carriers*) that offer unique features on the airport choice decision.

Airline characteristics are significantly dependent on the way that airlines choose to conduct operations. One clearly distinguished operation strategy is referred to as the 'focus' strategy. The focus strategy refers to the simplification of various production processes. It involves such simplicity in operations as shortened aircraft turnaround process (minimized in-flight services, fewer seat classes and fewer plane types) and simplified point to point network operations. This strategy is most often used by the so called low cost carriers (LCCs) because the focus strategy has generally enabled most LCCs to maintain low operation costs, resulting in low fares. In fact, Hofer et al. (2008) distinguish low cost carriers from legacy carriers, which are mainly operate through the hub and spoke legacy, based on the operating cost per available seat mile (this dissertation uses the recently updated list of the LCCs[1] provided in Cho et al. (2012), which incorporated the recent changes in the market such as exit and mergers). In addition, the simplified flight network helps LCCs offer higher frequency of flights (Doganis, 2006). In this way, LLCs have made a significant impact on the air transportation industry (Bennett et al., 1993).

1.1.2.2 Other Features of Low Cost Carriers

With their simplified operations discussed above (shortened aircraft turnaround process and point-to-point flight network), LCCs are able to charge lower fares and provide a higher frequency of nonstop flights on the routes they serve. In addition they also may be

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[1] JetBlue, Southwest, Air Tran, USA 3000, Sun Country, ASA, ExpressJet, Mesa, SkyWest, PSA, Comair, Midwest, Alaska, TransStates, Spirit, Frontier.

able to attract customers with the improvements in the following strengths: operation reliability, customer service and brand marketing image.

Their simplified operations allow them to better manage certain operation measures such as on-time performance and lost bags. In fact, the annual “Airline Quality Rating” reports (Table 1) over the last three years show that LCCs have been superior to the legacy carriers in both on-time performance and baggage handling. The ranking shows that LCCs dominate the top positions. For instance, the 2010 report (based on 2009 performance) reveals that three LCCs are included in the top five for on-time arrival performance and three LCCs are also included in the top five for mishandled bags respectively.

In addition, LCCs have been known for their excellent customer service operations. Customer service may be measured by how much staff care customers with empathy and resolves their issues responsively (Parasuraman and Grewal, 2000). Southwest Airlines, the leading LCC, emphasizes the importance of its staff as another competitive strength and often receives positive feedback from the customers (Southwest Airlines is ranked number one by American Customer Satisfaction Index for the 17th year in a row[2]). Other LCCs have closely followed the Southwest Airlines strategy and have been strong in this service aspect as well. In fact, “Airline Quality Rating” (Table 1) shows that LLCs have been highly rated by customers with a fewer number of customer complaints.

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[2] Source: American Customer Satisfaction Index (ACSI)’s website (http://www.theacsi.org/index.php?option=com_content&view=article&id=213:acsi-scores-june&catid=14&Itemid=262)

Table 1 Airline Quality Rating (2008, 2009 and 2010)

On-time Arrival Percentage

Ranking	2008	2009	2010
1	*Southwest	Hawaiian	Hawaiian
2	*Frontier	*Southwest	*Southwest
3	Delta	US Airways	*Alaska
4	*Air Tran	*Frontier, *Skywest	*Skywest
5	*Skywest	-	United

Mishandled Bags (per 1,000 persons)

Ranking	2008	2009	2010
1	*Air Tran	*Air Tran	*Air Tran
2	Northwest	Hawaiian	Hawaiian
3	Continental	*JetBlue	*Frontier
4	*JetBlue	Northwest	*JetBlue
5	United	Continental	Northwest

Complaint Numbers (per 100,000 persons)

Ranking	2008	2009	2010
1	*Southwest	*Southwest	*Southwest
2	*Frontier	*Alaska	*Express Jet
3	*SkyWest	*SkyWest	*SkyWest
4	*Alaska	*Frontier	*Alaska
5	*JetBlue	*Mesa, Hawaiian	American Eagle

* indicates low cost carriers. Note that the following carriers are referred to as LCC in the previous literature (Cho et al., 2012): Southwest, Air Tran, USA 3000, Sun Country, ASA, ExpressJet, Mesa, SkyWest, PSA, Comair, Midwest, Alaska, TransStates, Spirit, Frontier, and JetBlue.

Source: Dr. Brent D. Bowen Purdue University, College of Technology W. Frank Barton School of Business and Dr. Dean E. Headley Wichita State University Department of Aviation Technology Department of Marketing. (2008-2010 reports based on 2007-2009 performance)

More importantly, LCCs have established a brand image characterized by low fare marketing campaigns. As a marketing tool, brand image represents how a carrier's marketing image can better influence customers (Andreassen and Lindestad, 1998). This lower fare image may attract additional business even when an airline is not the low cost provider in a particular market all the time. This can be called "halo effect of the LCC's low-fare strategy." The customer who once experienced LCC's low fares in the past creates the belief that LCCs always offer low fares, even if they do not..

This study is potentially more interesting since recent industry trends have resulted in a narrowing gap between LCCs and legacy carriers with respect to fares (MSNBC.com, 2010[3]; USATODAY.com 2011[4]). In addition, the LCCs' high frequency service advantage has also been eroded as they expand their list of destinations to longer haul flights that often are serviced through connections.[5] As the LCC advantage in fares and frequencies may have been diminished it is interesting to see if some of their other service features are important as customers choose airports.

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[3] Low-Cost carriers don't always provide the cheapest fares. Legacy carriers often match or undercut prices to stay competitive and retain their market share, MSNBC.com, 10/19/2010

[4] Low-cost carriers get aggressive on fare hikes, USATODY.com, 02/02/2011

[5] For instance, Southwest Airlines has one nonstop flight out of a total of 15 flights from BWI to LAX, no nonstop flights out of a total of 15 flights from BWI to SFO and one nonstop flight out of a total of 14 flights from BWI to SEA. Air Tran at BWI also provides only two nonstop flights out of a total of its 14 flights to LAX, one nonstop flight out of a total of 9 flights to SFO, and 2 nonstop flights out of a total 10 flights to SEA. Southwest and Air Tran are the number one and number two LCC at BWI in terms of passenger market share.

1.1.3 Customer Characteristics

Customers are not homogeneous. Each customer has different characteristics. Particularly, some customers might have relatively higher importance in time and convenience utility than in monetary value. These customers may be more influenced by operational quality because it influences customer's time and convenience utility. I am interested in examining who is more sensitive to operational quality, resulting in changing their choice of airlines.

In addition, these customers may be more sensitive to the factors that affect customer's time and convenience utility in their choice of airport (i.e. flight frequency and airport access time). Thus, I will examine this issue as well. Lastly, knowing that a customer's geographical situation varies across customers, I am also interested in if this may influence a customer's choice of airport as well. When an alternative airport is located far away, increased access time to the alternative airport means an increased cost to customers. Thus, I intend to investigate the moderating effect of access time to an alternative airport on customer's choice of airport.

1.2 Research Question

This dissertation will investigate the impact of operational quality on the customer's choice of airlines and airports. Essay one will focus on airline choice and essay two will focus on airport choice. The first essay investigates the following issues: (1) Does airline operational quality influence a customer's choice of airlines? (2) Does a customer's operations exposure moderate the relationship between operational quality and a customer’s choice of airline? (3) Does a customer’s characteristics (i.e., relative importance in time and convenience utility) moderate the relationship between operational quality and the customer’s choice of airline?

The second essay tests the impact of LCCs presence at an airport in the customer’s choice of airport. LCCs have operated differently compared to the legacy carriers and have significantly influenced customers in the airline industry. Specifically I hope to address three issues: (1) Does the presence of an LCC on a specific route (airport to airport) influence a customer even after controlling for fares and frequencies offered? (2) Does a customer’s characteristics (i.e., relative importance in time and convenience value) moderate the relation between airport choice determinants and the customer’s choice of airport? (3) Does a customer’s geographical distance to an alternative airport moderate the relationship between airport choice determinants and customer’s choice of airport?

When customers in a multiple-airport region choose to use air service, they have to choose both an airport and an airline. Some customers choose both simultaneously. Some customers choose the airline first and then the airport, while others choose the airport first and then the airline. Rather than assume which form the customer choice takes (which we indeed do not know), this dissertation will address the research questions by separately investigating what factors drive the customer’s choice of airline and what factors drive the customer’s choice of airport.

1.3 Theoretical Framework

1.3.1 Airline Choice

The first essay focuses on airline choice and investigates three issues. The essay examines (1) the impact of operational quality on a customer's choice and (2) the moderating role of operations exposure. The essay also investigates (3) the moderating role of relative importance in time and convenience utility on the operational quality. These moderating roles test whether different customer characteristics influence customers.

The first question will look at the impact of operational quality on airline choice. Operational quality is associated with some operation elements. Operation elements are the activities that facilitate service operators to produce service consistently and efficiently (Stank et al., 1999). From a customer perspective, an operation element is associated with reliability and convenience. Reliability is the "ability to perform the promised service dependably and accurately" (Parasuraman et al., 1985, p. 6). Convenience is defined as the time and effort to be sacrificed in buying products (Brown, 1993). In the airline industry, departing at a time when a customer wants to leave is the key service factor in offering flight service because it reduces schedule delay, difference between preferred departure time and actual departure time (Brueckner and Flores-Fillol, 2007). Graham (1983) indicates that airline customers are sensitive to the amount of time a flight takes and therefore prefer nonstop flights to connecting flights. Further, customers are concerned about long wait-time and inconvenience due to delays and mishandled baggage (Dresner and Xu, 1995). As a result, operationally more reliable and more convenient services might include higher flight frequency, nonstop flights, higher on-time performance, etc.

Higher flight frequency provides more chances to depart at the customer's preferred time (Proussaloglou and Koppelman, 1995) and minimizes schedule delays (Brueckner and Flores-Fillol, 2007). Longer wait time for a flight is an additional cost and inconvenience for customers to use air flight services. If more flights are offered for a route during a period of time, customers are more likely, on average, to depart at the time they want and to reduce their wait time at the gate.

Nonstop flight operations should increase the reliability and convenience of services. Nonstop flights transport customers and goods from point A to point B without intermediate connections as opposed to connecting flights that require a connection at an intermediate stop and often a change of planes. Flights with a smaller number of connections result in reduced flight time, less waiting time for connecting flights, and often less aircraft switching time (convenience). Nonstop flights also reduce the chances for connecting disruption (reliability) (Lijesen, 2004).

On-time performance can also be viewed as a higher level of operational quality. Delays negatively impact customers. Poor on-time performance increases the chance that a customer arrives late at their final destination or misses a connecting flight at the intermediate airport. Poor operational quality should decrease the probability that a customer will choose a particular airline.

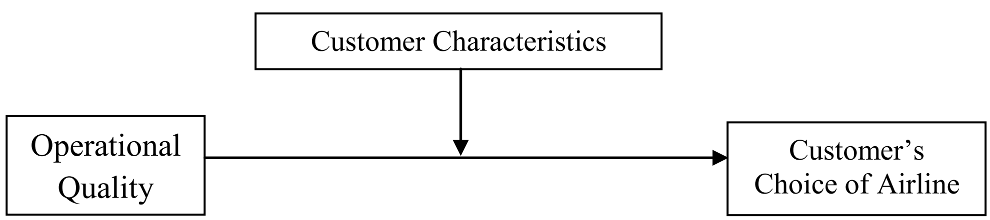
Additionally, the relationship between operational quality and a customer's choice may vary across different customer characteristics. The second and the third questions of this study examine this issue.

Through the second question in this essay, I investigate whether customers take into account how much they are exposed to airline operations when choosing an airline. The survey data utilized in this study includes detailed information on individual airline customers, including how many bags they checked and how many companions they traveled with. In the airline industry, customers traveling with check-in baggage are more exposed to service processes than those traveling without; that is, they go through the service of airline baggage handlers to properly load, unload, and sort their baggage. They also go through airline check-in staff to properly weigh and tag their baggage, and at the destination they go through the service of baggage handlers. Additionally, they are dependent on airline staff to claim the baggage if the baggage is delayed or missed. These customers have a greater chance for a negative experience if airline operational quality is bad. Therefore, customers want to either minimize their operations exposure to airline service or to seek higher operational quality airlines. This may also be true for airline passengers traveling with companions. When customers travel with companions, such as young children, elderly parents, or important business partners, they might have to process with more service users. Then, these customers may seek to minimize their exposure or look for service providers that offer more reliable and convenient service.

The third question involves whether certain types of customers place a higher value on operational quality than other customers. In particular, I suspect that a customer with a higher value of time (i.e., high income customers and business purpose customers) may put a relatively higher value on operational quality attributes such as reliability and convenience. High income and business customers tend to produce more income in a given time while the expense that they have to pay for better quality service is only a small portion of their income. These customers prefer an airline that offers better operational quality (Proussaloglou and Koppelman, 1995; Adler et al., 2005).

Based on these research questions, the proposed conceptual model of the airline choice (the first essay) is presented in Figure 1.

Figure 1: Conceptual Model of Airline Choice

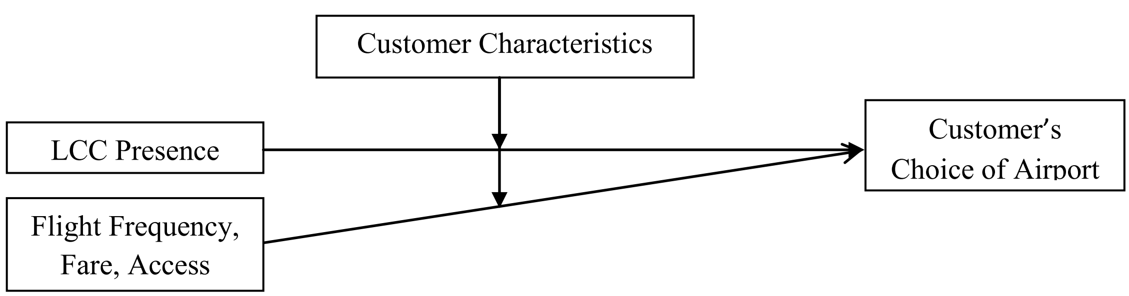


1.3.2 Airport Choice

The second essay will assess the impact of LCC presence on an airport route on the customer's choice of airport. Previous research indicates that a customer's choice of airport is primarily driven by three airport choice determinants such as fares, flight frequency and accessibility. LCCs have made a huge impact on the industry with their low fares and high nonstop flight frequency. Accordingly, LCC presence at airports attracts customers mainly through their low fares and high nonstop flight frequency. A question can also be made of whether LCCs have increased the impact of their presence at airports particularly through any factor other than low fares and high nonstop service frequency. It is discussed that LCCs have excellent operational quality, customer service, and brand image marketing. In the second essay, I am interested in whether LLCs' presence attracts customers above and beyond the fare and flight frequency effects. In addition, I will examine whether certain customers value the airport choice determinants including the LCC presence to a greater degree than other customers.

Based on the discussion above, the proposed model of the airport choice (the second essay) is presented in Figure 2.

Figure 2: Conceptual Model of Airport Choice



This question will be tested by including a LCC direct service presence dummy variable that is expected to pick up LCCs' additional advantages other than low fare and frequent service (i.e. operational quality, customer service and low fare brand marketing image).

Combined with the results regarding the impact of fares and frequency on customer choice, this model allows measuring the overall impact of LCC presence at an airport. In other words I will be able to measure any additional impact due to these additional operational quality factors on top of the impact of fares and nonstop flight frequencies.

Some LCCs simplify their operations to lower operation costs. They simplified their aircraft turnaround process by minimizing in-flight services and having fewer seat classes. These simplified operations produce additional benefits such as improved on-time performance and fewer mishandled bags. This helps LCCs not only reduce turnaround time, but also ultimately minimize operation disruptions such as delays and lost bags. Indeed, "Airline Quality Rating" (Table 1) shows that LCCs have been superior to the legacy carriers in both on-time performance and baggage handling. The rankings indicate that LCCs dominate the top positions for the last three years (2008, 2009 and 2010). In the 2010 report, three LCCs (Southwest, Alaska and Skywest) are included in the top five for on-time arrival performance. Another three LCCs (AirTran, Frontier and JetBlue) are included in the top five for mishandled bags. In fact, customers are highly displeased with the delays and mishandled baggage. Appendix 1 provides a list of the most annoying things about flying as compiled by US Consumer Report. According to the list, the issues that are related to both on-time performance (rank 7) and delayed baggage handling (rank 9) are pointed out as the one of the most annoying service aspects by customers.

A second factor that might make an LCC more attractive to customers, and as a result the airport that the LCC serves also more attractive, is customer service (i.e., service staff attitude). Service staff attitude may influence the customer's perception of service quality through the responsiveness and empathy, the service dimensions defined by Parasuarman and Grewal (2000).The responsiveness and empathy is how well and how much staff cares about customers' difficulties in using service. This notion is well supported by previous articles that emphasize the service encounter as the critical moment where good or bad impressions are formed by customers (Bitner and Boom, 1990). Excellent customer service can positively influence the customer's purchase decision (Roth and Menor, 2003).

Throughout their exposure toairline services, customers deal with different staff members at each travel stage including reservations, check-in, in-flight service, transferring and baggage claims. As a result customer service is an important service factor. In fact, customer service has been included as a measure of airline service quality in previous studies (Anderson et al., 2009; Coldren et al., 2003; Mikulic and Prebezac, 2010).

LCCs seem to increase their customer satisfaction through the excellence of their staff. It is revealed that the friendly service staff attitude was one of the concerns that United had when it creates United Shuttle to compete with one of the successful LCCs, Southwest (Kimes and Young, 1997). In fact, the drivers of the Southwest success include its service staff (Heskett and Schlesinger, 1994). Southwest views its staff as a valuable service asset that could increase customer satisfaction (Gillen and Lall, 2004) and focuses on creating a “fun and friendly” working environment that is highly appreciated by customers (Gilbert et al., 2001). Other LCCs that tend to reproduce the Southwest strategy seem to be excellent in this service aspect as well (Gittell, 2001). As a result, LCCs are often recognized as the most customer friendly carriers in “Airline Service Quality Rating” (see Table 1). The 2010 ranking indicates that LCCs (Southwest, Express Jet, Skywest and Alaska) occupy the four positions of the top five with regard to fewest customer complaints. While the number of complaints includes various service aspects, this indicator reveals how well the issues are handled by service staff overall, which can be a good proxy for the airline’s customer service quality.

LCCs have a strong brand image[6], primarily as a result of their low fares. In fact, Laura Wright (CFO, Southwest Airlines) stated that “Our low fare brand is who and what we are[7]”. LCCs use various gimmicks to promote their low fares. Ryanair celebrated its new service to Bergamo with 100,000 free tickets in 2003 (O'Connell and Williams, 2005). They also sold 900,000 tickets at 90 pence for its 90 millionth passenger celebration. These types of promotions result in a low fare image for carriers like Ryanair. This overall low fare brand image may encourage customers to choose the low fare carrier (and thus the low fare airport) without bothering to search for the actual lowest fare based on the belief (‘halo’ effect) that LCCs offer the lowest fares even though it may not be true all the time.

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[6] “Southwest emphasizes brand as others follow the low-fare leader” (Marketing News, the American Marketing Association, Vol.30 No.23, 1996)

[7] Micheline Maynard, “*So Southwest is Mortal After All”*, N.Y. TIMES, Oct. 16, 2005 at C1.

The following second and third question examines the moderating impact of different customer characteristics on the relationship between the airport choice determinants including the presence of LCCs and customer's choice of airport.

The second question in airport choice is whether certain customer groups are more sensitive to these service aspects than others. The customers whose time and convenience value is higher may be more serious about the airport choice determinants (nonstop frequency and access time) that influence time and convenience of the service while they may be less serious about the determinant such as fare. These customers may include higher income and business customers. As to the presence of LCCs, LCC have traditionally appealed to low income and leisure customers with their low fares. As a result we might expect that low income passengers are more likely to respond to these other service attributes than high income passengers. The same could be said for leisure passengers as opposed to business passengers. On the other hand, customers who are more time sensitive, such as high income and business customers, may view LCCs on time performance more highly than those with lower time sensitivity (low income and leisure passengers). Thus, this study intends to use interaction terms to test the moderating effect of the customer's income level and trip purpose on the relationship between LCCs' presence on a specific route at an airport and the customer's choice of airport.

Another potential moderating effect with regard to the importance of the airport choice determinants is how easily customers can reach their alternative airports. Customers view longer travel time to airports as additional costs and the length of travel time to the airport dominates customers' airport choice. This geographical limitation becomes more important when customers are seriously isolated with only one airport. On the other hand, when multiple airports are a similar distance away customers may consider other factors (i.e. LCC presence on the route) more seriously. Thus, this study uses interaction terms to test the moderating impact of the customer's additional travel time to alternative airports.

1.4 Contribution to the Literature

The contribution of this dissertation is to examine how the customer's choice of airline and airport are influenced by airline operational quality.

The first essay has two significant contributions: (1) the examination of operation quality on the customer's choice of airline and (2) the examination of operations exposure and its impact on the customer's choice.

First, previous air transportation research (Proussaloglou and Kopprelman, 1995, Dresner and Xu, 1995) established the relationship between major operational quality dimensions (i.e., service schedule, lost bags, flight delays) and customer response (i.e., airline choice and service satisfaction). However, these studies did not examine how these responses may differ by the operational attributes, such as customer operations exposure intensity. Thus, this study contributes to the air transportation literature by explaining in more depth how operational service quality affects customer choice. This study is the first test in the airline industry of the moderating effect of customer operational attributes on the operational quality and customer choice relationship.

Second, another contribution of this study to the service operations management literature is to expand the impact of a customer contact model (Chase and Tansik, 1983). Previous studies argued that customer contact determines service quality and customer satisfaction (Soteriou and Chase, 1998). This means that customer contact is considered as one service aspect (i.e., or a determinant of customer satisfaction) that influences customers. Accordingly, previous researchers investigated the types of and amount of a firm's resources that are required to serve customers successfully. But, I believe that different customers contingently may require different levels of contact, or exposure, with service operations while they are being served. I intend to show how different levels of operations exposure affect the relationship between a service provider's operational quality and a customer's choice of service providers. Thus, this study supports and expands the previous literature by boosting the previously overlooked moderating role of the operations exposure to customers in choosing a better operational quality service provider.

The contribution of the second essay is the first examination of the impact of LCCs on the customer's choice of airport. In particular this essay looks at the impact of LCC presence above and beyond the effect ('halo effect') due to lower fares and higher frequencies.

The impact of LCCs on fares and passenger demand has been extensively studied (Whinston and Collins, 1992; Dresner et al., 1996; Benett and Craun, 1993). Additionally, this study will assess the total impact of LCCs presence on airport choice by using LCC presence as an additional airport choice determinant beyond and above fare and flight frequency. As a result this study will facilitate a discussion of the overall impact of LCCs presence at an airport combined with the impact of lower fares and higher frequencies. Additionally, this study tests the impact of LCC presence across different customer characteristics.

The findings of this study may be meaningful to airport managers. Most of the airport choice determinants that were previously examined are outside of the control of airport managers (geographical distance to airport) and determined by airlines (fare and flight frequency). However, if LCC presence provides additional value to customers, this provides a variable over which airports can exercise a certain amount of influence. The development of the service that provides customers with unique value is strongly supported by previous literature (Sirohi et al., 1998). For instance, the efforts that Baltimore/Washington Thurgood Marshall Airport (BWI) made to introduce Southwest Airlines, one of the nation's leading low cost carrier, have turned out to be successful in attracting additional customers. This study will help to determine the overall impact of LCC presence, whether this is solely due to low fares and frequent service or if LCC presence has an added impact above and fares and flight frequency.

Another contribution of this study is the examination of the moderating effect of an alternative airport's proximity on the airport choice when customers choose an airport. Fournier et al. (2007) well examined that the impact of increased geographical distance to an alternative airport weakens the effectiveness of fares at the alternative airport in affecting customers, resulting in the need for that alternative airport to further lower fares to attract customers. The result of this dissertation is expected to show the similar result not only for fares but for other airport choice determinants as well. While flight frequency, fares, and LCC presence become less important, access time becomes more important when customers are particularly seriously isolated from alternative airports, because access time plays a more dominant role in customer's airport choice.

The rest of this dissertation is organized as follows. Chapter 2 reviews previous studies regarding airline choice, airport choice and the choice model. Chapter 3 examines the impact of the operational quality on customer's choice of airline (and airline types) with the moderating impact of operations exposure. Chapter 4 tests the impact of LCC presence on the customer's choice of airport. Lastly, Chapter 5 summarizes the findings of this study and suggests future research.

Chapter 2 Literature Review

Since the relationships I examine in this dissertation are the factors that drive customer choice of airlines and airport, I review previous studies regarding (1) what determinants influence a customer's choice of airline and (2) what determinants influence a customer's choice of airport. Methodologically, as both relationships are tested through a choice model, previous studies regarding the methodological development of a choice model is additionally summarized.

Specifically, the first section reviews how extant studies estimate a customer's choice of airlines. In addition, the latter part of the section reviews studies suggesting the moderating role of operations exposures on a customer's choice.

The second section reviews how previous studies predict a customer's choice of airport. Most of these studies predict airport choice with the three main determinants - airport accessibility, service schedules and fares. In addition, I discuss a low-cost carrier (LCC) whose presence may influence customer's choice of airport.

In the last section, I summarize the literature on the methodology of choice models. Particularly, this section reviews literature on how choice models are applied when there are different numbers of alternatives because the first essay runs a choice model across different routes where different numbers of airlines are available.

2.1 Airline Choice

In this section, I discuss studies on the factors driving a customer's choice of airlines. While airlines compete through price competition for customers, several other factors may also influence a customer's choice (Morrison et al., 1989; Proussaloglou and Koppelman, 1995). This section is divided into two parts. The first part discusses literature concerned with service schedules, such as schedule frequency and the number of connection on a route, and how these factors influence the choice of an airline. The second part of the section discusses operation performance factors, such as on-time performance and baggage handling, and how these factors determine a customer's choice of airlines. Most importantly, previous studies that examine customer's operations exposure are summarized since this may affect customer's choice of airline.

A primary factor affecting airline service quality is the provision of a service schedule that maximizes a customer's time and convenience utility, and thus positively influences customers. First, a frequent service schedule is a determinant of customer choice of an airline (Proussaloglou and Koppelman, 1995). Customers want to minimize wait time for a flight, the time different between preferred departure time and the actual departure time (Brueckner and Flores-Fillol, 2007). A carrier that offers a high frequency of flights will offer customers a greater chance that they will be able to depart at a time closer to their desired departure time. This results in convenience for customers so that they can minimize wait time for a flight and arrive at their destination at the desired times. Proussaloglou and Koppelman (1995) test this notion through multinomial logit model of airline choice using the passenger survey data collected in the Dallas area. The authors use subjective measures of schedule convenience for a specific route and find a positive relationship with a customer's choice of airlines. Suzuki (2007) also found that high flight frequencies are positively associated with a customer's choice of an airline. The implication of these results is that being able to depart at a convenient time is a significant determinant of a customer's choice of airline.

The number of connections required to reach a final destination also matters to customers in their choice among air carriers. Nonstop flights may be considered by customers to be of a higher quality (Lijesen, 2004) compared to connecting flights, and thus may prompt customers to choose the airline offering nonstop flights (Adler et al., 2005; Coldren et al., 2003). Previous studies argue that connecting flights increase travel duration time, incur the inconvenience of changing planes, and cause passengers to face the possibilities of flight delays and lost baggage (unreliable and inconvenient service). Adler et al. (2005) test the number of connection across different groups of customers by trip purpose in their choice of airlines. The authors show that business travelers are more sensitive to the number of connections on a routing than are non-business travelers. This result is likely due to the higher value that air travelers place on travel time when they travel for business purpose (Windle and Dresner, 1995). Moreover, they find that frequent travelers are more sensitive to on-time performance than are infrequent travelers, likely because they frequently experience poor service.

In the similar notion, Adler et al. (2005) show that business travelers are more sensitive to flight duration time than are non-business (say leisure) travelers. Morrison and

Winston (1989) test the sensitivity of air travelers to flight duration time, connecting time, schedule delays and a wait time between desired and schedule departure time through an airline choice model. The results of the study show that transfer time has the highest value to travelers followed by flight duration time. This argument supports that transfer time is the time that customers most want to avoid. As a result, customers want to avoid connecting routings in order to minimize transfers. In summary, this literature supports the argument that nonstop flights are important to customers, especially those with a high value of time (i.e., business travelers).

Secondly, a customer's choice of airlines is also affected by operation performance factors, including factors such as on-time performance and mishandled baggage. For instance, Proussaloglou and Koppleman (1995) examine the impact of on-time reliability on customer choice and find that customers prefer airlines with higher on-time performance. Dresner and Xu (1995) examine the relationship between operation service factors and financial performance through customer satisfaction. Operation performance in this study is assessed by a carrier's lost bags and on-time performance. Through a two-stage least squares model to link airline operation service factors to customer satisfaction, and ultimately to airline profits, the study reports that improving one measure of customer service (i.e. lost baggage) increases revenues more than costs and leads to a net increase in profits, whereas improving another measure of customer service (i.e., on-time performance) increases revenues less than costs and leads to a net decrease in profits. It is interesting to note that different operation service factors have differential impacts on customer's satisfaction and an airline's financial performance. The study, however, does not explicitly observe how operation service factors influence actual customer choices.

Tsikriktsis (2007) examines the direct relationship between operation performance factor and an airline's financial performance. Operation performance factors in the study include on-time performance and lost baggage for both "focused" carriers and full-service airlines. Focused carriers are defined as airlines that mainly connect less congested secondary airports with a single aircraft type within North America. These airlines include Southwest, America West and Alaska, which other authors may refer to as LCCs. The author argues poor on-time performance will cause more damage to the financial performance of focused service carriers than to full-service carriers since customers have higher expectation for focused carrier's service. However, no empirical results are presented to back this supposition.

In sum, it is worth noting that operation service factors have been found to influence customer satisfaction (Dresner and Xu, 1995) and financial performance (Drenser and Xu, 1995; Tsikriktsis, 2007).

2.2 Customer Operations Exposure

In order to further expand how different customers respond to airline service operational quality (nonstop flights and on-time performance) depending on the level of customer's operations exposure with airlines, I introduce an operation theory regarding how much customers are exposed to service operation, customer contact model (Chase and Tansik, 1983), in this section. Service provision necessarily involves interactions with customers. Indeed, one of the key service aspects is inseparability (Parasuraman and Grewal, 2000). Inseparability implies that service cannot be performed without customers.

Chase (1981) defines customer contact as a customer's direct interaction with service staff. Chase and Tansik (1983) conceptually develop the customer contact model. The model demonstrates that service operators need to identify the service operation processes that require a great degree of contact with customers and then provide the resources (e.g., customer friendly staff) to effectively serve customers in those processes. Kellog and Chase (1995) develop empirical measurements, such as communication time, intimacy and information richness, to gauge the degree of customer contact.

In the air transportation industry, the service provided is somehow homogenous such that most customers go through the same service processes; reservation service through airlines or travel agents, check-in and boarding service at airports, and flight service by airlines. However, some customers may be more exposed to the airline operations they are using than the others. For instance, customers traveling with checked bags are more exposed to airline operations than passenger traveling without checked bags. When customers check bags, they have to go through additional check-in process, including weighing and tagging the bags, potentially paying for checking the bags and for overweight bags, and answering additional security questions. The bags must then be subject to baggage handling equipment and personnel, and are subject to inspection by security personnel. Lastly, there is a baggage claim process at the destination that may involve a claims procedure, which could include additional contacts if bags are missing or delayed. In the same logic, when customers travel with more companions, they tend to go through all the regular process but with more people. Particularly, when companions include young kids and senior parents who might require additional services, the customers tend to be more exposed to service operation with longer communication and more information exchange.

The question posed by this thesis is whether customers with a high level of operations exposure (or more customer contacts) to airline service such as those traveling with checked bags or with companions, are more sensitive to operational quality than other customers. This may result in these high customer-contact travelers being more sensitive to service quality and, for example, seeking airlines that offer direct services (Lijesen, 2004), good on-time performance and better baggage handling performance? This question is investigated in Chapter 3.

2.3 Airport Choice

In this section, I review the main airport choice determinants that previous literature argues.

In many regions of the country and in many metropolitan areas, a passenger can travel from two or more airports, and thus has an airport choice decision to make. Three major variables that drive a customer's airport choice have been recognized by previous researchers. These are airport accessibility, service schedules of airlines at the different airports (Harvey, 1987; Windle and Dresner, 1995) and airfares offered by airlines at the different airports (Pels et al., 2003; Pathomsiri et al, 2005).

These three determinants, flight frequency, fare and access time are discussed as choice specific variables in Windle and Dresner (1995). The "choice specific" variables represent the different characteristics of the airports that may be attractive to customers. Then, these choice specific variables predict airport choice of customers. The authors also discuss the "chooser specific" variables that by distinguish different types of customers, such as residents versus non-residents of the metropolitan area, and business travelers versus leisure travelers. These chooser specific variables moderate the impact of the choice specific variables such as flight frequency, airport access time. Below, I review each of these three choice specific variables and additionally discuss the moderating effect of chooser specific variables.

2.3.1 Airport Accessibility

Accessibility is recognized as perhaps the most important variable in choosing an airport (Pels et al., 2003). In the Pels et al. (2003) study, a customer's airport choice is found to be positively associated with airport accessibility in terms of both lower access time and lower access cost. Access time is calculated by the travel distance between the trip origin location (home, business, or hotel) and an airport by the various modes of airport access. The authors also calculate the access cost for each ground transportation mode based on travel distance. They find higher elasticity for access time than for the access cost, especially for the business passengers. In a similar study by Hess and Polak (2005), in-vehicle access time is posited as a factor that will influence a customer's choice of airport. The authors find that in-vehicle access time is negatively associated with a customer's airport choice and interpret this finding as evidence of a customer's risk aversion; that is, his/her desire not to miss a flight by arriving late to the airport. Ground access time to an airport has been found by other studies to be the primary determinant of airport choice and consistently demonstrates a negative impact on a customer's choice among airports (Windle and Dresner, 1995; Basar and Bhat, 2004).

The importance of access time to the airport may vary among categories of passengers. Windle and Dresner (1995) estimate the impact of access time on customer choice among the three airports in the Washington Metropolitan Area. The study shows that high airport access time most negatively affects business customers regardless of whether they are resident or non-resident of the metropolitan area. This result may imply that business travelers have higher time values than do leisure travelers, and thus tend to minimize airport access time and the risk of missing a flight. Basar and Bhat (2004) also test access time across different customers grouped by the number of traveling companions in a group using data from the San Francisco Bay area airports. The authors argue that customers traveling in a group may use the access time for socialization purposes and thus may be less sensitive to access time than solo travelers. Recently, Loo (2008) examines the impact of flight length on access time and access cost to the five airports in the Hong Kong area. The author finds that access time is important for all passengers; including those traveling on short hauls, medium hauls and long haul flights. All the studies support the notion that access time consistently influences customer choice of airports, but its importance may vary across customer segments.

Pels et al (2003) examine a passenger's choice of airport in the San Francisco Bay area in order to determine the influence of airport access modes, such as private car, hired service, and public transportation. The authors note that actual ground travel time or distance can vary depending on the transportation mode used, and that customers consider a combination of airports and access modes in order to maximize their utility. In the study, two nested models are tested. The first model has access mode choice first and airport choice later. The second model has airport choice first and access mode choice second. The authors conclude that the nested model with airport choice first and access mode choice later is statistically preferable based on their empirical results. In addition, it is conceptually more intuitive. This conclusion implies that access mode choice may not drive airport choice, rather airport choice may help determine access mode.

Recently, Loo (2008) has tested the relationship between a customer's airport choice and the number of public access modes available to the five airports near Hong Kong. Accessibility is tested in terms of access time, access cost and access mode in the study. However, the study finds that only access time is significant in a customer's choice of airports. While showing that the number of available access modes may not significantly predict a customer's airport choice, these previous studies still leave open whether a unique access mode, such as a metro connection, may influence customer choice.

In sum, this section has reviewed literature discussing airport accessibility (access time, access cost, and access mode) to explain a customer's airport choice. Although airport accessibility is acknowledged as an airport attribute (Suzuki, 2007) airports have little control over this attribute, at least in the short run.

2.3.2 Flight Service Schedules

In this section, I examine the impact of airline service schedules on a customer's airport choice. The airports with more flights to a particular destination will attract customers wishing to fly to that destination. This is because the chance of finding a flight departing at a time that a customer prefers is higher, and customers can reduce potential waiting time for their flights accordingly (Harvey, 1987; Pels et al., 2001, Windle and Dresner, 1995).

Interestingly, the impact of schedule frequency may vary across customer segments, depending on attributes such as residency, income and trip purpose. Windle and Dresner (1995) find that non-residents (of a metropolitan area which contains the choice of airports) are more sensitive to the weekly frequency of flights on a route than are residents in choosing an airport. The authors attribute this finding to the idea that information about alternative airports and the flights at these alternative airports is less known to non-residents. Pathomsiri and Haghani (2005) investigate airport choice in the Washington Metropolitan Area and test the impact of daily flight frequencies. The authors find that the frequency positively influences the most of business passengers (82%) but negatively some business passengers (18%) in airport choice. Basar and Bhat

(2004) find the surprising result that high income travelers are negatively associated with the choice of airports with high frequencies to their destinations, while all travelers are positively associated with high frequencies. The authors attribute this finding to the fact that high income customers tend to travel during narrow peak hours and may not be sensitive to the frequencies throughout the whole day.

In sum, the literature supports the idea that flight frequency is a key driver in choosing an airport as long as customers have information concerning service frequency at alternative airports. In addition, the importance of frequency in airport choice may vary by customer segment.

2.3.3 Fares

While low fares should be a primary factor in a customer's choice among airports, previous studies show tend to show mixed results, perhaps due to data limitation. Cho et al. (2012) find strong passenger demand at airport pairs that over low yields (fares divided by distance). Pels et al. (2003) test average fares at the route level and find a negative relationship with a customer choice of airport. However, limitations in the availability of fare data have heavily restricted the use of fares in airport choice models. In fact, some previous studies (Pels et al., 2001; Windle and Dresner, 1995) do not include fares in their airport choice studies. Windle and Dresner (1995) argue that the inclusion of average fare information, instead of actual passenger fare data, may generate erroneous or misrepresentative results. This ambiguity is attributed to the highly aggregated level of fare data used in the choice studies (Harvey, 1987; Skinner Jr, 1976;

Windle and Dresner, 1995). Suzuki (2007) uses a passenger's perception of paying a lower fare than the market average price as a binary indicator in the prediction of airport choice and finds a significantly positive relationship. Loo (2008) directly asks for fare information in a survey questionnaire and finds that passengers, especially leisure travelers, choose an airport that has low fares among the five airports in the Hong Kong area.

In sum, although fare may be a primary factor in choosing airports, data limitations make the use of this variable challenging. However, the Suzuki (2007) study suggests the possibility of using the presence of low-cost carriers at an airport as a proxy for low fares in predicting a customer's airport choice.

To conclude this section, I reviewed the factors affecting a customer's choice of airports. These include airport accessibility, airline flight frequencies and airfares. In addition to these factors, I will review other factors in the next section.

2.4 LCCs Operations

Tsikriktsis (2007) argues that there are two different types of operations that airlines use to produce air service, resulting in different levels of operation performance in terms of quality and productivity. Skinner (1974) defines 'focus' as a strategy to simplify production processes and intensively produce limited products for a highly targeted niche market. In air transportation, there are carriers that mainly serve geographically limited areas instead of providing nationwide and/or international service using a simple network (without connecting processes) and a limited number of aircraft types. Focus carriers also simplify operation processes (Skinner, 1974; Kimes and Young, 1997), which enables them to maintain a lower operation cost structure (Gillen and Lall, 2004). Tsikriktsis (2007) argues that airlines with a focus strategy pursue productivity by improving the utilization of their primary fixed asset, aircraft (maximization of their air time).

2.4.1 Focused Service Carriers

Focus operation strategies have been adopted by low cost carriers (LCCs) to lower operation costs (Hofer, 2008). Although not every LCC executes all the methods discussed above, most LCCs use some of the focus strategies to simplify their operations and produce air services at a lower cost than most network or full-service carriers. Among LCCs, Southwest Airlines, the oldest and largest LCC, has been most loyal to this focus operation model (Kimes and Young, 1997; Oliveira and Huse, 2009).

Southwest Airlines started operations in Texas connecting three cities (Dallas, Houston and San Antonio) in 1967 and expanded its network by directly connecting less congested suburban airports, such as Midway Airport in Chicago and Baltimore/Washington Thurgood Marshall Airport. Unique operation characteristics of Southwest Airlines, especially its fast turnaround times, are well documented by (Gillen and Lall, 2004). The author notes that by not serving in-flight meals, Southwest both reduces loading costs for meals and unloading costs for trash. Southwest's open seating policy reduces boarding time. Its single aircraft type (Boeing 737) allows ground crews to increase their familiarity with operation procedures and reduces the complexity of parts inventory management. Finally, the reduced turnaround times significantly contribute to on-time performance.

In addition, focusing on the narrow market, such as routes between less congested secondary airports and flight schedules at less congested hours help Southwest Airlines to maintain high a level of on-time performance. Its simplified network, without complicated connecting processes (i.e., point-to-point network) reduces connecting passengers and bag transfers, leading to a reduction in turnaround time and to the improvement of on-time performance.

2.4.2 Full Service Carriers

Full service airlines are defined as carriers that serve destinations nationwide, as well as international destinations. They use multiple types of airplanes and offer multiple seat classes. They tend to provide more in-flight services than LCCs including in-flight sales, entertainment and meals. Most of the US "legacy" carriers, such as Delta, American and United, can be thought of as operating a full service model, using hub and spoke networks. Through these networks, the airlines increase usage of aircraft by combining passengers traveling to several destinations on their flights, resulting in lower operation costs per passenger. Gillen and Lall (2004) state that with hub and spoke systems, full service carriers can cover most US cities either directly or indirectly, which the focus service carriers cannot do the same.

However, at hub airports, flights arrive and depart during short time windows in order to connect transferring passengers heading to their final destinations. Handling a large number of planes within a limited time window at an airport increases operation complexity and congestion both in the air and on the ground, and may contribute to poor on-time performance. In addition, handling the bags for flights arriving and departing to several dozen destinations during the time window increases the chance of mishandled and damaged bags. In fact, Tsikriktsis (2007) shows that on-time performance of full-service airlines was worse than the performance for focused service carriers during the most of the study period for his paper (1987-1998). The author also reveals that full service airlines had a higher percent of lost bags for the same study period. These results support the notion that operation service factors (i.e., lost bags and on-time performance) of airlines can be affected by the operating model used by the airline.

In sum, I reviewed airline operations. Particularly in this section, it is noted that LCCs operated differently from the legacy carriers through focus strategy and accordingly generate unique operational service strengths.

2.5 Impact of LCC Presence at Airports

The impact of LCC on airport choice has been examined mostly in the two ways – through fares and more nonstop flights.

First, the main attraction of LCCs is their low fares. Fares offered by airlines may vary significantly depending on the complicated discount schemes of each airline (e.g., advanced purchase discounts, sales channels and different promotions). But the low fares of LCCs have been confirmed in a number of previous studies (Dresner et al. 1996; Windle and Dresner, 1999; Bennett and Craun, 1993; Whinston and Collins, 1992; Suzuki, 207). These studies commonly argue that LCCs positively influence customer demand. Dresner et al. (1996) empirically support the idea that LCC presence is positively associated with customer demand for a specific airport in a multi airport city. Recently, Suzuki (2007) tested the low fare impact that potentially results from LCC presence and is perceived by customers. He found that the perception of low fares influences a customer's choice of airports. (Note, the study does not directly observe LCC presence but uses a customer's perception of paying relatively low fares as a proxy of LCC presence).

Secondly, service frequency is highly appreciated by customers. Increased nonstop flight frequency at an airport increases the probability that a passenger will be able to depart at a desirable time. This implies that the passenger will be able to minimize wait time for his/her flight. Accordingly, nonstop flight frequency increases a customer's time utility, a result supported by previous airport choice studies (Windle and Dresner, 1995; Pels et al., 2001; Suzuki, 2007; Ishii et al., 2009). All of these studies find a significant positive relationship between frequency and a customer's choice of airport.

Some LCCs such as Southwest may provide more nonstop flights between the two end points particularly for shorter routes (Doganis, 2006; Gillen and Lall, 2004) while some of them may not (i.e. Ryanair). As discussed above, a shortened aircraft turnaround time helps LCC to maximize the air time of their most critical fixed assets (aircrafts), and allows them to offer high service frequency. LCCs may also be able to offer high frequencies due to their simplified networks (direct point-to-point routes). By not operating hubs, LCCs can, again, reduce ground time. (Not every LCC operates a simplified network. For instance, Air Tran has a hub at Atlanta.)

However, an LCC's impact in a market is not necessarily limited by these two factors. In addition to the low fares (Dresner et al., 1996) and high nonstop flight frequencies, previous studies (Gillen and Lall, 2004; Heskett and Schlesinger, 1994) suggest that Southwest Airlines, one of the prominent example of the LCCs, has other features that attract additional customers such as high operation reliability, a positive staff attitude and low-fare brand image.

Operation reliability may be assessed in the airline industry by the dependability and accuracy of the service provided (Parasuraman and Grewal, 2000) and is often represented by on-time performance and baggage handling accuracy. Tsikriktsis (2007) argues that the airlines using a focus strategy, such as most of the LCCs, provide better on-time performance and better baggage handling accuracy. The better performance may be due to the LCC's simplified network (fewer connecting flights) and simplified aircraft turnaround process (shorter turnaround time) that enable LCCs to perform well in both on-time performance and baggage handling.

Service staff attitude may be another factor that attract customers to LCCs. Empathy and responsiveness are defined as major dimensions of service quality and refer to how much service staffs cares about their customers (Parasuraman and Grewal, 2000). Previous literature emphasizes ‘service encounter’ as the critical moment that leaves either a good or a bad impression (Bitner and Boom, 1990), which determines a customer’s evaluation of the service and repurchase decision (Roth and Menor, 2003).

In the airline industry, customers encounter various airline staff members at different travel stages such as during the reservation process, at check-in, in-flight and at the baggage claim. Thus, staff attitude can be an important service factor. In fact, service staff quality has been included as a service aspect in measuring airline service quality in previous studies (Coldren et al. 2003; Mikulic and Prebezac, 2010; Anderson et al. 2009). A friendly attitude toward customers was emphasized as a critical service factor in order to compete with Southwest Airlines when United designed its United Shuttle (Kimes and Young, 1997). Heskett and Schlesinger (1994) pointed out that Southwest’s excellence in staff attitude was one of the airline’s success factors. Southwest Airlines, as the oldest and the largest LCC in the industry, manages its staff as the most important asset servicing its customers (Gillen and Lall, 2004) and focuses on creating a “fun and friendly” working environment that is highly appreciated by customers as well (Gilbert and Child, 2001). Accordingly, Southwest is often recognized as the most customer friendly airline (Kimes and Young, 1997).

Brand image is a marketing tool and can represent how a carrier's marketing image can facilitate its overall business. According to O'Connell and Williams (2005), Ryanair celebrated the launching of service to a new airport by offering passengers free tickets (e.g. 100,000 tickets for the Bergamo service in 2003) and a milestone in number of passengers by offering highly discounted tickets (e.g., 900,000 tickets at 90 pence for its 90 millionth passenger). LCC market their brand image[8] particularly for low fare campaigns. In fact, Laura Wright (CFO, Southwest Airlines) stated the following: "Our low fare brand is who and what we are[9]". It can be seen as the 'halo' effect of the low fare strategy. Although the actual fare level is not the lowest all the time, the customers who experienced lower fares in the past tend to have a belief that they pay lower when they choose a LCC, accordingly an airport where LCCs offer services.

In this section, I reviewed studies regarding on the three major airport choice determinants; airport access time, flight frequencies, and airfares. Additionally, I reviewed studies describing how airport attractiveness may increase with the presence of LCC service. Based on this review, the second essay in this dissertation will investigate the impact of LCCs in attracting customers to airports.

2.6 Choice Models

Since both essays in this dissertation estimate a customer's choice decision, this section briefly reviews the literature on choice models. Particularly, this section reviews

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[8] "Southwest emphasizes brand as others follow the low-fare leader" (Marketing News, the American Marketing Association, Vol.30 No.23, 1996)

[9] source: "*So Southwest is Mortal After All"*, N.Y. TIMES, Oct. 16, 2005 at C1

literature on the model that predicts customer's choice when choice makers have different number of alternatives as the first essay estimates customer's airline choice across the routes where there are different numbers of alternative airlines available.

2.6.1 Development of Choice Models

Theoretically, the development of early choice models was undertaken by both psychologist and economists. The decisions processes people go through when making a choice is a primary research subject in psychology. The factors that influence a choice decision are the main interests for economists. Economists argue that a rational person considers all the alternates in a given choice set and makes a decision in a way to maximize his or her utility. In this case, the decision is a choice, for instance, whether to walk home or drive home. Both cannot happen at the same time. This type of discrete choice is well developed and documented by McFadden (1972), the Nobel Prize winner. In his study (1972), he estimates a customer's choice of work trip transportation mode and reveals the trade-offs between the attributes that a choice maker considers in his/her decision making process. Ben-Akiva and Lerman (1985) estimate travel demand through a discrete choice model based on utility maximization theory in economics. Windle and Dresner (1995) argue that while a logit model does not directly measure a customer's utility, it does indicate that the chosen airport provides the customer with the highest utility among multiple alternatives.

Among discrete choice models, a multinomial model is used for this dissertation since customers choose a carrier or an airport among multiple alternatives. Windle and Dresner

(1995) estimate customer choice among the three airports in the Washington Metropolitan Area with a multinomial logit model. For instance, with three discrete choices, a multinomial model estimates the probabilities of choosing one of the three nominally distributed (but not ordered) choices. As my study examines an individual customer's choice among multiple airports or airlines in a way that maximizes his/her utility, I believe that a multinomial logit model is appropriate as suggested by Proussaloglou and Koppelman, 1995). The generic form of the multinomial model is presented below (Equation (1)).

$$\text{Prob (Alternative 1)} = \exp(U_{\text{Alternative 1}}) / \sum \text{Exp}(U_{\text{Alternative i}}, i = 1 \text{ to } n) \qquad (1)$$

The model estimates the probability of choosing Alternative 1 as a function of the expected utility that a customer will have by choosing Alternative 1 among the summation of the expected utility of all alternative airlines. Generally, the decision making unit could be an individual person, firm or organization. In this study, it is an individual customer who needs to choose an airline or an airport for his or her air trip, and it is assumed that all individuals make their decisions in order to maximize their utility. A choice model will predict the probability that one airline (or airport) is chosen over one or more alternative airlines (airports) while a customer maximizes his or her utility.

2.6.2 Variable Choice Set

I will discuss the application of running the choice sets that have different numbers of alternatives for different customers.

Most of the choice studies in the air transportation use the same number of alternatives for every choice decision maker (Pels et al., 2003; Windle and Dresner, 1995; Proussaloglou and Koppelman, 1995). It means the number of alternatives is fixed across the choice sets for all customers. Customers have not only the same number of alternatives but also they have identical alternatives in the same order. As the number and identity of alternatives do not change, it is called 'fixed choice set'. Fixed choice set does not include any choice decision maker observation that has missing alternatives or different alternatives. In the real world, it is quite easily observed that one or more alternative may not be available and cannot be considered as an effective alternative that a customer can choose. In other words, not every customer has the same alternative choice set. The number of alternatives could be different. Even if the number of alternative is the same, the alternatives may not be identical. For instance, the availability of alternative wholesale stores may vary across customers depending on the locations where they live. While a customer sees Grocery A and Grocery B as available alternatives in City A, a customer views Grocery C and Grocery D as the alternatives in his or her local area, City B.

Recently, Suzuki (2007) runs a choice model with the observations that have different numbers of airline alternatives. The choice for each route ends up with having different numbers of airlines across the sample routes after the author removes the carriers that are not considered as effective alternatives. As a result, each customer faces the different number of alternative airlines depending on which route they travel on.

In my first essay, I collect customers' airline choice decision across different routes originating from the three airports in the Washington Metropolitan area. There are different numbers of alternative airlines in each route and the alternative airlines are not identical across the routes. Instead of only examining the observations from the routes where the identical airlines, accordingly the same number of airlines, compete (Proussaloglou and Koppelman, 1995), my airline choice study estimates customer's choice of airline across various routes in which there are different numbers and different identities of the airlines. As indicated by a previous study (Suzuki, 2007) that estimates a logit model with different numbers of alternatives for each route, this study uses 'Nlogit 4.0' (i.e., a standard discrete choice statistical software package). When choice makers have the different numbers of alternatives in a choice set, it is called a 'variable-choice set' (Hensher et al., 2005). For other cases than the fixed-choice set case where all choice makers have the same number and the order of the identical alternatives, it is useful to use a variable choice set model because it is often possible that some choosers have the alternates that are not available to certain customers (i.e. certain airlines may be not be available on some routes). Nlogit 4.0 allows researchers to estimate customer choice probability when each customer has the different numbers of alternatives in his or her choice set.

2.7 Summary

This literature review section summarizes previous literature regarding airline choice determinants (Appendix 2) and airport choice determinants (Appendix 3). It seems that the airline operational quality influences the customer's choice of airlines. The review also shows that customers might have more concerns about the operational quality when they are more exposed to the service operations or they place higher importance on time and convince utility. If it is true, the level of operations exposure may influence the customer's choice of an airline. Accordingly, the research question for the first essay is (1) Does airline operational quality influence a customer's choice of airline? (2) Does customer's operations exposure to the service moderate the relationship between airlines' operational quality and a customer's choice of airline? And (3) Does customer relevance in time and convenience utility moderate the relationship between operational quality and a customer's choice of airline? These questions will be discussed in Chapter 3.

Further, it seems that LCCs have been unique in just more than low fares and high service frequency. If it is true, LCC presence may influence customers not only through fares and service frequency. Consequently, the research question for the second essay is (1) Does the impact of LCC presence at airports influence the customer's choice of airport through above and beyond fare and service frequency? And are the airport choice determinants, including LCC presence at an airport, moderated by customer characteristics such as (2) customer's relative importance in time and convenience utility and (3) the geographical proximity of an alternative airport? These research questions will be discussed in more detail in Chapter 4.

Chapter 3 The Impact of Airline Operational Quality on Airline Choice

3.1 Introduction

When people travel by air, they have to choose an airline if there is more than one airline available serving a route. Several factors would affect customer's choice. Some of the main factors include airline fares, the airline's customer loyalty program, its service quality, etc. This study intends to focus on service quality as a main determinant of a customer's airline choice.

Service quality influences a customer's choice of service provider. Service quality may include several aspects of service such as staff performance, physical equipment performance and overall operational quality. This study specifically investigates the relationship between operational quality and customer choice. The main interest of this study is examining when this operational quality-customer choice relationship becomes stronger and weaker. Particularly, how this quality and choice relationship varies by customer characteristics such as operation characteristics and demographic characteristics of a customer. Consequently, this study will provide some meaningful managerial implications on when operational quality more strongly (or less strongly) influences customers when selecting an airline, resulting in increased (or decreased) airline market share and profitability.

Regarding the customer's operation characteristics, this study intends to test the moderating effect of a customer's exposure to service operations on the relationship between service provider's operational quality and customer's choice of a service provider. When customers are exposed to service (i.e., when contact occurs between the airlines and the customers), customers experience and evaluate the service, ultimately leading to a customer's decision as to whether they eventually choose to use the same service provider again. This contact moment can be described as the critical moment at which a service provider can impress customers with its service quality. This critical moment of customer contact leads to some questions for the service provider to answer such as: which service operation process is more customer contact sensitive? Do more (or less) contacts with customers better satisfy customers? What types of and amounts of resources are required to provide a proper level of customer contact? Previous literature reviews these questions by testing how the different levels of customer contact affect customer satisfaction as either a major factor or a moderator. The findings imply that service providers can affect customers with different amounts of contact with customers assumed that each customer requires the same amount of contact.

However, previous literature overlooks the idea that the amount of contact between customers and service providers will vary between customers. Basically, not all customers are the same in terms of how much they need to be contacted to service providers in service. Some customers may inherently require being more contacted (or exposed) while others may not. It means that the customer exposure level may be an important customer characteristic. Consequently, whether this customer characteristic influences a customer's choice of service provider is an interesting question. In other words, are customers affected by their level of exposure to service provider when they choose a service provider?

I believe that customers who have more exposures to service providers may become more sensitive about the relationship between a service provider's operational quality and their choice of service providers. For instance, suppose that there is one person who attends a conference but needs to come back home after one night. He or she may not be as interested in hotel service quality and may choose a hotel close to the conference place because he or she may have little (i.e., just one night stay) to lose even if the hotel service quality is not good. However, what if he or she stays more than a single night, say one week? The customer is more exposed to the hotel service (i.e., more contact with the hotel) throughout the one week. Then, this customer would tend to be more interested in hotel quality characteristics such as cleaning, staff, room service, etc. in choosing a hotel. We can observe the same phenomenon when we observe dining habits. Dining out with family members may be different from simply grabbing a small lunch alone. Customers who dine out with more people may seek more reliable and convenient restaurants in terms of providing services such as staff friendliness, ordering easiness, food delivery service, billing accuracy and payment process and so on. In another example, customers who expect transactions with a bank across various services such as savings, mortgage arrangements, tax payments, and investments (i.e., more contacts with the service provider) tend to put relatively more importance on service quality than customers who need a bank simply for a checking account. When customers are more exposed to service operations (i.e., with more nights in a hotel, more companions in a restaurant and more services with a bank), they have more to lose when the service goes wrong (i.e., poor performance in reliability and convenience). Consequently, these customers become more serious about operational quality of service providers and are more likely to choose service providers that offer better operational quality in reliability and convenience.

There are other customer characteristics that would make people more serious about operational quality of service providers. These customer characteristics may include how much customers appreciate time and convenience utility. For instance, customers with higher income may be more serious about time and convenience utility simply because time is money for them and inconvenience is another cost that they want to avoid. Customers that use services for business purposes may also be more serious about the quality of service than those who use service for leisure purposes because bad service may hurt their money-making business outcome. Are these high income customers and business customers more sensitive about the quality of service providers ultimately choosing better service providers?

By using both customer survey data and archival data, this study intends to answer these research questions through a choice model. The customer survey data provides information about customer choice and other customer characteristics such as their contact level and demographic information. The archival data provide information about service providers such as an objective measure of operational quality. Therefore, this study uses a discrete choice model to see if operational quality of service providers is more important for certain customers based on their customer characteristics.

This study is expected to contribute to previous literature. Previous literature shows that customer contact influences customers. This study extends this idea by considering that the amount that customers are contacted by service providers may be different because some people are more exposed to a service than are others. Then, service providers need to understand who are more exposed to service with more contacts and whether these customers seek different levels of service quality, resulting in a stronger demand for a different quality service.

Practically, there is another interesting implication. It has recently been observed in the US that many air service providers charge customers based on their increased amount of customer contact because customers with more contacts require extra airline resources, leading to additional costs. Airlines charge these fees to customers based on the costs and overlook different demands for different levels of operational quality services. If customers with more contacts with airlines prefer a better quality of service, airlines may consider selectively charging those customers because the demand for higher quality service by these customers is stronger than from those who have fewer customer contacts. This study will discuss this notion in more detail later in the conclusion section with a recent airline industry example.

3.2 Background

3.2.1 Motivation

US airlines have constantly claimed that they consistently and voluntarily attempt to improve service quality (Delta CEO, 2011[10]). But, service quality in the airline industry has been heavily criticized by both airline customers and the US Government (DOT, 2010 and 2011[11]). This inconsistency may have several causes. Simply, the improvements that airlines have made are not good enough to meet customer requirements. This inconsistency could also occur because the airlines improved their quality in some areas other than those that customers think needed to be improved (i.e., improvement in the wrong areas). Or, some customers may be easily satisfied with the improvements while others may not be satisfied due to some different individual characteristics. Finally, all these cases could take place together (i.e., improvements for the wrong customers). This study does not directly measure customer satisfaction and investigate the inconsistency between customer satisfaction and quality improvements. However, this study is interested in the case where some customers are satisfied with the service offered while others are not, even by the same service operational quality level. What if some customers are more serious about operational quality than other customers? What if the airlines have a lack of understanding of these different customers and do not identify what service aspects to improve accordingly? If these questions are answered affirmatively, the improvements that the airlines have made could have been good

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[10] "We actually think that our being able to innovate on behalf of our customers shouldn't be something that necessarily we have to wait for the government to do," (Richard Anderson, Delta CEO, 2011)

[11] "Airline passengers deserve to be treated fairly, and this new rule will require airlines to respect the rights of their customers," (LaHood, USDOT Secretary, 2010)

enough to satisfy those specific customers and to solve the inconsistency in quality beliefs between these customers and the airlines. If any airline can understand the different degrees in customer sensitivity to service quality, the airline may be able to better satisfy specific customers and may be more likely to be chosen by customers over their competitors.

This potential cause of the inconsistency issue (i.e., lack of understanding of customers' different sensitivities to operational quality) motivates this study and suggests that researchers need to examine the relationship between operational quality and customer's choice of service provider based on different customer characteristics. Thus, the focus of this study is on the impact of service quality in the airline industry on customer choice that varies by customer characteristics. This study will address the following three issues: (1) the impact of operation service quality on customer choice, (2) the moderating role of the customer's operational characteristics (i.e., the extent to which customers are *exposed* to service operations), and (3) how customer demographic characteristics (i.e., income level and trip purpose) may affect the relationship between operational quality and customer choice. Below, I will explain these issues in more detail.

3.2.2 Airline Operational Quality

A passenger's choice of airline is influenced by various aspects of service quality. Service schedule quality related to departure frequency and departing schedule delays (Brueckner and Flores-Fillol, 2007) are major determinants of choice because these factors increase a customer's time utility by reducing the elapsed time between a preferred departure time and the actual departure time. In addition, operational qualities that impact customer choice include the operation of direct flights, on-time performance (Proussaloglou and Koppleman, 1995), and baggage handling performance. This operational quality means increased reliability and convenience to customers. Reliability can be thought of as the, "*ability to perform* the promised service dependably and accurately" (Parasuraman and Grewal, 2000, p.6). Convenience refers to customers using services with few difficulties. If a service provider's operations are not reliable or convenient, customers may avoid choosing that specific service provider again.

In the airline industry, an airline may become operationally more reliable and offer more convenience by providing direct flights and by increasing on-time performance. Each of these factors is discussed below.

First, nonstop flight operations may increase the reliability and convenience of airline services. Direct flights transport customers and goods from point A to point B without intermediate transferring processes, whereas indirect flights carry customers through intermediary points, thus necessitating one or more connection to the final destination. Trips with fewer connections result in a shorter in-flight travel time and eliminate wait time for connecting flights, leading to greater convenience. In addition, with more direct flights, there is a lower chance of facing connection disruptions, in particular missed connecting flights, resulting in greater reliability.

Secondly, dependable and accurate service is associated with on-time flight operations. Unreliable flight operations (e.g., delays) cause inconvenience and diminish customer utility, negatively impacting customer satisfaction. For instance, poor on-time performance (i.e., delays) increases the chance of passengers arriving late to their destinations or missing connecting flights.

3.2.3 Customer Characteristics

Not all airline passengers experience the same impacts from inconvenient or unreliable service. There are some customers that are more sensitive to operational quality than others. For instance, some customers that are heavily exposed to service operations may experience a greater impact from operational quality. Customers who have checked baggage and/or are traveling with family members or other companions tend to be more exposed to service operations than customers without checked baggage and/or customers traveling solo. Unlike the customers without baggage, customers with checked baggage have to go through the additional check-in process, baggage handling and claim process. This type of customer may be more sensitive to the reliability of service operations and may choose to fly with airlines that offer direct service or are known for reliable on-time operations. The same may be true for customers with traveling companions. Customers traveling as a group tend to be more exposed to service operations as the number of traveling companion increases. This means that these customers have more to lose when service quality is inconvenient and unreliable. For instance, customers traveling with their young kids, elderly parents or important business partners may consider more seriously convenience and reliability of service operations. In these cases, the customers who are traveling with companions may prefer airlines that provide better operational quality.

The concept that certain customers are more exposed to service operations has been initially examined by previous studies. Chance and Tansik (1983) suggest a Customer Contact Model that explains why service processes that have a high customer contact level may need different, better, or more firm resources to serve customers. For example, in the restaurant industry, servers who have direct contact with customers should be customer-friendly and active in solving potential issues with customers. On the other hand, the staff working in the kitchens may not need these same attributes. In other words, customers can be better served if firms assign different, better or more resources (i.e., customer-friendly staff in this example) for the process in which customers are exposed to the service operations. Firms can identify these customer sensitive processes and can serve customers with operationally superior resources. This rationale is consistent with the claim of a customer encounter from a marketing perspective, that the moment that customers are exposed to service operations is a critical moment. Then, service providers need to impress customers at the service encounter so that those customers are willing to come back again.

In this study, I try to identify which customers are more exposed to service operations and test whether they are more sensitive to operational quality while they are served by airlines. For instance, customers more sensitive to service operations, including those who check baggage and are traveling with companions, may choose airlines that provide the highest level of service in the airline industry. The airline transport service seems quite homogenous such that most customers go through the same service processes: reservation service through the airlines or travel agents, check-in and boarding service at airports, and flight service by airlines. However, some customers may be more exposed to certain airline service operations than others. For instance, customers traveling with checked baggage are more exposed to airline operations than passengers traveling without baggage. When customers check baggage, they have to go through a longer check-in process, including weighing and tagging the baggage, potentially paying for checking baggage, and perhaps paying extra charges for overweight bags. The baggage must then be subject to baggage handling equipment and personnel, and is subject to inspection by security personnel. Additionally, there is assistance provided during the baggage claim process at the destination when the baggage is delayed and missed.

The question posed by this study is whether customers with greater operations exposure to airline service (i.e., the more customers are exposed to service operations) such as those traveling with checked baggage, are more sensitive to operational quality than other customers. This may result in these customers being more sensitive to service quality and, for example, seeking airlines that offer direct services (Lijesen, 2004) and good on-time performance. The next section will discuss the research questions in more detail.

3.2.4 Research Questions

This study takes into account customer operation attributes of airline quality to better understand the relationship between airline operational quality and customer choice of airlines: (1) Does operational quality influence a customer's choice of airlines?

As part of this first research question, I investigate how customers may respond differently to service quality in their airline choice decisions based on the level of operations exposure (i.e., contact between customers and the service operations provider) that they expect with an airline, using customer survey data containing information on the number of passenger's checked baggage and of accompanying flight companion. As a result, this research addresses the second research question: (2) Does operations exposure moderate the relationship between operational quality and a customer's choice of airline?

Further, this study examines the moderating impact of demographic customer characteristics on the relationship between operational quality and customer's choice. Customers who tend to have higher time and convenience utility may be more serious about service operational quality and be more likely to consider operational quality in their choice of service providers. A customer whose income level is high, or whose trip purpose is business, may put relatively more importance on operational quality, and these customers may try (i.e., more so than other customers) to avoid operationally unreliable and inconvenient airlines. The third question is therefore: (3) Does customer relevance in time and convenience utility moderate the relationship between operational quality and a customer's choice of airline?

Based on the research questions, the proposed conceptual model is presented in Figure 1.

3.2.5 Contribution

The contribution of this essay is the examination of the role of customer contact intensity on customer choice of service operators. This examination is expected to contribute to both the air transportation literature and the service operations literature.

First, previous air transportation research (Proussaloglou and Koppleman, 1995, Dresner and Xu, 1995) established the relationship between major operational quality dimensions (i.e., service schedule, lost bags, flight delays) and customer response (i.e., airline choice and service satisfaction). However, these studies did not examine how these responses may differ by the operational attributes, such as customer operational contact intensity. As a result, the implications of previous research for airline managers are quite limited in terms of understanding the impact of operational service quality on customer choice. Thus, this study contributes to the air transportation literature by explaining in more depth how operational service quality affects customer choice. This study is the first test in the airline industry of the moderating effect of customer operational attributes on the operational quality and customer choice relationship.

Second, a contribution of this study to the service operations management literature is to expand the impact of a customer contact model (Chase and Tansik, 1983). Previous studies argued that customer contact has a direct impact on service quality and customer satisfaction (Soteriou and Chase, 1998). Either an increase or a decrease in the level of customer contact determines, in part, customer satisfaction. This means that customer contact is considered as one service aspect (i.e., or a determinant of customer satisfaction) that influences customers. Thus, previous operations management researchers were interested in the firm's efforts and strategy about the amount of customer contact that is needed. Accordingly, they investigated the types of and amount of a firm's resources that are required to serve customers successfully. On the other hand, this study believes that different customers inherently may require different levels of contact with service operations while they are being served. This study considers the level of customer's operations exposure as one customer characteristic. Then, this study is interested in how different levels of customer's operations exposures affect the relationship between a service provider's operational quality and a customer's choice of service providers. In other words, does the relationship between operational quality and customer choice become weaker or stronger based on these customer characteristics? This study attempts to support and expand the previous literature by testing the impact of customer contact on customers when they choose a service provider, particularly airlines in this study.

3.3 Literature Review

This literature review section is divided into two parts. The first part of the review discusses studies of the factors driving a customer's choice of airline. While airlines compete by price, previous research examined other determinants of a customer's airline choice. These other factors included schedule qualities and operational performance factors, such as on-time performance and baggage handling. The first part of this review intends to show how these factors influence the choice of an airline.

The second part of the review summarizes previous studies on customer characteristics. This part reviews two customer characteristics; operational characteristics and demographic characteristics. Both of these two customer characteristics may affect airline choice. In this second part, the first portion reviews previous literature on operational exposure between customers and service providers through the customer contact model. The second portion reviews previous literature about the impact of customer's demographic characteristics on customer choice.

3.3.1 Airline Choice Determinants

The most critical factor that drives a customer's choice of airline may be service schedule. Departing at a time when a customer wants to leave is the key factor in flight scheduling (Brueckner Flores-Fillol, 2007) because it reduces schedule delay for customers. A frequent schedule that maximizes the chance to depart at a time close to a customer's desired departure time positively influences customers. Proussaloglou and Koppelman's study (1995) tests this notion through a multinomial logit model of airline choice and finds a positive relationship between schedule convenience and a customer's choice of airlines. Suzuki (2007) also supports the idea that high flight frequencies are positively associated with a customer's choice of an airline. The implication of these results is that being able to depart at a convenient time is a significant determinant of a customer's choice of airline.

A nonstop flight to a final destination also matters to a customer's choice of airlines. Previous studies argued that connecting flights increase travel time, incur the inconvenience of changing planes, add connecting time, and cause passengers to face the possibilities of flight delays and lost baggage. Indeed, nonstop flights are considered by customers to be of a higher quality service (Lijesen, 2004) compared to connecting flights, and thus may attract customers (Coldren et al., 2003; Adler et al., 2005). Adler et al. (2005) test the impact of direct service on business customers. The study shows that business travelers are more sensitive to the number of connections and flight duration time than are non-business travelers. This result is likely due to the higher value that business travelers place on travel time (Windle and Dresner, 1995). Morrison and Winston (1989) show that transfer time has the highest value to travelers followed by flight duration time. The authors tested the sensitivity of air travelers to flight duration time, connecting time, flight delays and wait time between desired departure time and scheduled departure time through an airline choice model. This literature supports the finding that transfer time is the time that customers most want to avoid. This literature also supports the argument that direct flights are important to customers, especially those with a high value of time (i.e., business travelers). In short, customers consider connecting flights to be an inconvenient and unreliable service.

Regarding airline characteristics, Proussaloglou and Koppelman (1995) examine the relationship between operational performance factors and customer choice. The factors that influence a customer's choice of airlines include on-time performance and mishandled baggage. The research shows that customers prefer airlines that offer higher on-time performance. Dresner and Xu (1995) test the impact of operation service factors on customer satisfaction, and ultimately on airline profits. The operation service factors include on-time performance and lost bags. This study shows that improving one measure of customer service (i.e., lost baggage) increases revenues and leads to a net increase in airline profits, whereas improving another measure of customer service (i.e., on-time performance) increases revenues and leads to a net decrease in airline profits. However, the study does not explicitly observe how operation service factors influence customer choices. Further, Tsikriktsis (2007) examines operation service factors including on-time performance and lost baggage on an airline's financial performance. The author argues that poor on-time performance will cause more damage to the financial performance of some airlines whose known service strength is on-time performance. However, no empirical results are presented to back this supposition.

Before I summarize the review of airline choice determinants, one more determinant needs to be discussed. Although not a quality factor, airline trip fare is one of the most important determinants when customers choose an airline. Fare level is empirically tested by Proussaloglou and Koppelman (1995). They find that lower fares attract customers; particularly customers who travel frequently consider low fares more important than infrequent travelers. Later studies (Proussaloglou and Koppelman, 1999; Dresner, 2006; Addler and Hashai, 2005) find that low fares are more important for leisure travelers. Dresner (2006) and Addler and Hashai (2005) report the same result in their studies; that is, leisure travelers are more sensitive to fares in choosing an airline. This means that leisure travelers who tend to pay for their fares from their own pocket may choose airlines with low fares more so than will business travelers whose fares are often paid by their employers. Thus, fares need to be taken into account in the model that this study proposes.

In summary, this study tests the impact of operational quality on customer choice of airline. Then, this study will follow the previous studies that are discussed above and measure an airline's operational quality using nonstop service schedule and on-time performance, and then test these two variables on customer's choice. In addition, fare will be used as a control variable.

3.3.2 Customer Characteristics

This section will discuss two customer characteristics: operation characteristics and demographic characteristics. I will discuss the operation characteristics first.

3.3.2.1 Operation Characteristics

By introducing an operational theory regarding customer contact with service operators using a customer contact model (Chase and Tansik, 1983), I intend to expand on how different customers respond to airline operational quality (i.e., direct flights and on-time performance) based on how much they are exposed to service operations. Pervious literature explains why contact between customers and service providers take place. Service provision necessarily involves contact with customers, known as inseparability. Inseparability means that service cannot be performed separately from customer contact

(Parasuraman and Grewal, 2000). This means that customers are part of service operations and the interaction between service and customers will affect service quality (Parasuraman et al. 1985). These studies argue that service quality is experienced and evaluated when a customer encounters service. Customer contact is the critical timing when service impresses customers, and when customers decide whether to return for the same service.

In addition, previous researchers discuss service encounter from a slightly different point of view (Chase, 1981; Chase and Tansik, 1983; Kellog and Chase, 1995; Soteriou and Chase, 1998; Anderson et al., 2009). These researchers are more interested in a firm's role; that is, what firms do for the moment when service and customers are exposed to each other. The researchers investigates the service operations process that tends to have more contacts with customers; the types of and the quantity of a firm's resources required to successfully satisfy customers who are part of a service encounter. Thus, this previous research examined the relationship between the level of customer contact and customer satisfaction to understand how much a firm needs to increase or decrease a level of customer contact. Basically, these arguments were discussed based on the notion that customers are homogenous in terms of their contact requirement with service operation.

However, what if each customer is heterogeneous in that they are differently exposed to (or contacted by) service providers. I am interested in how does a customer chooses a service provider if a certain level of operations exposure is in advance expected by each customer. Which customers become more or less sensitive to a service provider's quality?

Which customers prefer a service provider that offers better operational quality? Does this imply something to service firms since there are different levels of demand for different service qualities? Before I further discuss my hypothesis, I will review the literature regarding customer contact in detail below.

Chase (1981) defines customer contact as a customer's direct contact with a service provider. The author distinguishes between how the front shop deals with customers and how the back office produces services. For example, in restaurants, serving customers at the hall is different from back kitchen operations, and is highly interacted with customers. Customer contact with hall service influences the overall service quality that customers receive. Chase and Tansik (1983) conceptually developed the customer contact model. The model demonstrates that service operators need to identify the service operation processes that require a greater degree of contact with customers and then provide the resources (e.g., customer friendly staff) to effectively serve customers in those processes. Kellog and Chase (1995) develop empirical measurements, such as communication time, information richness, and intimacy in order to gauge the degree of customer contact.

In short, the summary above argues that firms determine a level of customer contact which, in turn, influences customer satisfaction. In other words, the level of customer contact may change a customer's perception of the service provided. However, previous literature overlooked the notion that different consumers would require different levels of customer contact. In this essay, I view the amount of operations exposure as customer characteristics and examine how customer operations exposure level influences customers in terms of how much they become sensitive to operational quality, thus affecting a customer's choice of service provider. Thus, this study tests the moderating effect of this operations exposure on customer choice of service provider, using the airline industry as a research setting.

3.3.2.2 Demographic Characteristics

There some previous studies (Proussaloglou and Koppelman, 1995; Adler et al., 2005) that suggest that customers place different values on time and convenience for their airline trip. Customers who have a strong preference for (short) travel time and for convenience may be more sensitive to operational quality than less-sensitive customers, leading them to choose a service provider based, in part, on the operational quality.

The notion that different groups of air travelers may have different characteristics is discussed by Proussaloglou and Koppelman (1995). They find that frequent travelers are more sensitive to on-time performance than are infrequent travelers. The study also finds that business travelers are less sensitive to fares than are leisure travelers. Adler et al. (2005) segment business travelers and show that business travelers are more sensitive to flight duration time than are non-business travelers. Business travelers want to minimize travel time because they can use the saved time for further business. They are interested in shorter travel time and also being on time because they may lose business opportunities that could generate revenues if they are late. They also tend to appreciate convenience more than leisure travelers because they may want to rest while traveling.

Along these same lines, high income customers tend to place more value on time because each unit of time has the potential to generate more revenue (i.e., time is money for them) than for low income people. Indeed, Basar and Bhat (2004) tested to see if high income people prefer higher service quality, such as higher flight frequencies. However, they found the surprising result that high income air travelers are negatively associated with routes with high frequencies (a proxy for total travel time; i.e., high frequencies result in lower total travel time), while in general all travelers are positively associated with high frequencies. The authors attributed this finding to the fact that high income customers tend to travel during peak hours and may not be sensitive to overall frequencies throughout the day.

In summary, the literature supports the argument that customer characteristics may influence preference for service operational quality, which in turn, influences choice of service provider. This idea is investigated in the following section.

3.4 Hypotheses

Operational quality may positively influence a customer's choice of service provider. In previous studies, operational quality is defined in terms of characteristics such as consistency of service, accuracy of service and service utility provided to customers, such as time, place and form utility (Schlesinger and Heskett, 1991; Stank et al., 1999). From the customer's perspective, operational quality refers to the **reliability** and **convenience** of service. Previous studies testing the impact of operational quality support this notion. Roth and Van Der Velde (1991) find that consistent service determines a firm's competitiveness in the banking industry. Stank et al. (1999) found a positive impact from a supplier's operational performance, such as delivery dependability and accuracy of orders or promises, on customer satisfaction in the fast food industry.

In the airline industry, operational quality can be measured in at least two ways. First, the number of connections to the final destination might be a measure/proxy for operational reliability and/or convenience. Routes with more connections increase inconvenience, such as wait time and aircraft transfers. At the same time, routings with more connections increase the chance of being disrupted during the transfer process, such as missed flights and lost bags. In previous studies, the number of connections has been found to negatively impact a customer's choice of itinerary (Adler et al., 2005; Coldren et al., 2003). These studies commonly argue that unreliability of connecting operations is one of the reasons for a customer to avoid connecting flights.

Secondly, on-time operations can be determinants of operational quality. Basic airline service transports customers and their belongings to a final destination on schedule. Therefore, poor operational performance of this basic service (i.e., delays and lost baggage) can negatively affect customer choice. Previous studies test this idea. Proussaloglou and Koppelman (1995) separate on-time performance from service schedule quality, and measure it with subjective ratings based on travelers' experience across different airlines. The authors found that on-time operations are positively associated with a customer's choice of airlines. Tsikriktsis (2007) examines delays and lost bags. The author finds that delays diminish a carrier's profitability, implicitly arguing that customers respond negatively to delays. Tsikriktsis (2003) measures delays in two ways, using both variations in delay and average delays. He finds, particularly, that operational inconsistency influences customer responses. Further, Dresner and Xu (1995) measured an airline's service level using measures for lost baggage and flight delays. The authors argue that poor on-time arrival and poor baggage handling records negatively affect customer satisfaction, and ultimately affect an airline's financial performance. Based on these arguments, my first hypothesis is that an airline service provider with higher levels of operational quality, such as reliability of service, is more likely to be chosen by customers.

Hypothesis 1: Operational quality is positively associated with customer's choice of airline.

However, what if the customer contact level varies across customers? Previous studies did not examine variation in contact level across customers. However, many previous studies (Dresner, 2006; Armantier and Richard, 2008) suggest that airline passengers are heterogeneous. This study is interested in this variance, particularly in terms of customer contact level requirements. Customers with a higher level of customer contact tend to be more influenced by operational quality because they are more exposed to service operations. Once their exposure to service operations is high, customers want their service to be more reliable and convenient to maximize their utility.

In the airline industry, there are some customers who may anticipate more operations exposure with airline personnel. For instance, customers traveling with check-in baggage are more exposed to service processes than those traveling without; that is, they are also reliant on airline check-in staff to properly weigh and tag their baggage and are more reliant on airline baggage handlers to properly load, unload, and sort their baggage. Additionally, at the destination these customers are dependent on assistance from airline staff when the baggage is delayed or missed. If service quality is bad, these customers have a greater chance for a negative experience. Therefore, these customers may look for service providers that offer more reliable and convenient service, such as direct flights versus connecting flights. This may also be true for airline customers traveling with companions. When customers travel with companions, such as young children, elderly parents, or important business partners, they may seek a provider with high service quality. As a result, the following hypothesis is tested:

Hypothesis 2: Customer's exposure to service operation positively moderates the relationship between operational quality and customer's choice of airline.

A customer's demographic characteristics may also influence his/her airline choice. This study looks at two characteristics – income level and trip purpose, both of which may be correlated with the value of a customer's time and preference for convenient service. Basar and Bhat (2004) test the moderating impact of customer income on the relationship between customer choice of airports and daily flight frequency at an airport. Their results show a counterintuitive finding: high income customers are less sensitive to service frequency. The authors argue that trip frequency (measured in terms of number of flights per day) may not be desired by high income customers since they may only prefer to travel during peak time periods. On the other hand, Basar and Bhat (2004) found that high income customers are more sensitive to access time, thus implying that these customers may have a higher value of time. Since operational quality influences convenience and time utility, high income customers may more strongly respond to the level of operational reliability provided by an airline than low income customers. Along the same line, business customers may react more strongly to reliable service operations than leisure passengers (Morrison and Winston, 1989). In fact, business customer segmentation has been tested and found to be positively associated with various aspects of service quality (i.e., high service frequency and shorter airport access time) in previous air transportation studies (Windle and Dresner, 1995; Pels et al., 2001). Thus, I posit the following hypothesis:

Hypothesis3: Customer's relative importance of convenience and time value positively moderates the relationship between operational quality and a customer's choice of airlines.

3.5 Data Sample

3.5.1 Source

In order to test the proposed hypotheses, information is required regarding the airline chosen by each individual customer (i.e., airline choice) and levels of airline operational quality (i.e., airline characteristics). Information about airline choice and customer characteristics is obtained through survey data, while airline characteristics are obtained through two different archival data sources.

It is critical to separately measure customer choice and airline characteristics from two different data sources for the following two reasons. First, this research can avoid common method bias in testing a causal-effect relationship; that is, the same customers answered both the questions evaluating airline operational quality (i.e., cause) and their choice of an airline (i.e., effect). The second reason is that this study uses archival data to measure the operational quality with quantified values of the airline operational quality. Operational quality that is measured in quantified values based on airlines' actual performance provides a more objective evaluation of airline quality than does survey data from an individual customer's subjective evaluation. By using both survey data and archival data, the test results of the relationship between airline characteristics and a customer's choice of airline in this study will be more reliable.

Regarding the customer's choice of airline, the Washington-Baltimore Regional Air Passenger Survey is used as the data source. The survey has been implemented by the Metropolitan Washington Council of Governments (MWCoG) since 1981. Recently, the survey has been conducted every other year. This study uses the most recent three surveys conducted in 2005, 2007 and 2009. The sample includes passengers departing from the three airports in the Washington Metropolitan Area: Washington Dulles (IAD), Baltimore/Washington Thurgood Marshall (BWI), and Ronald Reagan National (DCA). Table 2 provides a summary of the three survey years of data.

Table 2 Summary of Survey Data

Survey Year	2005	2007	2009	Total
Survey Period (2 weeks)	Mar.6~9	Oct.7~20	Oct.11~24	6 weeks
Sampled Flights	675	685	679	2,039
Enplaned Passengers	48,000	55,500	59,300	162,800
Interviewed Passengers	24,000	27,300	29,700	81,000
Response Rate	50.0%	49.2%	50.1%	49.8%*
Completed Survey	16,000	19,000	20,900	55,900

* Average of the response rates of the three survey years

All scheduled flights departing from the three airports during the survey period were selected or interviews. Among these flights, approximately 675~685 flights were surveyed in all three years. The total number of the enplaned passengers for these flights is about 162,800. The survey staff was able to interview approximately 81,000 departing passengers waiting for their flights at the gate area and the response rate reached around 50%. Among these interviewed passengers, about 55,900 passengers completed the survey. [12]

[12] Potentially, there might be an imbalance among the surveyed passenger numbers across flights. Suppose that 30 passengers on Flight A completed the survey while only 5 passengers on Flight B did the same. Then, weighting the number of passengers by flight may be necessary. However, this study believes that the customers on Flight A are not significantly different from Flight B. For instance, customers flying on a flight from IAD to PDX (Portland, OR) may not be much different from the customers flying on a flight from BWI to PDX (or from IAD to San Antonio (SAT, TX)) particularly in responding to airline operational quality when they choose an airline. Thus, this study does not weight the passenger numbers by flight to control the imbalance of the surveyed passenger numbers.

The survey data provides information regarding the airline, the route and the flight that passengers used. The survey also provides specific customer demographic information, such as income level, trip purpose, the number of checked bags and companions that customers travel with (a copy of the survey questionnaire is provided in Appendix 4). The individual's income level and trip purpose may influence the customer's choice of airline. The number of bags and companions can indicate how much customers are exposed to the service operations.

The other information that is needed for this study is on airline operational quality, such as nonstop flight frequency and on-time performance. In order to obtain this information, my study uses two archival data sources: the flight service schedule data from the Official Airline Guides (OAG) and The Airline Origin and Destination Survey Databank 1B (DB1B) market data from the US Department of Transportation (DOT). The flight service schedule data was purchased from OAG. These data provide information regarding the number of connections and the frequency of flights for an airline on a specific route. The frequency of flights indicates how frequently flights were available for customers to choose (i.e., how much customers can minimize their wait time for a flight).

The second archival data is the DB1B market data bank. DB1B is publicly available and can be downloaded from the DOT's Bureau of Transportation Statistics (DOT BTS) web site. DOT generates DB1B by collecting a sample of 10% of all domestic tickets and recording all relevant information from the tickets. The information includes origin airport, destination airport, airline, air fare, etc. With this information, researchers can calculate average fares by route and by airline. Other data that can be obtained through DOT BTS includes an airline's on-time performance rate. This on-time performance data includes the number of flights, the delayed minutes and the number of delays longer than 15 minutes for a specific origin and destination airport pair. By using this information, the on-time performance by an airline on a specific route can be calculated to measure the airline's operational quality. More details on measurement are discussed later in the measurement section.

3.5.2 Sample Analysis

Three survey years (2005, 2007 and 2009) of the Washington-Baltimore Regional Air Passenger Survey data is provided by MWCoG. In their survey response, passengers indicated a flight number, thus identifying the operating airline and the flight destination airport. In addition, passengers were asked to indicate the number of traveling companions and the number of checked bags. They also revealed personal information, including trip purpose and household income.

The total number of survey observations for the three year survey was 55,900. This number was reduced to 36, 283 after connecting passengers and international passengers were excluded. Among these 36,283 observations, 9,900 observations were initially selected because only these observations had all the required information, such as number of bags, number of companions, income, trip purpose and final destinations to test the proposed hypothesis[13]. These 9,900 observations were collected across more than 300 airport pairs (322 in 2005, 312 in 2007 and 342 in 2009) originating from the three airports in the Washington Metropolitan Area.

This study selected sample routes based on market size, the existence of survey observations, and the existence of alternative airline services (thus allowing for customer choice). Market size refers to the volume of origin and destination passengers from the three airports in the Washington Metropolitan Area. Short distance routes with small traffic volumes are not included in the sample because these routes have few realistic options for customers to choose (Windle and Dresner, 1995). Given this argument, the top 45 routes from the Washington Metropolitan area were selected from the archival data, DOT DB1B (Appendix 6). None of the top 45 routes are short except for the routes to the airports in New York. But, these routes have a good amount of passenger traffic and accordingly multiple alternative airlines are easily available in these routes. These 45 city pair routes resulted in135 origin and destination airport pairs (i.e., 45 destinations multiplied by the three airports in the Washington Metropolitan Area). Each departing airport (BWI, DCA and IAD) was paired with the same top 45 destination airports over each of the three survey years, leading to 405 airport pairs (135 airport pairs x 3 years). Some of these 405 routes were not used for this study. I will explain the reasons below.

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[13] Once the observations that do not have all the required information are excluded from the sample, it is possible that the sample differs from the population (the whole domestic departing observations). Thus, this study performed the test of comparing the means of the customer characteristic variables between the whole population and the sample. The results of the test show that the sample is biased (Appendix 5). There are fewer business customers are included in the sample, resulting in fewer companions, fewer bags and lower income compared to the whole populations. I guess that fewer business passengers, who were usually busy, could finish all the survey questions.

It was necessary to verify the existence of an alternative airline on each route. The routes that did not have alternative airlines were excluded from the sample. To represent effective competition on a route, an airline must have significant market presence. In his analysis, Suzuki (2007) did not consider airlines with less than a 2% market share as effective competitor on a route. My study considers that airlines that have more than a 4% market share based on the number of flown passengers between the trip origin and destination airport (DB1B, DOT) as an effective competitor. This study used a higher market share cutoff than Suzuki (2007), since Suzuki examined a number of very thin routes from smaller airports. After excluding the airlines with less than a 4% market share, 80 of the 405 routes over the three survey years were excluded from the sample. Among the routes that were selected based on the passenger volumes obtained from the archival data, seventeen routes had zero observed customers because there might be no customers responded in the sample routes. These routes were excluded.

Table 3 shows the number of routes dropped from the sample and explanations for not including them in the sample. Additional routes were excluded due to missing values for important airline characteristic variables. When there is no on-time performance available for carriers, the routes are excluded. There are two reasons; no reporting carrier and no information. Twenty seven routes (439 observations) were dropped from the sample because at least one of the airlines that served the route did not have on-time performance records (no reporting carrier). US DOT only reports on-time performance for 18 large airlines[14]. For instance, Sun Country (SY), American Trans (TZ), Virgin America (VX) and Midwest (YX) did not report their on-time performance, and the routes that include these airlines were excluded from my sample. Besides, eighteen routes (401 observations) were excluded due to no data on on-time performance while it is shown that carriers provide nonstop flight for a route (no information). Furthermore, twenty one additional routes (193 observations) were dropped because none of the alternative airlines in these routes provides nonstop service. When there is no nonstop service available, customers can only choose connecting flights regardless of customer characteristics (i.e., income, trip purpose, number of bags and companions).

[14] BTS Airline On-Time Performance (http://www.bts.gov/help/aviation/index.html#q1): AirTran Airways (FL), Alaska Airlines (AS), American Airlines (AA), American Eagle (MQ), Atlantic Coast Airlines (DH), Atlantic Southeast Airlines, Comair (OH), Continental Airlines (CO), Delta Air Lines (DL), Hawaiian Airlines, JetBlue Airways (B6), Mesa Airlines (YV), SkyWest Airlines (OO), Southwest Airlines (WN), United Airlines (UA), US Airways (US)Alaska Airlines (AS), American Airlines (AA), American Eagle (MQ), Atlantic Coast Airlines (DH), Atlantic Southeast Airlines, Comair (OH), Continental Airlines (CO), Delta Air Lines (DL), Hawaiian Airlines, JetBlue Airways (B6), Mesa Airlines (YV), SkyWest Airlines (OO), Southwest Airlines (WN), United Airlines (UA), US Airways (US)

Table 3 Sample Routes and Observation (Obs.) Numbers

		2005		2007		2009		Route		Customers	
		Route	Obs.	Route	Obs.	Route	Obs.				
Domestic departing with all required information		322	2,942	312	3,138	342	3,820	976	-	9,900	-
Top 45 Destinations		135	2,178	135	2,427	135	2,887	405	41.5%	7,492	75.7%
No Observation		(5)	(0)	(6)	(0)	(6)	(0)	(17)		-	
Single carrier		(27)	(394)	(27)	(530)	(26)	(541)	(80)		(1,465)	
No on-time performance	No reporting carrier	(9)	(159)	(8)	(79)	(10)	(201)	(27)		(439)	
	No information	(10)	(102)	(5)	(26)	(17)	(289)	(32)		(417)	
All Connecting service		(8)	(46)	(5)	(50)	(8)	(97)	(21)		(193)	
More than 6 companions		-	(43)	-	(30)	-	(32)	-		(105)	
More than 4 check-in bags		-	(43)	-	(26)	-	(17)	-		(86)	
Total		76	1,391	84	1,686	68	1,710	228	23.4%	4,787	48.4%

* Note that the numbers in the parentheses are the reduced number of routes and observations.

In addition, certain observations that lacked customer-specific data or contained questionable survey data were also excluded from the analysis. Customers that traveled with more than six companions were excluded. The number of traveling companions is the key indicator showing the level of the contact between customers and service providers. However, customers that indicate such a large number of companions may actually be part of a tour group. Along the same lines, customers who reported more than four pieces of baggage were dropped from the sample.[15] As a result, the number of observations in the final sample was reduced to 4,787 across 228 routes.

[15] For instance, there is a customer indicated that he or she checked in fifty bags in 2007.

Table 4 shows the distribution of routes and observations by number of alternative airlines. Eighty six routes (2,219 customers) have two alternative airlines, accounting for the largest portion of the sample. A smaller number of routes (4,426 customers, 92.5% of the sample observations) have two to four airline competitors per route. The maximum number of alternative airlines that an individual route has is nine airlines (DCA-LAX in 2005). The average number of the alternative airlines is 3.2 airlines per route. Appendix 7 shows the origin and destination airport pairs and the number of alternative airlines by airport pair for all routes in the sample.

Table 4 Number of Sample Routes and Observations by Number of Alternative Airlines

Number of Alternative Airlines	Number of routes	%	Number of observations	%
2	86	38.0%	2219	46.4%
3	69	30.1%	1224	25.6%
4	45	19.7%	983	20.5%
5	13	5.7%	92	1.9%
6	5	2.2%	102	2.1%
7	7	3.1%	104	2.2%
8	2	0.9%	56	1.2%
9	1	0.4%	7	0.1%
Total	228	100.0%	4787	100.0%

Regarding the length of the routes, the average number of miles flown per route is 1,182. The longest route is DCA to OAK at 2,573 miles. The shortest route is DCA to LGA at 219 miles. There are only three routes (i.e., less than 3% in terms of flown number of passengers) with flown miles shorter than 300 miles. They are DCA to LGA, DCA to

RDU and IAD to RDU (refer Appendix 8 for the airport codes). This means that most of the routes in the sample are free from the substitution effect from other transportation modes, such as bus, train and car. For instance, driving longer than 300 miles (more than a five hour drive at 60 miles per hour) is not a very good substitute for air travel. Table 5 shows the flown route miles for each of the 106 airport pairs, which are unique airport pairs during the three survey years.

Table 5 Route Flown Miles

(The list of airport codes is attached in Appendix 8)

No	Route	Miles	Accumulated Percentage	No.	Route	Miles	Accumulated Percentage	No.	Route	Miles	Accumulated Percentage
1	DCA-LGA	219.0	0.9%	37	BWI-JAX	757.4	34.9%	73	IAD-SAT	1421.4	68.9%
2	DCA-RDU	229.9	1.9%	38	DCA-STL	769.2	35.8%	74	BWI-SAT	1462.4	69.8%
3	IAD-RDU	231.9	2.8%	39	IAD-MCO	791.0	36.8%	75	DCA-SAT	1480.8	70.8%
4	BWI-RDU	314.3	3.8%	40	BWI-STL	791.1	37.7%	76	DCA-DEN	1561.3	71.7%
5	BWI-CLE	325.6	4.7%	41	DCA-MCO	834.2	38.7%	77	BWI-DEN	1567.8	72.6%
6	IAD-BDL	326.8	5.7%	42	IAD-TPA	844.8	39.6%	78	IAD-DEN	1580.4	73.6%
7	IAD-CLT	343.0	6.6%	43	BWI-MCO	844.8	40.6%	79	IAD-SJU	1656.1	74.5%
8	DCA-CMH	345.9	7.5%	44	DCA-TPA	867.7	41.5%	80	BWI-SJU	1701.2	75.5%
9	BWI-BOS	368.7	8.5%	45	BWI-TPA	895.6	42.5%	81	IAD-ABQ	1720.7	76.4%
10	IAD-PVD	372.3	9.4%	46	DCA-PBI	914.9	43.4%	82	BWI-ABQ	1779.7	77.4%
11	BWI-CLT	384.1	10.4%	47	BWI-PBI	935.7	44.3%	83	IAD-SLC	1941.9	78.3%
12	DCA-CLT	385.3	11.3%	48	DCA-RSW	943.5	45.3%	84	BWI-SLC	1943.3	79.2%
13	IAD-DTW	392.2	12.3%	49	BWI-RSW	950.4	46.2%	85	DCA-SLC	1954.5	80.2%
14	DCA-BOS	399.2	13.2%	50	IAD-FLL	954.7	47.2%	86	IAD-PHX	2053.4	81.1%
15	IAD-BOS	413.0	14.2%	51	IAD-MIA	959.0	48.1%	87	DCA-PHX	2069.9	82.1%
16	IAD-MHT	417.4	15.1%	52	DCA-MIA	963.4	49.1%	88	BWI-PHX	2078.3	83.0%
17	BWI-DTW	423.8	16.0%	53	DCA-MSP	977.0	50.0%	89	IAD-LAS	2146.4	84.0%
18	DCA-DTW	426.7	17.0%	54	IAD-MCI	979.9	50.9%	90	BWI-LAS	2184.0	84.9%
19	IAD-BUF	431.4	17.9%	55	BWI-FLL	980.9	51.9%	91	DCA-LAS	2218.2	85.8%
20	DCA-CLE	463.3	18.9%	56	BWI-MSP	989.0	52.8%	92	IAD-SAN	2313.9	86.8%
21	IAD-IND	535.2	19.8%	57	BWI-MIA	993.0	53.8%	93	IAD-LAX	2335.2	87.7%
22	DCA-IND	538.8	20.8%	58	IAD-RSW	1008.4	54.7%	94	BWI-SAN	2385.1	88.7%
23	IAD-ATL	541.0	21.7%	59	IAD-MSY	1010.9	55.7%	95	BWI-LAX	2391.3	89.6%
24	DCA-SDF	547.8	22.6%	60	IAD-PBI	1011.1	56.6%	96	DCA-LAX	2412.1	90.6%
25	DCA-ATL	564.6	23.6%	61	DCA-MSY	1028.9	57.5%	97	IAD-SEA	2452.9	91.5%
26	IAD-BNA	596.1	24.5%	62	BWI-MCI	1071.9	58.5%	98	IAD-PDX	2458.5	92.5%
27	DCA-BNA	601.9	25.5%	63	BWI-MSY	1128.3	59.4%	99	IAD-OAK	2463.6	93.4%
28	BWI-ATL	602.7	26.4%	64	IAD-DFW	1210.8	60.4%	100	DCA-SEA	2469.6	94.3%
29	DCA-ORD	633.1	27.4%	65	IAD-IAH	1227.0	61.3%	101	IAD-SMF	2475.0	95.3%
30	IAD-ORD	645.1	28.3%	66	DCA-DFW	1239.4	62.3%	102	BWI-SEA	2504.4	96.2%
31	BWI-ORD	648.3	29.2%	67	DCA-IAH	1264.5	63.2%	103	BWI-SFO	2542.5	97.2%
32	BWI-IND	660.9	30.2%	68	BWI-DFW	1270.2	64.2%	104	BWI-OAK	2552.3	98.1%
33	IAD-JAX	669.9	31.1%	69	BWI-IAH	1284.1	65.1%	105	BWI-PDX	2554.3	99.1%
34	IAD-SDF	689.7	32.1%	70	IAD-AUS	1363.3	66.0%	106	DCA-OAK	2573.4	100.0%
35	DCA-JAX	690.4	33.0%	71	BWI-AUS	1395.6	67.0%				
36	BWI-MKE	713.4	34.0%	72	DCA-AUS	1409.1	67.9%				

3.6 Model

3.6.1 Model Specification

This study tests the relationship between a customer's choice of airline and airline characteristics. A customer's choice of airline is discrete. No one can choose more than a single airline for a flight as a customer's choice of airline is a discrete event. The Logit model can estimate this type of customer's discrete choice. Particularly, when there are more than two alternatives, a multinomial logit model is suggested by previous studies (Train and McFadden, 1978)

This study predicts a customer's choice of an airline among two or more alternative airlines. Thus, this study uses a multinomial logit model (Proussaloglou and Koppleman, 1995). The generic form of a multinomial logit model (Equation (2)) is shown below. The model estimates the probability of choosing Airline 1 as a function of the expected utility that a customer will have by choosing Airline 1 among the summation of the expected utility of all alternative airlines:

$$\text{Prob(Airline 1)} = \exp\left(U_{\text{Airline 1}}\right) / \sum \text{Exp}\left(U_{\text{Airline i}}, i = 1 \text{ to } n\right) \qquad (2)$$

Generally, the decision making unit could be an individual person, firm or organization. In this study, it is an individual customer who needs to choose an airline for his or her air trip, and it is assumed that all individuals make their decisions in order to maximize their utility. A choice model will predict the probability that one airline is chosen over one or more alternative airlines while a customer maximizes his or her utility. In the choice model, there are two groups of determinants that might influence a customer's choice as suggested by Proussaloglou and Koppelman (1995) and Windle and Dresner (1995): choice specific (i.e., airline operational quality characteristics) and chooser specific (i.e., customer operational characteristics and demographic characteristics). Consequently, the model shows what airline characteristics determine the probability that an airline is being chosen, and the relative importance of each choice determinant compared to other determinants. Finally, this study tests how the operational customer characteristics and the demographic characteristics influence the relationship between the airlines operational quality and the customer's choice.

Choice specific variables include measures for the quality of each airline's operations. In this study, I focus on operational quality, such as nonstop flights and on-time performance at the route level. Chooser specific variables vary depending on the characteristic of a particular customer and include factors such as trip purpose and income level. Customer's operations exposure is measured by the number of bags checked and the number of companions as chooser specific variables. These chooser specific variables are expected to moderate the relationship between the choice-specific variables (airline operational quality) and a customer's airline choice.

In order to test the hypotheses, this study uses a multinomial logit model to estimate a customer's discrete choice among multiple alternative airlines as suggested by previous studies (Proussaloglou and Koppelman, 1995; Windle and Dresner 1995). However, unlike these previous studies, my study has different numbers of alternatives. Thus, I will discuss the application of running the choice sets that have different numbers of alternatives for different choice makers.

Most of the choice studies in the air transportation use the same number of alternatives for every choice decision maker. It means the number of alternatives is fixed across the choice sets for all customers. Customers have not only the same number of alternatives but also they have identical alternatives even in the same order. As the number and the identity of alternatives do not change across choice makers, it is called ‘fixed choice set’. Fixed choice set does not include any choice decision maker observation that has a different choice set due to missing alternatives or different alternative identity. In the real world, it is quite easily observed that one or more alternatives may not be available or cannot be considered as an effective alternative for a choice maker to choose. In other words, not every customer has the same alternative choice set. For instance, the number of alternatives could be different. Even if the number of alternative is the same, the alternatives may not be identical. For instance, the availability of alternative grocery stores may vary across customers living in two different cities. Grocery 1 and Grocery 2 are alternatives for customers in City A whereas Grocery 1, Grocery 2 and Grocery 3 are alternatives that customers can use in City B.

In Suzuki (2007), each route has different numbers and identities of alternative airlines. As a result, customers in different routes face the different number of alternatives depending on which route they used. The author ran a choice model across the routes that had different number of airlines.

In my first essay, I collect customer's airline choice decisions across different routes originating from the three airports in the Washington Metropolitan area. There are different numbers of alternative airlines in each route and the alternative airlines are not even identical across the sample routes. Instead of using the observations only from the routes where the same airlines compete (Proussaloglou and Koppelman, 1995), my airline choice study estimates a customer's choice of airline across different routes in which there are different numbers and different identities of alternative airlines as hinted by Suzuki (2007). This type of choice set is called "variable choice set" (Hensher et al., 2005). This variable choice set model allows researchers to estimate a choice decision when each customer has different numbers of alternatives in different segments (e.g., different areas, different stores and different air routes). There is a statistical software package called "LIMDEP" and "NLOGIT" that allows researchers to estimate customer choice probability when each customer has a different number of alternatives in his or her choice set. I use NLOGIT 4.0 for this dissertation.

For testing Hypothesis 1 (i.e., the relationship between airline's operational quality and airline choice), operational quality is captured through two indicators; the nonstop flight service frequency of the current month and the airline's on-time performance of the previous month at a route level. While passengers may examine the current month's service schedule for their trips, they may have to refer to the previous month's on-time performance because the current month's on-time performance record is not available. In addition, a fare variable at a route level is included. The more detailed description of these measurements is in the measurement section (3.6.2).

In order to test Hypothesis 2 (i.e., the moderating impact of customer's operations exposure to service operations on a customer's choice), the model includes an interaction term between operational quality and customer airline choice. Passengers that travel with more companions and more bags tend to be more exposed to airline service and will have a greater preference for operation reliability than will other passengers. Therefore, four additional interaction terms (i.e., two customer operational characteristic variables are multiplied by two airline operational quality variables) are included in the model.

Lastly, for Hypotheses 3, the model uses interaction terms between customer's demographic characteristics and carrier's operational quality to examine the moderating impact of a customer's demographic characteristics on the relationships between airline operational quality and a customer's choice of airline. The customer's demographic characteristics included are income level and trip purpose. Thus, the four additional interaction terms (i.e., two customer demographic characteristics variables are multiplied by two airline operational quality variables) are included in the model.

In addition to the test the hypotheses, this study uses an interaction term for the fare variable in order to better reflect the fare effect. Specifically, this study noticed the idea that passengers traveling for different purpose may be differently sensitive to fare levels. The rationale for this notion is that business customers are often required to purchase their airline tickets with short notice and the ticket price tends to be higher when the ticket is bought close to the travel date. In addition, business tickets are often paid for or reimbursed by employers while leisure customers pay for their own tickets and may, therefore, be more serious about fare levels. More importantly, business passengers prefer the legacy airlines that offer premium services such as airport lounges and frequent flier programs. But, the average fare of the legacy carriers tend to be higher than that of LCCs. Based on these observations, the two different groups have different sensitivities to fares. Therefore, the model includes two interaction terms for fare; one is with business customers and the other is with leisure customers.

There is an additional effect on the fare side that may also have influenced a customer's choice of airline in 2009. Many airlines started to charge and additional fee for checked bags in 2008, but Southwest Airlines did not. The baggage fee effect is captured by an interaction term between the 2009 year dummy, the free-bag policy airline (i.e., Southwest Airlines) dummy, and the customer checked bag dummy (coded 0 if no bag is checked, 1 if one bag is checked, and 2 if more than two bags are checked in).

In sum, I included the two operational quality variables; nonstop service frequency (FQ) and on-time performance (OT). I added the fare related variables: a fare interaction terms respectively with business customers (FARE_BUSI) and with leisure customers (FARE_LEIS). I included the interaction terms between the free bag policy airline dummy in 2009 and a dummy variable capturing the customers who travel with checked bags (FB9B012). I call these five variables the main impact variables in choosing an airline. On top of the major effect variables, I created eight different combinations of interaction terms (i.e., two operational quality variables are multiplied by four customer characteristics variables). The model uses a nonstop flight presence dummy variable (FQD) for the eight interaction terms. Frequency (FQ) is measured by the number of weekly nonstop flights (i.e., service frequency), while the nonstop flight service presence is a dummy variable that is coded 1 if airlines provide nonstop flights on a route and 0 if they do not during a week. While the number of nonstop flights (FQ) shows how often (or how easily) customers can use nonstop flight service, the FQD simply shows whether nonstop flight service is available or not. This is because customers with baggage may not strongly respond to the changes in the nonstop frequency while they may clarealy react to the presence of nonstop flights. Similarly, this study uses dummy variables for bags (BAGD) and companions (COMD), indicating the presence or absence of checked bags and companions. Thus, the interaction terms with the nonstop flight presence dummy variable and the four customer characteristic variables are added (FQD · BAGD, FQD · COMD, FQD· BUSI, FQD· INC). The interaction terms between an on-time performance quality variable and the four customer characteristic variables are added as well (OT · BAGD, OT · COMD, OT· BUSI, OT · INC). The complete model to be tested is formed based on the discussion above as follows:

Customer's Choice of Airline

= FQ + OT + FARE · BUSI + FARE · LEIS + FREEBAG09 (Major effect)

+ FQD · BAGD + FQD · COMD + FQD · BUSI + FQD · INC (Nonstop interaction term)

+ OT · BAGD + OT · COMD + OT · BUSI + OT · INC (On-time interaction term)

I will explain how this study measures each variable in the following section.

3.6.2 Measurements

3.6.2.1 Dependent Variables:

A customer's choice among multiple airlines is the dependent variable and is captured from the passenger survey data. As noted above, this study excludes airline observations that have a market share below 4% on a route since these airlines may not be considered to be effective competitors (Suzuki, 2007) or easily available to customers.

3.6.2.2 Independent Variables

3.6.2.2.1 Airline Characteristics

- **Nonstop Service Frequency (FQ) and Presence Dummy (FQD)**

We use OAG data to obtain non-stop flight frequency information for each individual airline for the sample routes. OAG data contains direct flight frequency information for all airlines departing from each of the three airports in the Washington Metropolitan Area.[16] OAG provides the details of flight operations for each airport pair during the survey period. The details include the dates and the number of flights that were operated. In addition, OAG data shows how many connecting stops that passengers have to make to reach their trip destinations. I measured the frequency of nonstop flights (FQ) by

[16] The definition of an OAG direct flight includes all nonstop and multiple stop flights, as long as the flight number remains the same. For instance, a customer from BWI to SFO changes the planes at ORD. If the first leg flight (i.e., BWI to ORD) and the second leg flight (i.e., ORD to SFO) use the same flight number, OAG sees this itinerary as direct flight travel. However, this study intends to measure how customers respond to inconvenience and risks of changing planes. Thus, this study considers any itinerary that requires change of planes as a connecting flight and is not counted as direct flight.

counting the number of nonstop flights that each airline provided for the dates that the survey was implemented. For instance, the year 2007 survey was performed from October 7th to October 20th. I summed the number of nonstop flights that the airlines provided during the first week of the survey period (October 7th through October 13th). In addition, I used OAG data to create the dummy variable (FQD) to indicate if an airline provided any non-stop flights on a route.

- **On-Time Performance (OT)**

Airline on-time performance is also used as a measure of operational quality. US DOT BTS collects and provides on-time performance information for US airlines through its BTS website. The 18 airlines that have at least 1 percent of total domestic scheduled-service passenger revenue are required to report their on-time performance for the flights between origin and destination airports in the US. In addition, two other airlines[17] report voluntarily. DOT data provides on-time information of individual flights operating between origin and destination airports at both the minute level and at the 15 minute cutoff level. Minute level information shows how many minutes a flight is delayed compared to scheduled departure and arrival time. The fifteen minute cutoff level information indicates if a delay is 15 minutes or more.

For this study, the fifteen minute cut-off period is used to indicate on-time arrivals. The reason why I use the 15 minute cutoff rate is that customers may not easily remember and

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[17] Pinnacle Airlines (9E) and Express jet Airlines (XE)

use the more detailed information when choosing flights. The percentage of on-time flights according to the 15 minute period is more widely disseminated.

In addition, on-time performance is available for both the departure and arrival airports. Using either one of these figures may be fair enough in evaluating an airline's on-time performance as both departure on-time performance and arrival on-time performance tend to be highly correlated (i.e. late departure usually leads to late arrival for nonstop flights). I used the departure on-time performance. When a customer uses a connecting flight, on-time performance for the whole connecting itinerary is not available because DOT provides on-time performance only for nonstop flights between two airports. I used the departure on-time performance of the first flight leg of a customers' whole itinerary for this study.

In this study, I used a monthly departure on-time performance that is measured a month before customers traveled. Since an airline's delay may have a lagged effect on customer choice, the previous month's data for the given route is used to measure this variable. The reason that I used the most recent, previous month data is based on the assumption that customers tend to put more weight on the most recent data.

To calculate the on-time performance, I divided the number of flights that are delayed more than 15 minutes by the total number of flights that each airline operated on a route in the previous month. As the outcome of this calculation is the percent of delayed flights, a higher number means worse on-time performance. Thus, I subtract the percent of delayed flights from 1 to produce the on-time performance. Then, a higher number means better on-time performance.

For the on-time performance of alternative airlines that are not chosen by customers, if the on-time performance information of the nonstop flights was available in the DOT data, I used the on-time performance of the nonstop flights. However, if on-time performance information of nonstop flights was not available, I created hypothetical routes that might be available for customers to choose. This hypothetical route is assumed to fly through major airline hubs. What if a customer needs to fly from IAD to PDX (Portland, OR)? In this case, United Air usually flies through its major hub at ORD (Chicago, IL) and I used the on-time performance of IAD to ORD for the on-time performance of United Air's IAD-PDX route since IAD-ORD is the first leg of the itinerary. When multiple hubs are available for an airline, the hub that makes the route shorter was used. For instance, United Air can fly from IAD to PDX through another hub, DEN (Denver, CO). But, in this study, United Air still is assumed to fly through ORD rather than through DEN since flying through DEN makes the flight distance longer and I used on-time performance of IAD-ORD for United Air' IAD-PDX route.

- **Fares**

Fare information is provided by the USDOT DB1B database. The fare information includes taxes and fees that are paid at the time of ticket purchase. Although fares are significant drivers of customer choice, they are not often used in airline choice models due to data unavailability for individual customers. The fares each customer pays are expected to vary significantly across customers depending on different purchase times and different sales channels due to the complicated fare schemes that airlines use. Unfortunately, my data cannot provide actual fare information. Thus, this study uses the current quarter average airfare by route and by airline in the quarter when a person travels. I aggregated all individual fares and calculated an average fare for each airline for a specific origin and destination airport pair. Then, average fare information was matched with all alternative airlines for that route.

The fares that this study used are not the actual amounts each customer paid. This means that the fare variable may not be effective in predicting customers' choice of airline. However, Armantier and Richard (2008) indicate that the difference in the ticket prices that different customers paid can be captured at the aggregate level through the characteristics of customers. The customer characteristic that they use is advanced ticketing because the ticket prices vary based on the date of purchase. For instance, business customers are often required to travel with short notice and tend to purchase tickets at higher prices. These business customers usually are not able to change their schedule to seek a lower airfare.

This study tests the fare effect separately for business customers and leisure customers as suggested in a previous study (Adler et al., 2005) by assuming that there are significant variances in sensitivity between business and leisure customers. Business customers prefer to fly on the legacy airlines because these airlines provide premium services such as airline lounges. This means that business customers can spend their time more comfortably at airline lounges at airports and can easily travel to more destinations for their business. These airlines are also very attractive because business customers tend to travel more often than leisure customers. This means that business customers have more chances to earn and use the Frequent Flyer Programs (FFP). When customers use their earned miles for free seats, customers may want to have more destination choices, including international destinations. In addition, frequent travel needs makes business customers want to use the premium services of these airlines each time they travel. All of these reasons make business customers more loyal to the legacy airlines. Thus, this study includes a fare interaction term for business customers. The expected sign for the interaction term between fare and business customers is positive.

This study additionally proposes to consider the impact of the free bag policy used by Southwest Airlines. The expected impact of this policy is that customers are more likely to choose the airlines that do not charge for checked bags to avoid this newly added fee. This meant that customers could choose a different airline other than the one that they originally wanted to use based on whether or not they travel with checked bags. Thus, this model includes an interaction term between the free-bag policy dummy variable for airlines in 2009 (after other carriers instituted checked baggage fees – see Table 6) and the checked bag dummy variable indicating whether passengers check in bags. The expected sign is positive.

Table 6 Summary of Checked Bag Fee History

Airline	Date, Fee	Airline	Date, Fee
Air Tran	Nov. 12, 08, $15	Hawaiian	Aug. 1 , 08, $15
Alaska Air	Jul. 7, 08 , $15	Northwest	Nov. 5, 08, $15
American	Jun. 15, 08, $15	Southwest	No fee
Delta	Nov. 5, 08, $15	United	Jun. 13, 08, $15
Continental	Jun. 13, 08, $15	US Airways	Jul. 9, 08, $15

Source: Aviation Daily

3.6.2.2.2 Customer Characteristics

This study tests how differently customers react to airline operational quality based on customer characteristics. To measure customer characteristics, I used the following four customer characteristics: customer's income, trip purpose, the number of checked bags, and the number of travel companions.

- **Income (INC)**

Customer household income level information is collected through the air passenger survey. In the airport passenger survey data, customers revealed their income information by choosing one of the eight income range codes that were provided in the survey questionnaire (the questionnaire is in Appendix 1). The mean of each range is used for the customer's income level, with $175,000 used for the highest income level (Table 7). Then, the means of these eight ranges are used as customer's income. Note that 2005 survey used different income ranges and accordingly different means from 2007 and 2009 survey.

Table 7 Survey Household Income Range Codes and Range Mean

2005 Survey

Survey Code	Income Range	Range mean	Survey Code	Income Range	Range mean
a	less than $15,000	$7,500	e	$50,000~74,999	$62,500
b	$15,000~24,999	$20,000	f	$75,000~99,999	$87,500
c	$25,000~34,999	$30,000	g	$100,000~149,999	$125,000
d	$35,000~49,999	$42,500	h	$150,000 or more	$175,000

2007 Survey and 2009 Survey

Survey Code	Income Range	Range mean	Survey Code	Income Range	Range mean
a	less than $15,000	$7,500	e	$80,000~119,999	$100,500
b	$15,000~24,999	$20,000	f	$120,000~159,999	$140,500
c	$25,000~44,999	$35,000	g	$160,000~199,999	$180,000
d	$45,000~79,999	$62,500	h	$200,000 or more	$220,000

- **Business Trip Purpose (BUSI)**

In addition, a customer's trip purpose is answered through the survey. In the survey, customers are asked to choose one of the seven trip purpose categories. Among these purposes, three categories (Business related to the federal government including military, Business related to state or local government and Business that is not related to government) fall into the business related trip purposes. If a customer traveled for the one of these business related purposes, the customer is categorized as a business traveler and coded 1 as a binary variable.

- **Travel Companions (COM) and Checked Bags (BAG)**

Whether customers travel with companions and baggage is used to measure customer exposure to service operations. The airline passenger survey data provides information on whether passengers travel with companions and baggage. I created a dummy variable to indicate if customers traveled with one or more bags (BAGD). I also created a dummy variable to indicate if customers traveled with one or more companions (COMD). Then, the interaction terms were created between these service exposure variables and each airline operational quality variable, on-time performance (OT) and nonstop service presence (FQD).

3.7 Analysis and Results

3.7.1 Summary Statistics

The number of final sample that was used to test the hypotheses is 4,789 customers over the three survey years. The summary statistics of the final sample are shown in Table 8.

Table 8 Sample Summary Statistics

Variable	Mean	Std.Dev.	Min.	Max.	Observation
Number of Companions (COM)	1.18	1.13	0	6	4,789
Number of Checked bags (BAG)	1.03	0.97	0	4	4,789
Business Traveler (BUSI)	0.31	0.46	0	1	4,789
Household Income (INC)	115,923.42	61040.43	7,500	220,000	4,789

Four customer characteristic variables are reported in the sample summary statistics. The number of companion variable shows how many persons a passenger travels with. The average number of traveling companions is 1.18 for each customer. As described earlier, the customers who traveled with more than six people are considered to be a group and are excluded from the sample. Thus, the maximum number for this variable is six. The number of checked bags shows how many bags a customer checked for his or her air trip. The average number of bags is 1.03. Again, the customers who traveled with more than four bags are considered to be traveling in a group and were dropped from the sample. Thus, the maximum number of checked bags is four. Business travelers are coded 1 while leisure travelers are 0. The mean number of this variable is 0.31, which means that 31 customers out of 100 traveled for business purpose. Lastly, the customers were asked to choose one of the eight household income ranges. The range is 1 though to 8, with the lowest range ($0 to $15,000) and the highest range ($200,000 and more in 2007 and 2009 survey[18]). As described earlier, the mean of each income range is used. The figure, $7,500, is used as the mean of the first range ($0 to $15,000), and $220,000 is the income level used for the highest range. Thus, the minimum and the maximum of the income variable (INC) are $7,500 and $220,000 respectively. The overall mean is $115,923.

Many airlines started to charge for checked luggage in the summer of 2008. Indeed, passengers checked fewer bags in 2009 compared to the two previous survey years, 2005 and 2007, according to the yearly summary statistics in Table 9 below. This suggests that customers may be influenced by the checked baggage fee.

[18] The highest income range is $150,000 and more in 2005 survey

Table 9 Sample Summary Statistics by Survey Year

2005	Mean	Std.Dev.	Minimum	Maximum	Observation
COM	1.24	1.22	0	6	1,393
BAG	1.17	1.04	0	4	1,393
BUSI	0.33	0.47	0	1	1,393
INC	105,689.49	54,712.74	7,500	175,000	1,393

2007	Mean	Std.Dev.	Minimum	Maximum	Observation
COM	1.22	1.09	0	6	1,686
BAG	1.11	1.01	0	4	1,686
BUSI	0.32	0.47	0	1	1,686
INC	121,876.72	64,057.04	7,500	222,000	1,686

2009	Mean	Std.Dev.	Minimum	Maximum	Observation
COM	1.1	1.08	0	6	1,710
BAG	0.85	0.86	0	4	1,710
BUSI	0.29	0.45	0	1	1,710
INC	118,814.69	62,083.67	7,500	220,000	1,710

The correlations among the customer characteristic variables are shown in Table 10. Overall, the correlations are not significant for any pair of customer characteristic variables. Notably, the correlation between the number of companions and the number of checked bags shows the strongest correlation. The sign of the correlation is positive. This shows that the customers that travel with more companions, such as on a family trip, tend to check more bags. The number of bags is negatively correlated with business travelers. This means that leisure travelers tend to carry more bags compared to business travelers. The second highest correlation number is found between income level and the business trip dummy (0.19). This implies that high income customers are more likely to be business travelers relatively compared to low income passengers.

Table 10 Correlations of Customer Characteristics

	COM	BAG	BUSI	INC
COM	1.00			
BAG	0.21	1.00		
BUSI	-0.05	-0.12	1.00	
INC	0.03	-0.01	0.16	1.00

3.7.2 Choice Model Results

The results are presented in Table 11. The dependent variable is a customer's choice of airline among alternatives on the sample routes. The coefficients and the p-values are shown for each variable. In model 1, nonstop flight frequency (FQ), on-time performance (OT) and airline average fares (FARE) predict the probability of choosing an airline. The nonstop flight frequency (FQ) shows a positive sign as expected. This means that an airline that provides a higher nonstop flight frequency is more likely to be chosen by customers. However, the on-time performance (OT) shows a negative sign, which is the opposite from our expectation because it means that customers are more likely to choose poorer on-time performance airlines. Fare (FARE) has a significant but positive sign, a counterintuitive result. As discussed earlier, this is potentially because this study uses average fare rather than actual fares.

Table 11 Airline Choice Results: Main Effect Only

Dep. Var = Airline Choice	Model 1			Model 2			Model 3		
	Coeff	P-value		Coeff	P-value		Coeff	P-value	
OT	-0.580	0.040	**	-0.487	0.087	*	-0.015	0.959	
FQ	0.032	0.000	***	0.034	0.000	***	0.033	0.000	***
FARE	0.003	0.000	***						
FARE_BUSI				0.007	0.000	***	0.007	0.000	***
FARE_LEIS				0.000	0.523		0.000	0.630	
FREEBAG09							0.392	0.000	***

*** p<0.001, ** p<0.05, * p<0.1

In model 2, the fare (FARE) variable is replaced with FARE_BUSI and FARE_LEIS while the other variables (FQ and OT) remain the same. The sign of FARE_BUSI is positive, which is inconsistent with our expectation because fare variable is expected to show a negative sign. The sign for FARE_LEIS is insignificant. I will explain the results of the fare variables in more detail later in this section.

Model 3 has the variable that tests the effect of the free bag policy in 2009 (FREEBAG09). The results for this model are more intuitive than previous results. In particular, the key quality variable, OT, is no longer significant. FREEBAG09 shows a positive and significant sign. It implies that customers traveling with bags are more likely to choose the airlines that waived the checked bag fee in 2009.

In order to confirm that this variable picks up the free bag policy effect correctly, I checked the robustness of the variable. Since the 2009 free bag policy effectively measures the impact on Southwest Airlines, the one carrier that did not institute baggage charges, I created the same variables for both 2005 (SW05BAG) and 2007 (SW07BAG) with Southwest Airlines. An insignificant coefficient for these two variables would support the assertion that the 2009 interaction term is picking up a free bag effect rather than a more generic Southwest effect for travelers with checked baggage. The results in Table 12 show that the coefficient of SW05BAG (the Southwest Airlines interaction term for 2005) is actually negative indicating that passengers with bags were less likely to choose Southwest in that year.

Table 12 Robustness Check of Southwest Free Bag Effect (2005, 2007 and 2009)

Variable	Coeff.	P-value	
OT	-0.140	0.646	
FQ	0.034	0.000	***
FARE_BUSI	0.007	0.000	***
FARE_LEIS	0.000	0.523	
FREEBAG09	0.384	0.000	***
SW05BAG	-0.170	0.025	**
SW07BAG	0.119	0.073	*

*** $p<0.001$, ** $p<0.05$, * $p<0.1$

The coefficient of SW07BAG (the Southwest Airlines interaction term for 2007) is positive and marginally significant at the 10 percent level, although the magnitude of the coefficient is less than in 2009. These results show some support to the assertion that the 2009 interaction term is picking up a free bag effect rather than a more generic Southwest preference for travelers with checked bags.

In summary, I found Model 3 to be consistent with previous literature and will use Model 3 as the base model to test the proposed hypotheses; the moderating impact of the customer characteristics on the relationship between the operational quality and customer's choice. Below are the choice model results (Table 13).

Table 13 Airline Choice Results: Interaction Terms Tested Separately

Dep. Var = Airline Choice	Model 3 (Base Model)		Model 4		Model 5		Model 6		Model 7	
	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value
OT	-0.015	0.959	-0.370	0.487	0.140	0.771	0.313	0.375	0.501	0.380
FQ	0.033	0.000 ***	0.026	0.000 ***	0.028	0.000 ***	0.030	0.000 ***	0.025	0.000 ***
FARE_BUSI	0.007	0.000 ***	0.006	0.000 ***	0.006	0.000 ***	0.004	0.000 ***	0.004	0.000 ***
FARE_LEIS	0.000	0.630	-0.003	0.000 ***	-0.003	0.000 ***	0.000	0.740	-0.003	0.000 ***
FREEBAG09	0.392	0.000 ***	0.303	0.000 ***	0.283	0.000 ***	0.386	0.000 ***	0.314	0.000 ***
OT_COMD			1.622	0.010 ***						
OT_BAGD					0.895	0.141				
OT_BUSI							-0.212	0.739		
OT_INC									0.000	0.467
FQD_COMD			1.520	0.000 ***						
FQD_BAGD					1.429	0.000 ***				
FQD_BUSI							1.216	0.000 ***		
FQD_INC									0.000	0.000 ***

*** p<0.001, ** p<0.05, * p<0.1

I created the eight interactions terms (four customer characteristics variables are multiplied by the two operational quality variables). In order to test the moderating effect of each customer characteristic, I added the interaction terms one by one. In Model 4, the two companion interaction terms with both the on-time performance and the nonstop frequency dummy variable (OT_COMD and FQD_COMD) are added to the base model (Model 3). The two baggage interaction terms with both the on-time performance and the nonstop frequency dummy variable (OT_BAGD and FQD_BAGD) are added in Model 5 and so on (the business interaction terms in Model 6 and the income interaction terms in Model 7).

The result of the major effect variables in Model 4, Model 5, Model 6, and Model 7 are quite consistent with Model 3 (base model). On-time performance (OT) is still insignificant. Nonstop flight service frequency remains strongly significant and positive. The fare variable for business travelers (FARE_BUS) is positive and significant, which is consistent from the base model (Model 3) as well. Once the interaction terms are added, the biggest difference from the base model (Model 3) is that the fare variable for leisure travelers (FARE_LEI) became significant and negative signs in all models except Model 6. This means that leisure travelers are more likely to choose airlines that provide lower fares. The free bag policy effect (FREEBAB09) remains unchanged (significantly positive). The customers who traveled with checked bags in 2009 consistently prefer using the free bag policy carrier.

Model 4 tests the companion dummy interaction terms with the on-time performance (OT_COMD) and with the nonstop service presence dummy (FQD_COMD). Both of the companion dummy interaction terms have positive coefficients. This means that customers are more likely to choose airlines that provide better on-time performance and nonstop service between a customer's origin and destination airports when they travel with companions.

Model 5 tests the checked baggage dummy interaction terms with the operational quality variables. The coefficient of the interaction (OT_BAGD) between the on-time performance and the baggage dummy is positive but insignificant. The coefficient of the interaction term (FQD_BAGD) between the baggage dummy and the nonstop service presence dummy is positive and significant. This means that customers are more likely to choose an airline that provides nonstop service to the customer's destination airport when they have checked bags.

Model 6 tests the business traveler dummy interaction terms with the on-time performance variable and the nonstop service presence dummy variable. The coefficient of the interaction term (OT_BUSI) between the on-time performance and the business traveler dummy is insignificant. However, the coefficient of the interaction term (FQD_BUSI) between the nonstop service presence and the business traveler dummy is positive and significant. This means that customers are more likely to choose an airline that provides nonstop flight service to a customer's destination when they travel for business purposes.

Model 7 tests the moderating effect of a customer's income level with the on-time performance and the nonstop service presence respectively. The coefficient of the interaction term (OT_INC) between the on-time performance and customer's household income level is insignificant. The coefficient of the interaction term between the nonstop flight service presence and the household income (FQD_INC) is positive and significant. This means that customers are more likely to choose an airline that provides nonstop service to a final destination when their household income level is relatively high.

Overall, the results show that all of the interaction terms between the nonstop service presence dummy variable (FQD) and the four customer characteristics variables (COMD, BAGD, BUSI and INC) have positive and significant coefficients. On the other hand, the interaction terms between the on-time performance (OT) and the three customer characteristics variables (BAGD, BUSI and INC) are insignificant, however, the interaction term between the companion dummy and on-time performance (OT_COMD) was positive and significant.

In Table 14, Model 8 has all eight interaction terms in one model. The first four interaction terms are created between the airline's on-time performance and the four customer characteristics variables. The interaction between the on-time performance and the companion dummy variable (OT_COMD) is significant at the 0.1 level while the other three interaction terms are not significant.

Table 14 Airline Choice Results: All Interaction Terms in One Model

Dep. Var = Airline Choice	Model 3 (Base Model)			Model 8			Model 9			Model 10		
	Coeff	P-value		Coeff	P-value		Coeff	P-value		Coeff	P-value	
OT	-0.015	0.959		0.137	0.863		0.027	0.969		-0.089	0.909	
FQ	0.033	0.000	***	0.025	0.000	***	0.025	0.000	***	0.024	0.000	***
FARE_BUSI	0.007	0.000	***	0.005	0.000	***	0.005	0.000	***	0.004	0.000	***
FARE_LEIS	0.000	0.630		-0.004	0.000	***	-0.004	0.000	***	-0.004	0.000	***
FREEBAG09	0.392	0.000	***	0.292	0.000	***	0.287	0.000	***	0.287	0.000	***
OT_COMD				1.096	0.086	*	1.263	0.046	**	1.142	0.075	*
OT_BAGD				0.301	0.623		0.427	0.484		0.329	0.592	
OT_BUSI				-1.055	0.104		-0.935	0.144				
OT_INC				0.000	0.671					0.000	0.884	
FQD_COMD				0.612	0.000	***	0.975	0.000	***	0.605	0.000	***
FQD_BAGD				0.429	0.000	***	0.727	0.000	***	0.418	0.000	***
FQD_BUSI				-0.170	0.239		0.235	0.080	*			
FQD_INC				0.000	0.000	***				0.000	0.000	***

*** p<0.001, ** p<0.05, * p<0.1

The second four interaction terms between the nonstop service presences dummy (FQD) and the four customer characteristics variables are also in Model 8. The nonstop service presence dummy interaction terms with the companion dummy (FQD_COMD) and the checked baggage dummy (FQD_BAGD) are positive and significant. This means that customers are more likely to choose an airline that provides nonstop flights when they travel with companions and checked bags. The interaction terms between the nonstop service presence dummy and the customer demographic characteristics (FQD_BUSI and FQD_INC) show mixed results. Income level and business purpose trip measure how much customers appreciate time and convenience values. The interaction term between the nonstop service presence dummy and customer's household income (FQD_INC) shows a positive and significant sign.

However, the interaction term between the nonstop service presence dummy and the business traveler dummy (FQD_BUSI) is insignificant. I suspect that this inconsistency is because the business traveler dummy variable (BUSI) is correlated with the income variable (0.16 in Table 10). The coefficient between these two variables is not significantly high but it is still potentially high enough to create this issue. Thus, I decided to run two additional models. They are Model 9 and Model 10. Model 9 tests all variables except the income variable (INC) and Model 10 tests all variables except the business purpose variable (BUSI). It is clear in Model 9 when the interaction term between the frequency dummy and income is removed, the interaction term between business travel and the frequency dummy becomes positive and significant, as hypothesized.

Capturing the fare effect, two variables (FARE_BUSI and FARE_LEIS) are used according to previous studies (Armantier and Richard, 2008), one each for business and leisure customers respectively, and included as a control variable. In Model 1, the coefficient of the fare variable has a strong positive sign. However, once the fare variable is split into two variables based on the customer's trip purpose, the fare variable for business travelers (FARE_BUSI) becomes significant and positive while the fare variable for leisure travelers (FARE_LEIS) is negative but insignificant. Once the interaction terms are added (Model 4 to Model 10), both FARE_BUSI and FARE_LEIS are significant and show a positive sign and a negative sign[19]. The results suggest that business travelers often end up with airlines that charge higher fares (legacy carriers with premium services) while leisure travelers tend to seek the airlines that charge lower fares (LCCs). These differences become much clearer when tickets are purchased later than earlier (Armantier and Richard, 2008). Many business travelers are often in the situation that they have to purchase tickets on short notice, close to the traveling dates, and prefer the legacy carriers whose fare level is often higher than that of LCCs, leading to business travelers are less sensitive to fares.

Another fare control variable that is included in the models is the airline's free bag policy variable (FREEBAG09). The coefficient of the interaction term that tests the effect of the free bag policy in 2009 for those who travel with bags is significant and positive in all models. It means that customers are more likely to choose an airline that charges no fee for checked bags in 2009 when most of the airlines, except Southwest Airlines, charged for bags. Although this study does not intend explicitly to test the effect of the fare variable, the findings of this study suggest that the free bag policy is effective in attracting customers. Setting aside the on-going argument in the industry that collecting this additional fee helps airlines to earn more profits, this study evidently shows that this free bag policy influences customer's choice.

[19] One exception is that FARE_LEIS is insignificant in Model 6 where the business dummy and the operational quality interaction terms are added to the base model.

3.7.3 Hypotheses Results

In this section, I will discuss whether the results that are described in the previous section support the hypotheses of this study.

This study intends to answer three research questions; (1) how operational quality influences customer's choice of airline, how customer characteristics (both (2) operations exposure and (3) customer's relative importance in time and convenience utility) moderate the relationship between operational quality and customer's choice. In order to answer these research questions, this study needs to test the three hypotheses that are proposed earlier in the hypothesis section.

The first hypothesis tests the positive relationship between operational quality and customer's choice. I measured operational quality with the airline's on-time performance and nonstop flight frequency. This hypothesis asserts that customers are more likely to choose an airline that provides better on-time performance and higher nonstop flight frequency. In order to test this hypothesis, I included these two operational quality variables in Model 1 through to Model 10. The on-time performance (OT) remains positive but insignificant in all models except Model 1 and Model 2. This means that an airline's on-time performance does not influence a customer's choice of airline. This may suggest that customers are not really aware of or do not significantly consider an airline's on-time performance in the process of the airline choice decisions. However, the coefficient for the other operational quality variable, nonstop flight frequency (FQ) shows positive and significant signs in all models (Model 1 to Model 10). This is strong evidence that customers are more likely to choose an airline that provides more nonstop flights to a final destination. This result partially supports the first hypothesis. The empirical test results of this study are summarized in Table15 below.

Table 15 Summary of Hypotheses Testing

Hypothesis	Testing variable	Hypothesized effect on customer's choice: Main effect	Interaction effect with: Nonstop service	Interaction effect with: On-time performance	Finding	Empirical support for hypothesis
H1	Nonstop flight frequency	+			+	Partially Yes
	On-time performance	+			Insignificant	
H2	Travel with companion		+		+	Partially Yes
				+	+	
	Travel with check-in bag		+		+	
				+	Insignificant	
H3	Business traveler		+		+	Partially Yes
				+	Insignificant	
	Higher income level		+		+	
				+	Insignificant	

The second hypothesis tests the positive moderating effect of customer's operations exposure on the relationship between operational quality and customer's choice. I measured operations exposure size with the dummy variables that show whether customers traveled with companions or checked bags. The hypothesis asserts that customers are more likely to choose an airline that provides better on-time performance and higher nonstop flight frequency particularly when customers are more exposed to service operations with their companions and checked bags. I created four interaction terms between these two customer contact dummy variables and the two operational quality variables. For the nonstop frequency variable, I created Model 4 and Model 5 by separately adding the companion interaction terms and the baggage interaction terms to the base model (Model 3). The results of Model 4 and Model 5 strongly suggest that customers are more likely to choose airlines that provide nonstop service particularly when customers are accompanied with companions and check bags. This result is consistent in Model 8, Model 9 and Model 10 as well.

For the same hypothesis, another operational quality variable that is tested with the customer contact variables is on-time performance of airlines. In Model 4 and 5, the interaction term between the on-time performance and the companion dummy (OT_COMD) is positive and insignificant. But, the interaction term between the on-time performance and the bag dummy (OT_COMD) is positive but insignificant. The same results are repeated in Model 8, Model 9 and Model 10. This means that customers are more likely to choose a better on-time performance airline when they travel with companions but not with bags. This is not fully consistent with the proposed hypothesis. Thus, the second hypothesis is partially supported.

The third hypothesis tests if customer characteristics regarding time and convenience positively moderate the relationship between operational quality and customer's choice. I measured the customer's sensitivity to time and convenience with their household income level and trip purpose. Customers are more serious about operational quality when their income is higher or they take a trip for a business purpose. Then, the hypothesis asserts that customers are more likely to choose an airline that provides better on-time performance and nonstop flight service particularly when the customer's income level is high or their trip purpose is business. In order to test this hypothesis, I created four interaction terms between these two customer characteristic variables and the operational quality variables. I created Model 6 by adding the business interaction terms to the base model (Model 3) and created Model 7 by adding the income interaction terms to the base model (Model 3). The results for Model 6 and Model 7 suggest that customers are more likely to choose airlines that provide nonstop service particularly when the customer has a high income level or travels for business. The coefficient of the interaction term between the on-time performance and the companion dummy variable are positive and significant. However, when all the interaction variables are put in a single model, the business interaction term is no longer significant or positive.

Regarding the interaction terms with the on-time performance (OT_BUSI and OT_INC), the results of Model 6 and Model 7 indicate that customers are not as sensitive to on-time performance based on their income level or their trip purpose. The interaction terms with the on-time performance (OT) are statistically insignificant. The same results repeat when all variables are included in one model (Model 8). Thus, these results do not support the proposed hypothesis that customers are more likely to choose an airline that provides better on-time performance when their income level is high or they travel for business.

3.8 Discussion

In order to clearly understand the impact of operational quality on customer's choice of airline, this section will discuss the meaning of the results by interpreting the changes in predicted probability when the operational quality and the customer characteristics change. The predicted probability is defined as the probability of choosing airline A as a function of each airline's expected utility among the summation of expected utility for all airlines for a specific route (refer to the generic form of a multinomial logit model (Equation (1)).

Based on the equation, the models that I ran in the previous section are expected to estimate the probability that an airline with a higher level of operational quality is more likely to be chosen by a customer. According to Model 9, the predicted increase in the operational quality will increase the probability of choosing the airline with the higher operational quality (i.e., I decided to use Model 9, which did not include the income variable due to the potential correlation issue with the trip purpose variable). The model also indicates that the probability becomes higher when customers travel with companions or bags or when customers travel for business. Thus, I tested the impact of the changes in on-time performance and nonstop service on the change in the probability across the varying customer characteristics. What would be the predicted probability if an airline increases its on-time performance by10 percent? Or what if an airline increases its nonstop service from 0 to 7 per week? This means that the on-time performance of the sample is 87.6%. If it is increased by 10 percent, an airline's on-time performance (OT) is 96.4%. When an airline that did not provide any nonstop service starts to provide one daily flight, the weekly service frequency (FQ) changes to 7 and the nonstop service dummy (FQD) becomes 1 from 0. I also created eight different combination cases with the three customer characteristics (8 cases = 2 x 2 x 2). The customers travel with companions (COMD), checked bags (BAGD), and for business purpose (BUSI). Table 16 shows the changed probability when the on-time performance or the nonstop service improves across the eight customer cases (the probability calculation details are presented in Appendix 9).

Suppose that there are two airlines on a route because the routes that have two alternative airlines (Alternative 1 and Alternative 2) are the biggest portion of the sample. Alternative 1 airline provides the mean level on-time performance (87.6%) and no nonstop service (0 weekly flights). If Alternative 2 airline provides the same level of on-time performance (87.6%) and nonstop service (0 weekly flights), the probability that Alternative 2 airline is chosen is the same as with Alternative 1, which is 50.00% for each (assuming other factors are the same between the airlines). Say this is the base case. But, what if Alternative 2 airline improves its operational quality?

Table 16 Impact of Changes in Operational Quality on Predicted Probability across Customer Characteristics

Customer Characteristics				Probability (based on Model 9)	
Case	with Companion	with Bag	for Business	On-time (OT) 10% ↑	Weekly flight (FQ) 0 →7 Nonstop presence (FQD) 0 → 1
1	No	No	No	0.06%	4.44%
2	Yes	No	No	2.82%	26.01%
3	No	Yes	No	0.99%	21.21%
4	No	No	Yes	-1.99%	10.19%
5	Yes	Yes	No	3.75%	36.77%
6	Yes	No	Yes	0.78%	30.03%
7	No	Yes	Yes	0.78%	25.78%
8	Yes	Yes	Yes	1.71%	39.24%

Case 1 shows the probability predicted by Model 9 when the on-time performance improves by 10% assuming a customer has no companions, no bags and travels for leisure. Compared to the airline that has the mean level on-time performance (87.6%), the probability that the airline with a 10% increase in on-time performance (96.4%) is chosen by a customer is increased by 0.06%. What if the customer's characteristics change? In Case 2, a customer travels with companions but still without bags for leisure purpose. Then, the probability of choosing Alternative 2 airline increases by 2.82% compared to the case where both Alternative 2 airline and its competitor (Alternative 1 airline) maintain the same level of on-time performance (87.6%).

The predicted probability shows a decrease in Case 4 where a customer travels for business, without companions, and without bags because the coefficient of the interaction term between on-time performance and business purpose is negative (OT_BUSI) in Model 9. The highest probability with the on-time performance improvement is a 3.75% increase in Case 5 when a customer travels with companions and bags, but not for business.

As to the improvement in nonstop service, if Alternative 2 airline starts to offer seven nonstop flights per week, the nonstop frequency variable (FQ) increases from zero to seven. In addition, the nonstop service dummy (FQD) changes to 1 from 0. Then, Case 1 predicts that the probability will increase by 4.44% for the customer who has no companions, no bags, and travels for leisure. The probability will increase by 26.1% if a customer brings in any number of checked bags in Case 2. The highest increase in the probability for the nonstop service quality improvement occurs for the customers who have companions, bags and travel for business. The probability increases by 39.24% in Case 8.

Another interesting finding in this study comes from the results from the fare variable and the free bag policy impact. The fare variable is divided into two variables for business travelers (FARE_BUSI) and leisure travelers (FARE_LEIS) separately. The interaction term that tested the free bag policy effect in 2009 (FREEBAG09) for those who checked bags shows a significantly positive effect. Table 17 shows the changed probability when an airline decreases fares by 10 % from the mean level ($179.46 to $161.52) or uses the free bag policy and waives the associated fees.

Table 17 Impact of Free Bag Policy on Predicted Probability

	FARE 10% ↓		Free Bag 0 → 1 for customers with bags
	BUSI	LEIS	
Change in Probability	-2.19%	1.59%	7.12%

As shown in the table above, when an airline lowers its fare by 10%, the model predicts that the probability decreases by -2.19% for business travelers. However, this is an inappropriate interpretation. The negative probability change does not mean that business customers are less likely to choose the airline. As explained in the earlier section, the negative fare coefficient for the fare variable for business customers captures the fact that business travelers just tend to pay higher fares. The interpretation for the leisure passengers is rather straightforward. When an airline lowers its fare by 10%, the probability that the airline is chosen by a leisure customer increases by 1.59%. But, it may be understated because this study does not use the actual ticket price that customers used.

More interestingly, they are more likely to choose an airline that waives the checked bag fee whenever customers check bags. The change in the probability is an increase of 7.12% when an airline waives the fee for any given route where two airlines compete. This percentage can provide a more accurate measure of price elasticity because the change in the free bag binary variable is equivalent to $15. When an airline waives a baggage fee, it is equivalent to fare reduction of $15(which is a decrease of 8.35% from the average fare, $179.46). Then, the probability that a customer choose the carrier increases by 7.12%. It is a very significant effect when we consider that the average number of bags per customer is 1.03. Indeed, Mr. Gary Kelly, Southwest Airlines CEO, in a recent news article[20] argues that obtaining one customer brings in several times more revenue than does the baggage fee. He also asserts that a strong revenue gain for the fourth quarter in 2008 compared to the same period in the previous year is strong evidence that Southwest's free bag policy has been favored by customers. I believe that my study empirically supports Mr. Kelly's assertion.

Then, what could be a managerial implication that this study can find from this free bag policy? Many airlines in the US charge customers for their checked bags. Baggage consumes extra fuel, requires extra labor, extra hours of their facilities and equipment and so on. In other words, the rationale that supports the baggage fee collection is based on the additional costs that occur. However, according to the finding of this study, it seems that customers traveling with more checked bags prefer higher operational quality service such as nonstop flights and better on-time performance. This means that there is relatively stronger demand for nonstop flights, than for connecting flights, from the customers who travel with checked bags. Then, airlines may want to consider charging fees more selectively than they do now. For instance, airlines can waive the fees or charge lower fees in the markets where they provide zero or fewer nonstop flights than their competitors do. This policy attracts customers that might otherwise choose the nonstop flights of the competing airlines. In other words, airlines may also consider

[20] "Revenue Gains Show Fee Strategy Is Paying Off, Southwest CEO Says," (Andrew Compart, Aviation Daily, January 27, 2009)

charging higher fees for the markets where they have strong nonstop flight presence because there is a strong demand for their nonstop flights anyways from the customers traveling with more checked bags. In practice, airlines may believe that it is more rational to charge fees based on the costs associated with baggage because transporting checked bags through connecting flights consumes extra resources. This study suggests that the airlines may want to consider determining their baggage fee policy based not only on their costs but also on the operational quality that they offer and the associated customer demand.

3.9 Conclusion

I was motivated by the inconsistent claims between the government and airlines in the US airline industry. The government on behalf of customers is not satisfied with the service quality that the US airlines provide although the industry has constantly claimed that they voluntarily put their best efforts in to improve the service quality. I believed that part of this inconsistency results from the lack of understanding that customers are heterogeneous. Thus, I segmented the customers who might be more serious about operational quality based on their operational attributes and demographic attributes and tested to see if customers try to avoid airlines whose service quality is unreliable and inconvenient.

The primary interest of this study is to empirically test how customer characteristics moderate the relationship between the airline's operational quality and the customer's choice. Both the demographic customer characteristics and the operational customer characteristics are investigated and are shown to impact the operational quality and customer choice relationship. Particularly, this study tests if the increased customer contact level with service operation promotes customers to choose a higher operational quality airline.

Regarding the theoretical contribution, based on a review of previous theoretical arguments and empirical tests, this study contributes to two research streams. First, this study contributes to previous air transportation studies by adding operational attributes as another customer characteristic to be taken into account, in addition to the demographic customer characteristics, such as income level and trip purpose, that moderates the relationship between operational quality and customer's choice. Second, this study contributes to previous operations management literature. The operations management literature argues that a service provider needs to carefully manage highly customer contact oriented service operation process to better satisfy the customers. This argument is based on the assumption that every customer is homogeneous. Then, what it is overlooked is that each customer may require different levels of operations exposure. This study tried to examine this overlooked notion by discussing how different operations exposure degrees affect the customer's choice of airline when the operations exposure level varies by customers. This study is the first empirical attempt to investigate the moderating role of the changing customer contact level, contributing to the operations management literature.

Using both the archival and the survey data from the US airline industry, the empirical results clearly support the following hypotheses; (1) operational quality positively influences customers' choice of airlines, (2) customer characteristics (i.e., customer operations exposure degrees) and (3) customer demographic characteristics (i.e. income level and trip purpose) positively moderate the relationship between operational quality and choice of service providers.

Regarding the managerial implications, the results from this study suggests segmenting customers who are more sensitive to service operational quality and who, thus, have a stronger preference for a higher quality service product. Using the recent baggage fee example, the study also shows that airlines may need to take into account the service operational quality level that might influence customer demand in determining fees that are based on the amount of operations exposure between customers and airlines. The key message is that airlines may want to charge customers selectively to increase their revenues.

The limitations of this study are three-fold. First, while this study examines a customer's choice of airline, the study did not have the actual monetary amount that customers paid to purchase a ticket. This problem is not unique to this study and has been a problem in previous studies (Windle and Dresner, 1995) as fare is a major determinant in choosing an airline. The second limitation is the inability to measure on-time performance for passengers traveling on connecting flights. I used only the first leg of a journey, and this is clearly suboptimal. The last limitation is that the sample that this study used differs from the whole population. Some of the observations not included in the sample due to unanswered questions, resulting in fewer business customers in the sample.

This study can be extended by testing various moderating variables for the relationship between service operational quality and customer's choice of service provider. A potential moderator for this relationship may include service provider characteristics. For instance, I believe that customers may respond to operational quality differently based on airline characteristics. Different airlines have different service strengths that are generated by their operation strategies. If customers know what operation strategy airlines use to produce their services, customers might have different levels of expectations. For example, expectations may vary between low-cost carriers and full service carriers. This implies that customer choice may be moderated by who produces the service (or what service strength is associated with service providers).

Chapter 4 Low Cost Carrier (LCC) Impact on Airport Choice

4.1 Introduction

This essay investigates the question of whether the presence of Low Cost Carriers (LCCs) at an airport influences a customer's choice of airport. Previous literature has argued that a customer's choice of airport is determined by three main airport choice determinants: service frequency, access time (Windle and Dresner, 1995; Pels, 2003) and fares (Suzuki, 2007). Previous studies also argue that LCC presence reduces fares and increases passenger demand (Cho et al, 2012). LCC's high nonstop flight frequency (most notably the strategy of Southwest Airlines) can increase customer utility and may attract customers. In this way, while the impact of LCC presence on a customer's choice of airport has not been directly examined in the previous literature, the impact of fare and nonstop flight frequency, through which the LCC presence potentially influences, has been examined.

However, the impact of LCCs may not necessarily be limited to low fares and high frequency. In addition to these factors, LLCs are known for their operation performance, such as high levels of on-time performance, a low number of lost bags and high levels of customer service. Heskett and Schlesinger (1994) suggested in their service industry study that Southwest, which has been the leading LCC over the past three decades, seems to have features other than fare and frequency that attract customers. Indeed, LCC excellence in operation performance is well reported and recognized by the public (Table 1). Additionally, LCCs have been consistently known for their low fare image, even if their fares are not actually the lowest in a market. Thus, it is possible that the presence of

LCCs at an airport influences customer choice through features other than actual low fares and high service frequency. The purpose of this essay is to examine not only the impact of fares and flight frequencies on airport choice, but also the possible impact of LCC presence above and beyond these two determinants.

This study may be interesting because recent industry trends have shown a narrowing gap between LCCs and legacy carriers with respect to fares (MSNBC.com, 2010[21]; USATODAY.com 2011[22]). In addition, the LCCs' high nonstop flight frequency advantage has also been eroded as they expand their list of destinations to longer haul flights that often are serviced through connections.[23] As the LCC advantage in fares and frequencies is reduced, it may be their other features that are seen as important to customers.

Additionally, this study is interested in testing how the airport choice determinants may be relatively more or less important across customer characteristics. Customer characteristics include time and convenience utility, and geographical situation. Customers who highly appreciate time and convenience value may be more sensitive to the determinants that would influence their time and convenience utility. In addition,

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[21] "Low-Cost carriers don't always provide the cheapest fares" , MSNBC.com, 10/19/2010

[22] "Low-cost carriers get aggressive on fare hikes", USATODY.com, 02/02/2011

[23] For instance, Southwest Airlines has one nonstop flight out of a total of 15 flights from BWI to LAX, no nonstop flights out of a total of 15 flights from BWI to SFO and one nonstop flight out of a total of 14 flights from BWI to SEA. Air Tran at BWI also provides only two nonstop flights out of a total of 14 flights to LAX, one nonstop flight out of a total of 9 flights to SFO, and 2 nonstop flights out of 10 total flights to SEA. Southwest and Air Tran are the number one and the number two LCCs at BWI in terms of flown passenger market share.

customers have different geographical situations in terms of access to alternative airports. Depending on distance to alternate airports, time and distance convenience may or may not be important.

4.1.1 Three Main Determinants in Airport Choice

Previous literature has shown that there are three main determinants that drive a customer's choice of airport, namely, access to the airport, flight frequency, and airfare. Access to the airport refers to the physical distance from a customer's starting place (usually their home for residents of the area or their hotel or visiting place for visitors) and each airport under consideration. This distance reflects the travel cost and travel time to reach the airport. Shorter distances will result in lower travel costs (both out of pocket costs and time costs). Flight frequency refers to the number of flights on a specific route provided by airlines. High flight frequency implies that there are more opportunities for a customer to depart at their preferred time and thus minimize the waiting time for a flight. In particular, high frequency of nonstop flights removes the inconvenience and connecting time of hub airports and may be strongly favored by time and convenience-sensitive customers. Lastly, airfares reflect the monetary value that customers pay for their flights. Airports with low fares attract more customers *ceteris paribus*.

4.1.2 Low Cost Carrier (LCC)

This section first explains the two factors (fares and frequency) through which an LCC potentially influences customers. Next, the section discusses three possible LCC features that may influence customer choice of airport other than fare and frequency

4.1.2.1 LCC's FARE and Nonstop Flight Frequency

LCCs are defined as carriers that are driven by the 'cult of cost reduction' (Lawton, 2005), in an attempt to offer low fares. Carriers, such as Southwest, AirTran and JetBlue, all meet this definition (Graham and Vowles, 2006). Hofer et al. (2008) distinguished twelve LCCs from high cost carriers, which are mainly hub-and-spoke legacy carriers, based on the carriers' operating costs per available seat mile. Cho et al. (2012) provide a list of LCCs[24] that incorporates recent entries into and exits from the market. This study uses the list that Cho et al. (2012) provide.

LCC presence affects a customer's choice of airport mainly through low fares and service frequency. A simplified service operation is the primary source of many LCCs' low fares and service frequency (Skinner, 1974; Kimes and Young, 1997). This simplified operation enables LCCs to maintain lower operational costs and maximize the amount of time that their aircraft are in the air (Gillen and Lall, 2004). Examples of simplified service operation procedures employed by LCCs include minimal in-flight services and only one seat class. Some LCCs standardize their fleets to a greater extent than legacy carriers. Southwest and Jet Blue use single types of aircraft (B737 and A320, respectively) while Air Tran uses only two aircraft types (B717 and B737). This fleet standardization helps LCCs reduce their operating costs by maintaining lower parts inventories and minimizing staff (i.e., mechanics and pilots) training costs. This focus on a limited

[24] JetBlue, Southwest, Air Tran, USA 3000, Sun Country, ASA, ExpressJet, Mesa, SkyWest, PSA, Comair, Midwest, Alaska, TransStates, Spirit, Frontier.

number of aircraft types may also increase staff expertise in specific types of aircraft, ultimately leading to higher productivity and shorter aircraft turnaround time.

LCCs' fast aircraft turnaround time helps to maximize the time each aircraft spends in the air. Since aircraft are the most expensive assets the airline owns, keeping them in the air is crucial to lowering costs. High service frequency is also enabled by LCCs' point-to-point service, as opposed to a hub and spoke network (Hansson et al., 2003) that demands longer ground time for aircraft to coordinate flights.[25] As a result of this point-to-point network, LCCs are able to provide high service frequency and attract customers that prefer this service.

4.1.2.2 LCC's Other Features

Many LCCs perform well in terms of operation performance reliability, staff attitude and brand marketing image. Reliability refers to the dependability and accuracy of the service provided. With airline service, service reliability is often evaluated by on-time performance and the percent of handled bags that are lost (Parasuraman and Grewal, 2000). Staff attitude refers to the level of customer service. Staff attitude may be evaluated by how well and passionately staff care about customers and resolve their issues (Parasuraman and Grewal, 2000). This could involve all stages of a trip, including reservations, check-in, in-flight service and baggage claims. Brand image is a marketing

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[25] Note, however, that not every LCC adopts point-to-point service. For instance, Air Tran has a hub at Hartsfield in Atlanta, GA.

tool and can be represented by how a carrier's marketing image can better facilitate overall business.

First, as discussed above, some LCCs simplify their operations (e.g., by minimizing in-flight services and providing fewer seat classes). These simplified operations can produce benefits such as improved on-time performance and fewer mishandled bags. As an example, Southwest Airlines has a dedicated on-site agent for each flight who coordinates all ground handling jobs, such as fueling and loading and unloading of baggage, whereas the same work is managed by multiple different staff (Gillen and Lall, 2004). This helps LCCs reduce turnaround time and ultimately minimize operational disruptions, such as delays and lost bags. In fact, the "Airline Quality Rating" reports over the last three years (2008, 2009 and 2010) show that LCCs have been superior to legacy carriers in both on-time performance and baggage handling (Table 1).

Second, another factor that might make an LCC more attractive to customers, and as a result the airport in which it operates, is that the LCCs may provide a high level of customer service. Empathy and responsiveness are defined as major dimensions of customer service quality, and refer to the degree to which service staff cares about their customers (Parasuraman and Grewal, 2000). Why is customer service important? Previous literature emphasizes the concept of the 'service encounter' as the critical moment where good or bad impressions are formed by the customer (Bitner and Booms, 1990). Excellent customer service can positively influence a customer's purchase decision (Roth et al., 2003). In the airline industry, customers deal with staff members at each travel stage, in-flight service and baggage claims. As a result, customer service is an important part of the airline's service and has been included as a measure of airline service quality in previous studies (Coldren et al., 2003; Mikulic and Prebezac, 2010; Anderson et al., 2009). Appendix 1 provides a list of the most annoying things about flying as compiled by U.S. Consumer Reports[26]. According to the report, while the most critical factors are monetary issues, such as fees and charges, the rest of the top positions are dominated by the lack of customer service such as *rude or unhelpful staff* (rank 3), *can't reach a live service rep* (rank 4), and *poor communication about delays* (rank 5).

In fact, when United instituted its United Shuttle to compete with LCCs, it emphasized "customer-friendly" staff attitude as a critical service factor (Kimes and Young, 1997). Heskett and Schlesinger (1994) pointed out Southwest's service excellence as one of its success factors. Southwest Airlines, as the oldest and the largest LCC in the industry, considers its staff as the most important asset serving customers (Gillen and Lall, 2004) and focuses on creating a "fun and friendly" work environment that is highly appreciated by customers (Gilbert and Child, 2001). Accordingly, Southwest is often recognized as the most customer-friendly airline (Kimes and Young, 1997). In fact, "Airline Service Quality" rankings (Table 1) show that LCCs (Southwest, Express Jet, Skywest and Alaska) occupy four of the top five spots with regard to fewest customer complaints per 100,000 passengers. While the number of complaints includes several service aspects, this may be an indicator of how well issues are handled by service staff, which can be a good proxy for customer service.

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[26] *"What annoys travelers most",* Consumer Reports Magazine, Consumers Union of U.S., Inc., June 2010

Third, LCCs often have a strong brand image[27], primarily as a result of their low fares. In fact, Laura Wright (CFO, Southwest Airlines) stated that "Our low fare brand is who and what we are."[28] LCCs use various gimmicks to promote their low fare brand image. Ryanair celebrated its new base at Bergamo with 100,000 free tickets in 2003. It also offered 900,000 tickets at 90 pence each to celebrate its achievement of carrying the 90 millionth passenger in 2004. These types of promotions result in a low fare image for carriers like Ryanair (O'Connell and Williams, 2005). This marketing strategy may attract customers. Then, this low fare brand image may result in customers choosing the LCC (and thus the airport in which it operates) without actually bothering to search for the lowest fare.

In short, this study argues the presence of an LCC at an airport may be a factor that influences airport choice, even after controlling for fare, frequency and airport access.

4.1.3 Customer Characteristics

In the previous section, I discussed four airport choice determinants. However, different types of customers may respond to these determinants differently. In this section, I will discuss three customer characteristics that might potentially influence customer sensitivity to the four airport choice determinants described above (frequency, access

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[27] "*Southwest emphasizes brand as others follow the low-fare leader",* Marketing News, the American Marketing Association, Vol.30 No.23, 1996

[28] Micheline Maynard, "*So Southwest is Mortal After All"*, N.Y. TIMES, Oct. 16, 2005 at C1.

time, fare and LCC presence). These customer characteristics include customer's income level, trip purpose and distance to a closest alternative airport.

Some customers highly appreciate time and convenience utility. These customers may include high income travelers and business travelers. These travelers are interested in saving time and having a reliable and convenient itinerary. For instance, these customers are often interested in minimizing wait time or connecting time for a flight. In other words, these high income customers and business customers may be sensitive to nonstop flight frequencies at an airport and access time to an airport. On the other hand, fares may not be an important airport choice determinant because air fares account for only a small portion of their income (for high income travelers). For business travelers, fare is often paid by employers. Therefore airports that offers more nonstop frequencies and are located closer to customers may be more likely to be chosen by high income or business travelers. The airport with lower fares may be more likely chosen by leisure customers or low income customers.

In the same way, this study is also interested in whether certain customers are more sensitive to the presence of LCCs. LCCs are known to offer low fares, better operational reliability and customer service than the legacy carriers, as described in an earlier section. However, LCCs have traditionally appealed to low income and leisure customers with their low fares. As a result we might expect that low income passengers are more likely to respond to these service attributes than high income passengers. The same could be said for leisure passengers as opposed to business passengers. On the other hand, customers who are more time sensitive, such as high income and business customers, may value LCCs more highly than those with lower time sensitivity (low income and leisure passengers). Thus, this study intends to use interaction terms to test the moderating effect of a customer's income level and trip purpose on the relationship between LCC presence on a specific route at an airport and the customer's choice of airport.

In addition to customer income level and trip purpose, another potential moderating effect with regard to the importance of the four airport choice determinants is the distance to alternative airports. Customers view longer travel time to airports as a cost, and the length of travel time to an airport may dominate a customer's airport choice. When all alternative airports are a similar distance away, customers have similar access to all airports. Then, customers may seriously consider airport choice determinants other than airport access time (i.e., nonstop flight frequency, fare, and LCC presence). On the other hand, airport access time may become more relevant when a significant amount of additional travel time is required to reach an alternative airport. This implies that airport choice determinants, other than access time, become less important for these customers. By using interaction terms between the distance gap (to the closest (alternative) airport not chosen by the customer) and the airport choice determinants, this study tests the moderating impact of distance to an alternative airport on the customer's choice of airport.

4.1.4 Research Question

Based on the discussion above, this study addresses the question of whether LCC service presence at an airport influences customer choice of airports. Specifically, this study investigates the following research questions: (1) Does LCC presence on a particular airport route (after controlling for the impact of access time, fares and frequency) influence airport choice, ultimately causing customers to choose airports that are served by LCCs? (2) Does customer's relative importance in time and convenience value moderate the relationship between airport choice determinants and customer's choice of airport? (3) Does customer's geographical distance to an alternative airport moderate the relationship between airport choice determinants and customer's choice of airport?

These questions will be addressed using survey data collected from customers departing from the three airports in the Washington Metropolitan area. This data includes extensive information on each customer, including income level, trip purpose and geographical information (the sample survey questionnaire is provided in Appendix 4). Based on these research questions, the conceptual model is presented in Figure 2.

4.1.5 Contribution

The impact of LCCs on fares and passenger demand has been extensively studied (Whinston and Collins, 1992; Dresner et al., 1996; Benett and Craun, 1993), but not directly on the customer's choice of airport. This study will be one of the first to examine the impact of LCC route presence on airport choice above and beyond any effect due to lower fares and higher nonstop service frequencies. Combined with the impact of lower fares and higher nonstop flight frequencies, this paper will be able to assess the total impact of LCC presence on airport choice. As a result this study will facilitate a discussion of the overall impact of LCCs presence at an airport. Additionally, this study tests the impact of LCC presence across different customer characteristics such as income, trip purpose and how far an alternative airport is.

Fournier et al. (2007) documented the impact of geographical distance to an alternative airport on a customer's choice of an airport. The authors show that when customers are located further away from an alternative airport the fare at the alternative airport needs to be decreased to attract customers by canceling the impact of longer access time. This study examines if other airport choice determinants (aside from airport access time) become less influential as the distance to an alternative airport increases. This result would be consistent with previous studies arguing that airport choice determinants do not influence customers uniformly but differently depending on how easily a customer can reach his or her closest alternative airport.

4.1.6 Managerial Implications

The results of this study should have implications for airport managers. While various factors drive a customer's choice of airport, most of these factors are outside of the control of airport managers (geographical distance to airport) and/or determined by airlines (fare and frequency). For instance, closeness is not really controllable by airport operators once the airport location is decided by the long term plans of the government. Service schedules and fares at airports also significantly impact a customer's choice of airports, but both are determined by airlines, not airports. However, if LCC presence provides additional value to customers, this provides a variable over which airports can exercise a certain amount of influence. The airport operator can attempt to recruit LCCs to provide service to the airport. As a result, airports may become more attractive to customers. For instance, Baltimore/Washington International Airport (BWI) put a significant amount of effort into recruiting Southwest Airlines, one of the major LCC carriers in the nation, after US Airways reduced its service in the early 1990s. The introduction of LCC service at BWI has been successful in attracting customers. This study will help to determine if this is solely due to low fares and frequent service or if LCC presence has an added impact above and beyond fares and frequency.

4.2 Literature Review

4.2.1 Airport Choice

In this section, I review the determinants that previous literature found to drive airport choice, along with different customer characteristics that may influence these variables. In addition, I review the literature regarding low cost carriers that may influence customer choice of airport.

In many regions of the country and in many metropolitan areas, a customer can easily access two or more airports, and thus has an airport choice decision to make. Previous researchers have recognized three main determinants that drive a customer's airport choice, namely, airport ground accessibility, service schedules of airlines at the different airports (Harvey, 1986; Windle and Dresner, 1995) and airfares offered by airlines at the different airports (Pels et al., 2003; Pathomsiri and Haghani, 2005). Below, I review how each of these three airport choice determinants that may influence a customer's airport choice.

4.2.1.1 Accessibility

First, accessibility is recognized as perhaps the most important variable in choosing an airport (Pels et al., 2003; Suzuki, 2007). In the Pels et al. (2003) study, a customer's airport choice is found to be positively associated with airport accessibility in terms of both (lower) access time and (lower) access cost. Access time is calculated by the travel distance between the trip origin location (home, business, or hotel) and an airport, by the various modes of airport access. The authors also calculated the access cost for each ground transportation mode based on travel distance. They found higher elasticity for access time than for access cost, especially for the business passengers. In a similar study by Hess et al. (2006), in-vehicle access time is posited as a factor that will influence a customer's choice of airport. The authors found that in-vehicle access time is negatively associated with a customer's airport choice and interpreted this finding as evidence of a customer's risk aversion; that is, his/her desire to not to miss a flight by arriving late to the airport. Ground access time to an airport has been found by other studies to be the primary determinant of airport choice and consistently demonstrates a negative impact on a customer's choice among airports (Windle and Dresner, 1995; Basar and Bhat, 2004).

The importance of access time to the airport may vary among categories of customers. Windle and Dresner (1995) estimated the impact of access time on customer choice among the three airports in the Washington Metropolitan area. The study shows that high airport access time most negatively affects business customers regardless of whether they are residents or non-residents of the metropolitan area. This result may imply that business travelers have higher time values than do leisure travelers, and thus tend to minimize airport access time and the risk of missing a flight. Basar and Bhat (2004) also tested access time across different customers grouped by the number of traveling companions in a group, using data from the San Francisco Bay area airports. The authors argued that customers traveling in a group may use the access time for socialization purposes and thus may be less sensitive to access time than solo travelers. All the studies support the notion that access time consistently influences customer choice of airports, but its importance may vary across customer segments.

Although airport accessibility is acknowledged as an airport attribute, airport operation managers have little control over this attribute, at least in the short run.

4.2.1.2 Flight Frequency

Second, I examine the impact of airline service schedules on a customer's airport choice. It is posited that airports with more flights to a particular destination will attract customers wishing to fly to that destination. This is because the chance of finding a flight departing at a time that a customer prefers is higher, and customers can reduce potential waiting time for their flights accordingly (Harvey, 1987; Pels et al., 2001).

Interestingly, the impact of schedule frequency may vary across customer segments, depending on attributes such as residency, income and trip purpose. Windle and Dresner (1995) found that non-residents (of a metropolitan area that contains a choice of airports) are more sensitive to the daily frequency of flights on a route than are residents in choosing an airport. The authors attribute this finding to the idea that information about alternative airports and the flights at these alternative airports are less known to non-residents. Pathomsiri and Haghani (2005) investigated airport choice in the Baltimore-Washington Metropolitan area and tested the impact of daily flight frequencies. The authors found that frequency positively influences a majority of business passengers (82%) but negatively influences a minority of business passengers (18%) in airport choice. Basar and Bhat (2004) found the surprising result that high-income travelers are negatively associated with the choice of airports with high frequencies to their destinations, while all travelers (as a whole) are positively associated with high frequencies. The authors attribute this finding to the fact that high income customers tend to fly during narrow peak hours and may not be sensitive to the frequencies throughout the whole day.

These studies support the idea that flight frequency is a key driver in choosing an airport as long as customers have information concerning service frequency at alternative airports. In addition, the importance of frequency in airport choice may vary by customer segment.

4.2.1.3 Fare

Last, while fares should be a primary factor in a customer's choice among airports, previous studies tend to show mixed results, perhaps due to data limitations. Cho et al. (2012) finds strong passenger demand at airport pairs that offer low yields (fares divided by distance). Pels et al. (2003) tested average fares at the route level and found a negative relationship with customer's choice of an airport. However, limitations in the availability of fare data have heavily restricted the use of fares in airport choice models. In fact, some previous studies (Pels et al., 2001; Windle and Dresner, 1995) do not include fares in their airport choice models. Windle and Dresner (1995) argued that the inclusion of average fare information, instead of actual passenger fare data, might generate erroneous or misrepresentative results. Suzuki (2007) used a passenger's perception of paying a lower fare than the market average price as a binary indicator in the prediction of airport choice and found a significantly positive relationship. Loo (2007) directly asked for fare information in a survey questionnaire and found that passengers, especially leisure travelers, chose an airport that has low fares among the five airports in the Hong Kong area.

These studies argue that fare may be a primary factor in choosing an airport, but data limitations make the use of this variable challenging. However, the Suzuki (2007) study suggested the possibility of using the presence of low-cost carriers at an airport as a proxy for low fares in predicting a customer's airport choice.

To conclude this section, I reviewed the determinants affecting a customer's choice of airports. These include airport accessibility, airline flight frequencies and airfares. Appendix 3 summarizes the airport choice literature discussing these determinants.

4.2.2 Impact of LCC Presence at Airports

In addition to the major airport choice determinants discussed in the previous section, the impact of LCCs on airport choice has been examined in two ways – through fares and more direct services.

4.2.2.1 LCC's Fare and Nonstop Flight Frequency

The main attraction of LCCs is their low fares. Although fares offered by airlines may vary significantly depending on the complicated discount schemes of each airline (e.g., advanced purchase discounts, sales channels and different promotions), the impact of LCCs' low fares have been confirmed in a number of previous studies (Dresner, et al. 1996; Windle and Dresner 1999; Bennett and Craun 1993; Whinston and Collins 1992). These studies commonly argue that there is a positive impact of LCCs on market demand. Recently, Cho et al. (2012) empirically support the idea that LCC presence is positively associated with customer demand for a specific airport in a multi-airport city.

Recently, Suzuki (2007) tested the low fare impact that potentially results from LCC presence at an airport. He found that the perception of low fares influences a customer's choice of airports. (Note: The study does not directly observe LCC presence but uses a customer's perception of paying relatively low fares as a proxy for LCC presence).

Second, service frequency is highly valued by customers. Increased frequencies at an airport raise the probability that a passenger will be able to depart at a desirable time. This implies that the passenger will be able to minimize wait time for his/her flight. Accordingly, flight frequency reduces a customer's time cost, a result supported by previous airport choice studies (Windle and Dresner, 1995; Pels et al., 2001; Suzuki, 2007, Ishii et al., 2009). All of these studies find a significant positive relationship between frequency and a customer's choice of airport.

LCCs may provide higher direct service frequency than their full-service competitors (Gillen and Lall, 2004). High nonstop flight frequency is a strategic choice for some LCCs, notably Southwest Airlines.

LCCs may also be able to offer high frequencies due to their simplified networks (direct point-to-point routes). By not operating hubs, LCCs can, again, reduce ground time. (Not every LCC operates a simplified network. For instance, Air Tran has a hub at Atlanta.)

4.2.2.2 LCC's Features Other than Fare and Nonstop Flight Frequency

However, an LCC's impact in a market is not necessarily limited by these two factors. In addition to the low fares (Dresner et al., 1996) and high frequencies of direct services (Gillen and Lall, 2004), Heskett and Schlesinger (1994) suggested that Southwest Airlines, the largest LCC in the United States, has high operational reliability and a positive staff attitude. More interestingly, Coldren et al. (2003) reported that the image of a carrier might also be important in influencing passenger choice. I will address these three factors.

First, operational reliability may be assessed in the airline industry by the dependability and accuracy of the service provided (Parasuraman and Grewal, 2000) and is often represented by on-time performance and baggage handling accuracy. Tsikriktsis (2007) argued that the airlines using a focus strategy, such as most of the LCCs, provide better on-time performance and better baggage handling accuracy. The better performance may be due to the LCC's simplified network (fewer connecting flights) and simplified aircraft turnaround process (shorter turnaround time) that enable LCCs to perform well in both on-time performance and baggage handling.

Second, previous management literature emphasizes the importance of service staff attitude. Bitner and Boom (1990) introduced the concept of the 'service encounter' moment and argued that it is an important moment because customers evaluate the service at this time. Roth et al. (2003) also support that a positive evaluation may lead to a customer's repurchase decision in the service industry.

In the airline industry, there are many stages where customers experience customer service. These stages include check-in, in-flight, transfer and baggage claims. During these stages, staff attitude may matter to customers. Previous airline studies indicate that staff attitude is an important factor to be considered in evaluating the airline service (Coldren et al. 2003; Mikulic and Prebezac, 2010; Anderson et al., 2009).

LCCs use a positive staff attitude to attract customers. Heskett and Schlesinger (1994) argued that, as the one of the oldest LCCs in the industry, a friendly staff attitude is one of Southwest's strengths. Southwest effectively uses its human resources to deliver its service. In fact, Southwest Airlines traditionally views its staff as the most important resource servicing its customers (Gillen and Lall, 2004) and focuses on maintaining a "fun and friendly" working circumstance, which is positively supported by customers (Gilbert and Child, 2001). Kimes and Young (1997) point out that United needed to consider a "customer-friendly" attitude when it designed the United Shuttle's service to compete with Southwest Airlines (Kimes and Young, 1997).

Third, previous literature supports the idea that a company's brand image may help its overall business. Andreassen and Lindestad (1998) noted the importance of company image, which may be different from the customer's actual experience with the company. This brand image may be formed through advertising, direct marketing, etc. Then, it is argued that as a quality image brand affects customer behavior in purchasing (Fornell, 1992)

4.3 Hypotheses

This study proposes that LCCs attract customers with their unique value aside from any flight frequency and fare they may offer. Although both nonstop service frequency and lower fares are the main airport choice determinants through which LCC presence influences customer's choice of airport, previous studies suggest that there are other LCC features that attract customers (Coldren et al., 2003; Jou et al, 2008; Mikulic and Prebezac, 2010). This study proposes that the following factors are important in airport choice and are associated with LCC presence on a route: operational reliability, customer service and low-fare brand image. Therefore, my first hypothesis is the following:

Hypothesis 1: The presence of LCCs on an airport route positively impacts airport choice even after controlling for differences in fares and frequency.

Further, this study investigates the moderating effect of customer characteristics on the airport choice determinants (nonstop flight frequency, fare, airport access time and LCC presence). In particular, this study is interested in how customer time and convenience value influences airport choice. Customer appreciation of time and convenience utility may increase as income level rises or may be higher for business travelers than for leisure travelers. Therefore, the following hypotheses are proposed:

Hypothesis 2a (Hypothesis 3a): Nonstop flights frequencies on a route are relatively more important for high income (business) travelers than for low income (leisure) travelers in choosing an airport.

Hypothesis 2b (Hypothesis 3b): Access time to airports is more important for high income (business) travelers than for low income (leisure) travelers in choosing an airport.

On the other hand, high income and business travelers may not be as sensitive to fares as those whose income level is low and whose trip purpose is leisure. Therefore, the following is proposed:

Hypothesis 2c (Hypothesis 3c): Fare is less important for high income (business) travelers than for low income (leisure) travelers in choosing an airport.

More interestingly, this study tests the moderating effect of LCC presence on income and trip purpose. As discussed earlier, LCC presence may represent several factors (i.e., reliability, customer service and low-fare marketing image). The service aspects of LCCs may be relatively more attractive to high income and business customers. Therefore, it is plausible to propose that high income and business customers value LCC presence to a greater degree than low income and leisure customers.

However, the primary reason to fly LCCs is low fares (O'Connell and Williams, 2005). As discussed earlier, a low-fare brand may drive customers to both LCCs and the airports they serve. In contrast to operational reliability and customer service, low income and leisure customers may view the low fare aspect of LCCs as more valuable than high income customers or business customers. Thus, the low-fare brand image may be more effective with low income and leisure passengers.

In addition, LCCs might not provide services valued by business and high income customers, such as premium seats, assigned seating, extensive frequent flyer programs, airport lounges, (Mason, 2000) and a more formal staff attitude. In particular, LCCs' Frequent Flier Programs (FFPs) may not be as strong as the legacy carriers' FFPs because of the limited number of destinations served by LCCs.

We believe that the importance of the low-fare image to a customer's airport choice will dominate the higher value of operation reliability. Thus, this study posits that high income and business customers may react less strongly to LCC presence than low income and leisure passengers as stated as follows:

Hypothesis 2d (Hypothesis 3d): Presence of LCC on a route is less important for high income (business) travelers than for low income (leisure) travelers in choosing an airport.

Lastly, customers who have a longer access time to alternative airports might not be very responsive to fares, nonstop frequencies, and LCC presence. In other words, when alternate airports are not easily accessed, factors such as fares and frequencies no longer have a strong impact on customer choice. On the other hand, airport access time becomes relatively more important. Therefore the difference in access time between customer's preferred airport and the customer's next best choice may act as a moderating variable in choosing an airport as stated as follows:

Hypothesis 4a: A longer access time gap between the closest and the next closest airport negatively moderates the relationship between frequency and a customer's airport choice

Hypothesis 4b: A longer access time gap between the closest and the next closest airport negatively moderates the relationship between fare and a customer's airport choice.

Hypothesis 4c: A longer access time gap between the closest and the next closest airport negatively moderates the relationship between LCC presence and a customer's airport choice.

Hypothesis 4d: A longer access time gap between the closest and the next closest airport positively moderates the relationship between access time and a customer's airport choice.

4.4 Data

4.4.1 Data Source

In order to test the proposed hypotheses, this study requires information regarding what airport was chosen by each individual customer (airport choice) and the airport choice determinants that would influence customer's choices. The airport choice determinants include nonstop flight frequency, fare, LCC presence and airport access time. The information on airport choice is obtained through survey data, while the airport choice determinants are obtained through two different sources of archival data.

It is critical to separately measure customer choice and airport choice determinants using different data sources for the following two reasons. First, this research can avoid common method bias in testing a cause-effect relationship; that is, the same customers answering both the questions evaluating airport choice determinants (i.e., cause) and their choice of an airport (i.e., effect). Second, archival data allows for the quantification of the determinant measures; that is, objective measures for the determinants.

Regarding the customer's choice of airport, the Washington-Baltimore Regional Air Passenger Survey is used as the data source. The survey has been implemented by the Metropolitan Washington Council of Governments (MWCoG) since 1981. Recently, the survey has been conducted every other year. This study uses the most recent three surveys conducted in 2005, 2007 and 2009. The sample includes passengers departing from the three Washington Metropolitan area airports: Washington Dulles (IAD), Baltimore/Washington Thurgood Marshall (BWI), and Ronald Reagan National (DCA). Table 2 provides a summary of the three survey years of data.

Passengers on all scheduled flights departing from the three airports during the survey period were selected for interviews. Among these flights, approximately 675~685 flights were surveyed in all three years. The total number of the enplaned passengers for these flights is about 162,800. The survey staff was able to interview approximately 81,000 departing passengers waiting for their flights at the gate area and the response rate was around 50%. Among these interviewed passengers, about 55,900 passengers completed the survey. [29]

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[29] Potentially, there might be an imbalance among the surveyed passenger numbers across flights. Suppose that 30 passengers on Flight A completed the survey while only 5 passengers on Flight B did the same. Then, weighting the number of passengers by flight may be necessary. However, this study believes that the customers on Flight A are not significantly different from Flight B. For instance, customers flying on a flight from IAD to PDX (Portland, OR) may not be much different from the customers flying on a flight

The survey provides information regarding airport choice, the route and the flight that passengers used. The survey also provides specific customer demographic information, such as income level, trip purpose, and the zip code of the trip origin (a copy of the survey questionnaire is provided in Appendix 4). The zip code can be used to measure access distance to all three airports.

The other information that is needed for this study concerns nonstop flight frequency. In order to obtain this information, my study uses an archival data source, Official Airline Guides (OAG). OAG offers information regarding the number of connections and the frequency of flights for an airline on a specific route.

The second archival data source is the DB1B market data bank. DB1B is publicly available and can be downloaded from the DOT's Bureau of Transportation Statistics (DOT BTS) web site. DOT generates DB1B by collecting a sample of 10% of all domestic tickets and recording all relevant information from the tickets. The information includes origin airport, destination airport, airline, air fare, etc. With this information, researchers can calculate average fares by airline route. Other information that can be obtained through DB1B includes the number of passengers on a route. By using this information, the sample routes were selected for this study. More detail on measurement is discussed later in the measurement section.

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from BWI to PDX (or from IAD to San Antonio (SAT, TX)) particularly in responding to airline operational quality when they choose an airline. Thus, this study does not weight the passenger numbers by flight to control the imbalance of the surveyed passenger numbers.

4.4.2 Sample Routes

This study is interested in testing the relationship between a customer's choice of airport and the airport choice determinants. In order to test this relationship, this study needs to define the sample routes in terms of two aspects; city pairs and market size.

4.4.2.1 City Pair for Destination

When a customer flies to a destination city from the Baltimore/Washington region, a customer has to choose one airport among the three airports. When choosing a departing airport, a customer considers airport choice determinants, such as flight frequency, fares, and presence of certain carriers. However, this study recognizes that there is another key factor that influences a customer's choice of a departing airport, notably the arrival airport. If a specific destination airport is only served from a specific departing airport, customers may not have a real airport choice.

In addition, customers who travel from the Washington Metropolitan area to Chicago (and to other destinations) have two alternate destination airports, O'Hare (ORD) and Midway (MDW). This study considers any airport pair in the same destination city as a single choice set for customers even though it is recognized that they are not exact substitutes.

In order to group the multiple airports within a destination city, this study follows Cho et al. (2012) which grouped airports by Consolidated Metropolitan Statistical Area (CMSA). The grouping table is provided in Appendix 10.

4.4.2.2 Market Size

This study also considered the market size when choosing sample routes. Market size refers to the volume of origin and destination passengers from the three airports in the Washington Metropolitan Area. Routes with small traffic volumes are not included in the sample because these routes have few realistic options for customers to choose (Windle and Dresner, 1995). Thus, this study uses top 45 destination cities from the Washington Metropolitan Area as the sample routes.

In order to examine the market size, this study uses the departing traffic volume of origin and destination passengers. The departing traffic volume information is obtained from DB1B (DOT). DB1B data were downloaded for the 1st quarter for 2005 and the 4th quarter for 2007 and 2009 because the survey data that this study used were implemented in March 2005 and in October 2007 and 2009. The number of passengers is aggregated across flights by origin and destination airport pair. The total number of the passenger is 14,096,060 (4,498,690, 4,949,300 and 4,648,070 for each year respectively) across 3,107 route years (1059, 1028 and 1020 for each year).

Among these 3,107 route year, the number of the unique airport destinations from the Washington Metropolitan area is 390. When the 390 airport destinations are grouped by city at destination, the number of pairs decreased to 370 city pairs[30] . I ranked these city pairs based on the number of the departing passengers. A volume cutoff was set in order to select the sample city pairs. The cutoff was 70,000 passengers for the departing passenger summation. In this way, this study identified the most popular 45 destination cities to be used as the sample routes (See Table 18) from DB1B archival data. The departing passengers to these 45 destination cities account for 84.1% of the total departing passengers flying from the three airports in the Washington Metropolitan area. The table shows the number of passengers who flew each quarter between the Washington Metropolitan area and the top 45 destination over the three years. The market share distribution across the three departing airports is also presented in the table.

[30] According to the Consolidated Metropolitan Statistical Area (Cho et al., 2012), 37 airport pairs are grouped into 14 city pairs. The three airports in the Washington Metropolitan Area were dropped because this study uses Washington, DC airports as the origin airports. 34 airports were grouped into 13 destinations (Appendix 10). Note that one multi airport city that was not observed in DB1B data is Philadelphia because there was no service (served only on occasional flights) to its second airport (Atlantic City International Airport) from Washington Metropolitan Area.

Table 18 Top 45 Destination Cities from the Washington Metropolitan Area with Number of Passengers and Market Shares (2005, 2007 and 2009 combined)

Rank	City Name	Passenger	Market Share		
			BWI	DCA	IAD
1	Boston	1,031,230	53.1%	29.4%	17.5%
2	Chicago	713,700	32.4%	44.9%	22.7%
3	Miami	683,450	36.2%	40.9%	23.0%
4	Los Angeles	680,740	25.1%	16.8%	58.1%
5	Orlando	673,700	47.1%	21.1%	31.8%
6	Atlanta	662,290	30.7%	44.6%	24.7%
7	New York	610,260	13.6%	67.4%	18.9%
8	San Francisco	513,690	22.5%	14.1%	63.4%
9	Dallas	407,900	37.0%	41.1%	21.9%
10	Tampa	376,000	47.7%	26.0%	26.4%
11	Denver	359,800	33.8%	32.7%	33.5%
12	Las Vegas	324,160	47.2%	19.4%	33.5%
13	Detroit	299,390	40.3%	42.4%	17.2%
14	Houston	289,270	45.8%	41.2%	13.0%
15	Phoenix	248,910	52.7%	28.5%	18.8%
16	San Diego	228,130	40.7%	20.9%	38.5%
17	Minneapolis	219,650	25.4%	49.5%	25.1%
18	Seattle	196,310	33.4%	36.5%	30.1%
19	St. Louis	184,150	45.8%	40.3%	13.9%
20	New Orleans	176,160	44.7%	37.0%	18.3%
21	Charlotte	174,610	52.0%	24.0%	24.0%
22	Hartford	170,230	65.8%	19.8%	14.4%
23	Kansas City	164,750	37.2%	46.3%	16.5%
24	Nashville	162,980	64.1%	20.7%	15.2%
25	Palm Beach	155,050	49.8%	38.4%	11.9%
26	Jacksonville	154,640	47.1%	30.0%	23.0%
27	Raleigh-Durham	154,210	47.3%	36.9%	15.8%
28	San Antonio	132,490	53.5%	27.0%	19.6%
29	Fort Myers	132,230	50.6%	37.5%	11.9%
30	Salt Lake City	130,140	42.0%	29.9%	28.1%
31	Cleveland	123,970	70.2%	14.8%	15.0%
32	Austin	120,510	52.5%	25.0%	22.4%
33	Indianapolis	118,770	45.0%	37.4%	17.6%
34	Buffalo	110,540	83.0%	11.0%	6.1%
35	Columbus	109,360	67.3%	26.3%	6.5%
36	Milwaukee	100,900	42.9%	52.0%	5.1%
37	San Juan	99,570	30.9%	23.3%	45.8%
38	Albany	96,920	74.4%	14.3%	11.3%

39	Albuquerque	91,940	43.7%	31.2%	25.1%
40	Portland	88,260	39.5%	27.5%	33.0%
41	Louisville	87,970	67.3%	21.7%	11.1%
42	Sacramento	78,160	34.5%	21.2%	44.3%
43	Honolulu	74,010	36.5%	24.1%	39.3%
44	Pittsburgh	71,020	42.9%	33.3%	23.7%
45	Birmingham	70,630	75.7%	16.5%	7.8%
	Sum	11,852,750	46.0%*	30.8%*	23.2%*

* Average market share by departure airport

Among the top 45 destination cities, the most popular destination city from the Washington Metropolitan area is Boston and the number of flown passengers to Boson is 1,031,230. All sample routes have more than 70,000 quarterly departing passengers for the destination cities. In general, departing passengers are divided fairly evenly among the three airports in the Washington Metropolitan area. Exceptions are routes to Buffalo, Columbus, Milwaukee and Birmingham from IAD with a market share of less than 10%. On average, the most popular departing airport is BWI with an average market share of 46.0%, followed by DCA (30.08%) and IAD (23.2%). This may not match up with overall passenger shares for the three airports because these numbers are only based on Top 45 destinations.

Table 19 shows the number of available airports at each destination city and the flown miles to these destinations. The metropolitan areas that have the maximum number of airports are Los Angeles and New York, each with five. Most of the other cities have one or two alternative airports except for Boston and San Francisco who has three airports. The average length of a route is 1,201 miles. The shortest route is New York (LGA) with a length of 196.0 miles. All other routes are longer than 260 miles, so there is little substitution effect from land transportation modes. All distances are measured from BWI to the destination airport (if there are multiple airports in a destination city, the largest airport is used. For instance, ORD is used for Chicago and BOS for Boston).

Table 19 Number of Available Airports in and Flown Miles to Destination City

Rank	City Name	Airport Number	Miles	Rank	City Name	Airport Number	Miles
1	Boston	3	368.7	24	Nashville	1	667.3
2	Chicago	2	648.3	25	Palm Beach	1	935.7
3	Miami	2	980.9	26	Jacksonville	1	757.4
4	Los Angeles	5	2391.3	27	Raleigh-Durham	1	314.3
5	Orlando	1	844.8	28	San Antonio	1	1462.4
6	Atlanta	1	602.7	29	Fort Myers	1	950.4
7	New York	5	196.0	30	Salt Lake City	1	1943.3
8	San Francisco	3	2542.5	31	Cleveland	2	325.6
9	Dallas	2	1270.2	32	Austin	1	1395.6
10	Tampa	2	895.6	33	Indianapolis	1	660.9
11	Denver	1	1567.8	34	Buffalo	1	331.2
12	Las Vegas	1	2184.0	35	Columbus	1	430.5
13	Detroit	2	423.8	36	Milwaukee	1	713.4
14	Houston	2	1284.1	37	San Juan	1	1701.2
15	Phoenix	1	2078.3	38	Albany	1	297.7
16	San Diego	1	2385.1	39	Albuquerque	1	1779.7
17	Minneapolis	1	989.0	40	Portland	1	2554.3
18	Seattle	1	2504.4	41	Louisville	1	560.3
19	St. Louis	1	791.1	42	Sacramento	1	2539.1
20	New Orleans	1	1128.3	43	Honolulu	1	4946.5
21	Charlotte	1	384.1	44	Pittsburgh	1	260.8
22	Hartford	1	283.3	45	Birmingham	1	738.3
23	Kansas City	1	1071.9		Average	1.42	1201.82

4.4.3 Survey Sample Analysis

Three survey years (2005, 2007 and 2009) of the Washington-Baltimore Regional Air Passenger Survey data are provided by MWCoG. In their survey response, passengers indicated their final destination and personal information such as trip purpose, household income, zip code of trip origin and etc.

The total number of survey observations for the three year survey is 55,900. This number is reduced to 36, 283 after connecting passengers and international passengers are excluded. Among these 36,283, only 12,598 observations[31] had all the required information, such as address of the trip origin, income level and trip purpose, in order to test the proposed hypotheses.

As explained in the previous section, I grouped airport pairs by city at destination. This study is interested only in the customers traveling to the top 45 city destinations based on the number of departing passengers from the airports in the Washington Metropolitan area and 9,231 surveyed passengers traveled to these destinations. Thus, the usable sample accounted for 25.4 % of the total domestic departing customers from the three airports who responded to the survey (36,283). Table 20 shows the distribution of the customer observations departing from each of the three airports by destination city. The

[31] Once the observations that do not have all the required information are not included in the sample, it is possible the sample differs from the population (the whole domestic departing observations). Thus, this study performed a bias test by comparing the means of the customer characteristic variables between the population and the sample. The results of the test show that the sample is biased (Appendix 11). There are fewer business customers are included in the sample to the whole populations. It is thought that fewer business passengers, who were busy, finished all the survey questions. The mean of the sample income is lower. It is believed that the biggest portion of the sample is the passengers departing from BWI (Table 20), where there were more leisure passengers than business passengers (Table 25).

distributions are not noticeably different from the ones that are calculated with DB1B archival data (Table 18) in which BWI has the largest number of passengers followed by DCA and IAD.

Table 20 Distribution of Customer Observations by Destination City

No.	Destination City	BWI	DCA	IAD	Total
1	Boston	504	221	156	881
2	Chicago	335	190	138	663
3	Miami	180	212	75	467
4	Los Angeles	149	70	169	388
5	Orlando	225	108	128	461
6	Atlanta	254	213	118	585
7	New York	142	270	142	554
8	San Francisco	103	59	133	295
9	Dallas	151	68	81	300
10	Tampa	224	53	36	313
11	Denver	125	60	47	232
12	Las Vegas	232	43	49	324
13	Detroit	159	117	41	317
14	Houston	107	99	29	235
15	Phoenix	151	25	36	212
16	San Diego	65	36	39	140
17	Minneapolis	48	58	28	134
18	Seattle	52	39	39	130
19	St. Louis	94	35	37	166
20	New Orleans	60	72	28	160
21	Charlotte	95	29	47	171
22	Hartford	152	21	18	191
23	Kansas City	36	29	4	69
24	Nashville	108	16	22	146
25	Palm Beach	14	29	0	43
26	Jacksonville	28	21	29	78
27	Raleigh-Durham	91	69	21	181
28	San Antonio	42	15	18	75
29	Fort Myers	75	27	7	109
30	Salt Lake City	16	6	23	45
31	Cleveland	115	29	10	154
32	Austin	59	14	9	82
33	Indianapolis	67	36	19	122

34	Buffalo	120	4	11	135
35	Columbus	77	33	12	122
36	Milwaukee	33	18	1	52
37	San Juan	11	7	26	44
38	Albany	62	4	17	83
39	Albuquerque	25	13	29	67
40	Portland	23	11	9	43
41	Louisville	34	15	3	52
42	Sacramento	16	6	21	43
43	Honolulu	11	12	8	31
44	Pittsburgh	29	28	10	67
45	Birmingham	60	7	2	69
	Total	4759	2547	1925	9231
	%	51.6%	27.6%	20.9%	100.0%

4.5 Model

4.5.1 Model Specification

This study tests the relationship between a customer's choice of airport and the airport choice determinants. A customer's choice of airports is discrete. No passenger can choose more than a single airport for a flight. The Logit model can be used to estimate this type of customer's discrete choice. In particular, when there are more than two alternatives, a multinomial logit model is suggested by previous studies (Train and McFadden, 1978)

This study predicts a customer's choice of departure airport among the three airports in the Washington Metropolitan area (e.g., BWI, DCA and IAD). Thus, this study uses a multinomial logit model as suggested by previous studies (Dresner and Windle, 1995, Pels et al., 2003). The generic form of a multinomial logit model (Equation (3)) is shown below. The model estimates the probability of choosing Airport 1 as a function of the expected utility that a customer will have by choosing Airport 1 among the summation of the expected utility of using all alternative airports:

$$\text{Prob(Airport 1)} = \exp(U_{\text{Airport 1}}) / \sum \text{Exp}(U_{\text{Airport i}}, i = 1 \text{ to } n) \quad (3)$$

In general, the decision making unit can be an individual person, firm or organization. In this study, it is an individual customer who needs to choose an airport for his or her air trip, and it is assumed that all individuals make their decisions in order to maximize their utility. A choice model will predict the probability that one airport is chosen over one or more alternative airports while a customer maximizes his or her utility. In the choice model, there are two groups of determinants that might influence a customer's choice as suggested by previous studies (Proussaloglou and Koppelman, 1995; Windle and Dresner, 1995): choice specific (airport characteristics) and chooser specific (customer characteristics). Choice specific variables are defined as the variables that vary across choice alternatives. In this study, choice alternatives are airports. Thus, the choice specific variables in this study are airport characteristics at a route level. Each of the choice specific variables represents how attractive each airport is and predicts a customer's choice of airport. Note that airport access time has both chooser specific and choice specific properties because it also varies across customers.

Chooser specific variables vary depending on the characteristic of a particular customer. These chooser specific variables can moderate the relationship between the choice-specific variables and a customer's airport choice across different customers. In order to clarify which variables are choice and chooser specific characteristics, Table 21 summarizes the variables by their characteristics.

Table 21 Variables by Choice Specific and Chooser Specific

Variables	Main Airport Choice Determinants	Moderators
Choice specific (Airline characteristics)	Nonstop flight frequency (FQ)	-
	Average Fare (FARE)	-
	LCC presence (LCC)	-
Both Choice and Chooser specific (Airport and Customer characteristics)	Airport access time (ACCESS)	-
	-	Additional access time to an alternative airport (GAP)
Chooser Specific (Customer characteristics)	-	Income (INC)
	-	Trip purpose (BUSI)

The choice and chooser specific variables included in the model are consistent with those in previous studies. These studies (Windle and Dresner, 1995; Pels et al., 2003) suggested that there are several choice specific variables that influence choice of airport. They include flight frequency (FQ), fare (FARE) and airport access time (ACCESS). While both flight frequency and fare are clearly airport (choice) specific, airport access time has both choice (airport) and chooser (customer) specific properties. In the same way, access time to the next closest airport has both choice and chooser specific characteristics as well.

In addition to these factors, this study hypothesizes that an airport with a low cost carrier (LCC) presence influences a customer's airport choice because of widespread customer belief that LCCs offer low fares. Thus, LCC presence is added to the model as a choice specific variable.

In short, a customer's choice of airport is the function of the three major determinant variables (FQ, FARE and ACCESS) and low cost carrier's presence (LCC) variable.

In addition, three chooser specific variables that are used to test the moderating effect across different customers (Dresner and Windle, 1995; Fournier et al., 2007). This study hypothesizes that the relationship between airport choice and its main determinants may vary based on customer characteristics. The characteristics included are customer income level and trip purpose.

Finally, this study is interested in the moderating effect of the substitutability with neighboring airports based on ground access time on the four airport choice determinants. This study measures the physical distance gap (GAP) between the closest airport and the second closest airport. Then, the interaction terms between the gap variable and the main airport choice determinant variables (FQ, FARE, LCC and ACCESS) are created and added in the model to test the moderating effect of the additional access time to substitute airports.

If the additional travel time to the closest airport is between 30 and 45 minutes, a dummy variable is created and called G3045. If it is longer than 45 minutes, it is called G45. These two gap variables create eight interaction terms with the four airport choice determinants. The expected signs on these gap interaction terms are opposite to the three airport choice determinants (FQ, FARE and LCC) and the same sign for airport access time (ACCESS).

In summary, this study uses a multinomial logit model to model a customer's discrete choice among the three airports. The complete model to be tested is formed based on the discussion above as follows:

Airport choice

= FQ + FARE + LCC + ACCESS

+ INC · FQ + INC · FARE + INC · LCC + INC · ACCESS

+ BUSI · FQ + BUSI · FARE + BUSI · LCC + BUSI · ACCESS

+ G3045 · FQ + G3045 · FARE + G3045 · LCC + G3045 · ACCESS

+ G45 · FQ + G45 · FARE + G45 · LCC + G45 · ACCESS

+ Airport dummies

In the following section, I explain how this study measures each variable included in the model.

4.5.2 Measurement

The model in this study estimates a customer's choice of airport. Thus, the dependent variable of the model is a customer's choice. The independent variables are the airport characteristics. The interaction terms between the airport characteristics and the customer characteristics are added as independent variables, as well.

4.5.2.1 Dependent Variable

A customer's choice among the three airports (BWI, DCA and IAD) in the Washington Metropolitan area is the dependent variable captured from the passenger survey data. Each customer in the sample has three airports as available alternatives. The airport that was chosen is coded 1 while the other two airports are coded 0.

4.5.2.2 Independent Variables

The independent variables in the model include the four airport choice determinant variables (FQ, FARE, LCC, and ACESS) and the interaction terms between the four airport choice determinant variables and three customer characteristic variables (BUSI, INC and GAP (i.e., G3045 and G45)).

4.5.2.2.1 Airport Characteristics

- **Nonstop Service Frequency (FQ)**

We use OAG data to obtain non-stop flight frequency information for each route. OAG data contains direct flight frequency information for all airlines departing from each of the three airports in the Washington Metropolitan area.[32] OAG provides the details of flight operations for each airport pair during the survey periods. The details include the dates and the number of flights that were operated. I measured the frequency of nonstop flights (FQ) by counting the number of nonstop flights that each airline provided for the dates that the survey was implemented. For instance, the 2007 survey was performed from October 7th to October 20th. I summed the number of nonstop flights that were operated on a specific route during the first week of the survey period (October 7th and October 13th) to obtain the weekly nonstop flight frequencies.

Lastly, this study consolidates the weekly frequency of the nonstop flights across destination airports in the same city destination. The final product is the nonstop weekly service frequency from each of the departing airports to each destination city.

- **Fare (FARE)**

Fare information is provided by the USDOT DB1B database. The fare information includes taxes and fees that are paid at the time of ticket purchase. Although fares are significant drivers of customer choice, they are not often used in airport choice models due to data unavailability for individual customers. The fares each customer pays are expected to vary significantly across customers depending on different purchase times and different sales channels due to the complicated fare schemes that airlines use.

[32] The definition of an OAG direct flight includes all nonstop and multiple stop flights, as long as the flight number remains the same. For instance, a customer from BWI to SFO changes the planes at ORD. If the first leg flight (i.e., BWI to ORD) and the second leg flight (i.e., ORD to SFO) use the same flight number, OAG sees this itinerary as direct flight travel. However, this study intends to measure how customers respond to inconvenience and risks of changing planes. Thus, this study considers any itinerary that requires change of planes as a connecting flight and is not counted as direct flight.

Unfortunately, my data cannot provide actual fare information. Thus, this study uses the quarterly average airfare by route in the month when the surveys were conducted. I aggregated all individual fares and calculated an average fare for a specific origin and destination airport pair. I weighted fares by the number of passengers and aggregated them across destination airports. Then, average fare information was matched with all alternative routes.

- **Presence of LCC**

The presence of low cost carrier nonstop service on a route is one of the variables that influence a customer's choice of airports. This study obtains nonstop service frequency by low-cost carriers by departing airport in the same way as for overall nonstop flights as described earlier. Basically, I summed the number of nonstop flights that the LCCs provided for the survey periods and generated the nonstop service frequency by airport pair. Then, I consolidated the frequency of the nonstop flights that go to the same city destination. If any low-cost carrier provides at least one nonstop flight to a destination city, the variable is coded as 1. It is coded as 0 otherwise.

- **Access Time (ACCESS)**

The travel time between a customer's trip origin location and each airport is measured to indicate access times. Customer's access time to each airport is calculated based on customer location information provided by the survey data. In the survey, each customer reveals their origin location zip code. Then, the access time is calculated using Google Maps (maps.google.com), which provides the travel time between two endpoints in minutes. This study uses zip code for customer's starting point and the airport codes, BWI, DCA and IAD, for the airport endpoints.

4.5.2.2.2 Customer Characteristics

This study measures customer characteristics as moderators between the airport characteristics and customer's choice of airport. Customer characteristics include customer income level, trip purpose and additional travel time to alternative airports. I explain these customer characteristic variables in detail below:

- Income (INC)

Customer household income level information is collected through the air passenger survey. In the survey, passengers revealed income information by choosing one of the eight income range codes provided in the questionnaire (the questionnaire is in Appendix 4). This study uses the mean of the range. In 2005 year survey, I entered $20,000 for the range of $15,000~$24,999. The first range is less than $15,000 and this study entered $7,500, which is the midpoint between $0 and $15,000. In the same way, the last range is more than $150,000 and this study entered $175,000 for the last range (see Table 7). Then, the income variable has one of these eight mean numbers for each customer. Note that 2005 survey has the different income ranges and accordingly different means from 2007 and 2009 survey.

- Business Trip Purpose (BUSI)

In addition, a customer's trip purpose is addressed through the survey. Passengers were asked to choose one of the seven trip purpose categories. Among these purposes, three categories (business related to the federal government including military, business related to state or local government and business that is not related to government) fall into the business-related trip purpose. If a customer traveled for the one of these business-related reasons, the customer is categorized as a business traveler. The binary variable is then coded 1. Other trip purposes are coded 0.

- Geographical Distance Gap to the Closest Alternative Airport (GAP)

This study examined the moderating effect of access time to the closest alternative airport on a customer's choice of airport. Google Maps (maps.google.com) provides the travel time between two endpoints in minutes. Google Maps identifies two end locations with actual street address, zip code or the name of landmark such as airports. This study uses zip code for a customer's starting point and the airport codes; that is, BWI, DCA and IAD for, the airport endpoints. In this way, this study obtains driving time (in minutes) for each customer to each airport. The gap between the closest airport and the second closest airport is obtained by subtracting the driving time to the closest airport from the driving time to the next closest airport. If the additional travel time to the closest airport is between 30 and 45 minutes, a dummy variable is created and called G3045. If it is longer than 45 minutes, it is called G45. These two gap variables are used to create eight interaction terms with the four airport choice determinants.

4.6 Analysis and Results

4.6.1 Summary Statistics

4.6.1.1 Airport Choice Determinants

This study proposes four airport choice determinants (LCC presence on the top of the main airport choice determinants such as FQ, FARE and ACCESS) and three customer characteristics (INC, BUSI and GAP). This section describes these airport choice determinants first and customer characteristics next.

The four airport choice determinants are nonstop flight frequency (FQ), LCC presence (LCC), average fare (FARE) and airport access time (ACCESS). The summary statistics for these variables are provided below in Table 22. Note that FQ, LCC and FARE are measured at a route level. ACCESS shows the travel time from each customer to the three airports.

Table 22 Summary Statistics of Airport Choice Determinants

Variable		Mean	Std.Dev.	Minimum	Maximum	Cases
FQ (weekly flight)	BWI	80.56	70.35	0.00	270.00	4,759
	DCA	94.30	100.98	0.00	371.00	2,547
	IAD	81.05	70.85	0.00	378.00	1,925
FARE ($)	BWI	154.97	44.82	76.11	463.04	4,759
	DCA	209.65	45.91	116.04	475.39	2,547
	IAD	198.77	62.48	94.80	479.68	1,925
LCC	BWI	0.88	0.33	0.00	1.00	4,759
	DCA	0.26	0.44	0.00	1.00	2,547
	IAD	0.45	0.50	0.00	1.00	1,925
Access time (driving minutes)	Access time to the 1st closest	35.18	27.90	4	306	9,231
	Access time to the 2nd closest	56.88	31.84	21	329	9,231
	Access time to the 3rd closest	73.46	30.04	36	332	9,231

Regarding nonstop flight frequency (FQ), DCA provides 94.3 nonstop flights per route on average, which is the highest among the three airports. BWI has the highest percentage of routes with at least one nonstop flight provided by an LCC at 88%. Both DCA and IAD have less than half of their routes served by LCC nonstop flights. In particular, only 26% of DCA routes have LCC nonstop service.

Regarding fares (FARE), BWI has the lowest average fare at $154.97 compared to $209.65 at DCA and $198.77 at IAD.

The airport access time (ACCESS) to a passenger's closest airport is 35.18 minutes on average. The average access time to the second closest and the third closest airport are 56.88 minutes (61.7% longer than to the closest airport) and 73.46 minutes (108.9% longer than to the closest airport), respectively.

Table 23 shows the correlations among the airport choice determinants. The correlations are presented by departure airport. Note that access time is excluded from the tables because it is expected to have no correlation with the other variables that are determined primarily by airlines.

Table 23 Correlations among Airport Choice Determinants

BWI	FQ	LCC	FARE
FQ	1.00		
LCC	0.32	1.00	
FARE	-0.55	-0.59	1.00

DCA	FQ	LCC	FARE
FQ	1.00		
LCC	-0.14	1.00	
FARE	-0.24	-0.19	1.00

IAD	FQ	LCC	FARE
FQ	1.00		
LCC	0.27	1.00	
FARE	-0.41	-0.06	1.00

In the first table for BWI departures, the strongest correlation is between LCC and FARE at -0.59. This may be expected since LCC presence decreases the fare level at airports.

The second strongest correlation is between FQ and FARE (-0.55). This correlation may be an indicator of economies of density. In addition, LCCs, in particular Southwest, offer higher high nonstop flight frequencies, and this is reflected in the positive correlation between LCC and FQ.

In the second table based on departures from DCA, none of the correlations is significantly high. The strongest correlation is observed between FQ and FARE at -0.24, again likely reflecting economies of density. In the last table using IAD data, the strongest correlation (-0.41) is found, again, between FQ and FARE. Finally, FQ is positively correlated (0.27) with LCC and FARE.

4.6.1.2 Customer Characteristics

This study tests the relationships between the airport choice determinants and customer's airport choice across these different customer characteristics; household income, trip purpose and the gap in travel time between a customer's closest airport and the second closest airport. The summary statistics on the three customer characteristics are presented in Table 24. Mean income is about $97,000 per household; about 42% of passengers are traveling on business, and the gap in travel time averages little over 21 minutes.

Table 24 Summary Statistics of Customer Characteristics

	Mean	Std.Dev.	Minimum	Maximum	Case
INC ($)	97,002	53,525.8	7,500	175,000	9,231
BUSI (binary)	0.42	0.49	0	1	9,231
GAP (driving min.)	21.69	14.92	0	70	9,231

A summary of customer characteristics by departure airport is presented in Table 25. The data in the tables show that about 36% of BWI passengers are business travelers, compared to 50% at DCA and 44% at IAD. BWI has the lowest average household income level at about $91,082 compared to $104,044 at DCA and $102,319 at IAD. BWI customers had the highest average airport access time (27.53 minutes) while DCA has the lowest airport access time (14.55 minutes).

Table 25 Summary Statistics of Customer Characteristics by Departure Airport

BWI	Mean	Std.Dev.	Minimum	Maximum	Observations
INC	91,082.40	52,155.50	7,500.00	175,000.00	4,759
BUSI	0.36	0.48	0.00	1.00	4,759
GAP	27.53	15.09	0.00	70.00	4,759

DCA	Mean	Std.Dev.	Minimum	Maximum	Observations
INC	104,044.00	54,565.20	7,500.00	175,000.00	2,547
BUSI	0.50	0.50	0.00	1.00	2,547
GAP	14.55	9.97	0.00	51.00	2,547

IAD	Mean	Std.Dev.	Minimum	Maximum	Observations
INC	10,2319.00	53,803.80	7,500.00	175,000.00	1,925
BUSI	0.44	0.50	0.00	1.00	1,925
GAP	16.72	12.10	0.00	50.00	1,925

Table 26 shows the correlations among the customer characteristic variables. The correlation between income level and business travel is 0.27, reflecting the higher income of business travelers compared to non-business travelers. All other correlations are very small.

Table 26 Correlations of Customer Characteristic Variables

ALL	INC	BUSI	GAP
INC	1.00		
BUSI	0.26	1.00	
GAP	0.01	0.02	1.00

4.6.2 Choice Model Results

4.6.2.1 Impact of Airport Choice Determinants

The results of the airport choice model with the airport choice determinants only are presented in Table 27.

Table 27 Airport Choice Results: Airport Choice Determinants Only

Dependent Var. = Airport	Model 1			Model 2		
	Coeff.	P-value		Coeff.	P-value	
FQ	0.012	0.000	***	0.013	0.000	***
FARE	-0.017	0.000	***	-0.011	0.000	***
ACCESS	-0.063	0.000	***	-0.068	0.000	***
LCC				1.131	0.000	***

*** p<0.001, ** p<0.05, * p<0.1

The dependent variable is a customer's choice of departure airport among the three airports in the Washington Metropolitan area. In Model 1, nonstop flights (FQ), average fares (FARE) and airport access time (ACCESS) are used to predict airport choice, as suggested by previous studies (Windle and Dresner, 1995; Pels, 2003). The results are all significant and consistent with the previous studies. Nonstop flight frequency has a positive sign (0.012, p-value 0.000), implying that airports with more nonstop flights to a destination city are more likely to be chosen by customers. Average fares on a route are negatively associated with airport choice (-0.017, p-value 0.000). Airport access time has a negative sign (-0.063, p-value 0.000) indicating that airports with shorter access time are more likely to be chosen by passengers. Airport access time has the biggest coefficient and is the most dominant determinant in the customer airport choice decision.

In Model 2, LCC presence (LCC) is added to the model to test whether the presence of LCCs attracts customers even after controlling for fare level and nonstop flight frequency. As a binary variable, LCC presence is coded 1 if there are one or more nonstop flights provided by any low cost carriers on a specific route. The results indicate a significant and positive coefficient (1.131, p-value 0.000) for LCC. This result implies that airports with LCC presence on routes are more likely to be chosen by customers, even after controlling for fares and frequency. This study uses Model 2 as the base model for further analysis.

4.6.2.2 Moderating Impact of Customer Characteristics

As proposed, this study is interested in how the relationships between the four airport choice determinants and a customer choice vary across different customer characteristics. The results are presented in Table 28.

In Model 3, the results of the four main airport choice determinants show the same sign direction as Model 2 and all are significant at the 1% level. The interaction term between income and fare (INC_FARE) has the only statistically significant coefficient. The sign of the INC_FARE coefficient is positive (0.000, p-value 0.000). It does not necessarily mean that high income people want to go to the airport with higher fares. It is rather thought that high income customers end up choosing the airport that has higher average fares. The rationale is that high income passengers prefer legacy carriers that provide premium services such as airport lounges, more in-flight entertainment and better mileage programs. Since the average fare of the legacy carriers tends to be higher than the average fare of the low cost carriers the INC_FARE variable could be picking up the preference of high income passengers for these amenities.

Table 28 Airport Choice Results: All Interaction Terms in One Model

Dependent Var. = Airport choice	Model 2			Model 3			Model 4			Model 5		
	Coeff.	P-value		Coeff.	P-value		Coeff.	P-value		Coeff.	P-value	
FQ	0.01	0.00	***	0.01	0.00	***	0.01	0.00	***	0.01	0.000	***
FARE	-0.01	0.00	***	-0.02	0.00	***	-0.02	0.00	***	-0.01	0.000	***
ACCESS	-0.07	0.00	***	-0.06	0.00	***	-0.06	0.00	***	-0.06	0.000	***
LCC	1.13	0.00	***	1.12	0.00	***	1.06	0.00	***	1.18	0.000	***
INC_FQ				0.00	0.12		0.00	0.02	**			
INC_FARE				0.00	0.00	***	0.00	0.00	***			
INC_ACCESS				0.00	0.60		-0.00	0.08	*			
INC_LCC				0.00	0.37		0.00	0.74				
BUSI_FQ				0.00	0.26					0.00	0.080	*
BUSI_FARE				0.01	0.00	***				0.01	0.000	***
BUSI_ACCESS				-0.01	0.00	***				-0.01	0.000	***
BUSI_LCC				-0.25	0.01	***				-0.23	0.013	**
G3045_FQ				0.00	0.60		0.00	0.54		0.00	0.616	
G3045_FARE				-0.01	0.00	***	-0.01	0.00	***	-0.01	0.003	***
G3045_ACCESS				0.00	0.54		0.00	0.40		0.00	0.547	
G3045_LCC				0.62	0.00	***	0.63	0.00	***	0.63	0.002	***
G45_FQ				0.00	0.49		0.00	0.44		0.00	0.492	
G45_FARE				0.01	0.11		0.01	0.12		0.01	0.154	
G45_ACCESS				-0.02	0.00	***	-0.02	0.00	***	-0.02	0.000	***
G45_LCC				-0.17	0.54		-0.18	0.52		-0.17	0.545	

*** $p<0.001$, ** $p<0.05$, * $p<0.1$

The interaction term with nonstop flight frequency (INC_FQ) shows a positive sign, indicating that high income customers are more likely to choose the airport that has more nonstop flights. Although it is consistent with my expectation, it is not statistically significant (p-value 0.125). The income interaction term with LCC presence (INC_LCC) implies that high income customers are more likely to choose the airport that has LCC presence but is not significant (p-value 0.370). The interaction term with the airport access time (INC_ACC) is negative indicating that high income customers are more likely to choose the airport that is geographically located closer to customers. But, the p-value of the coefficient is insignificant (p-value 0.597).

Referring to the coefficients of the business customer interaction term with the four airport choice variables in Model 3 provides the following results. The interaction term between the business customer variable and the average fare (BUSI_FARE) is positive and significant (p-value 0.000) indicating that business customers choose the airport with a higher fare. This does not necessarily imply that business customers prefer the airport with higher fares; rather, it is thought that business customers, like high income customers, prefer legacy carriers that offer premium services.

The coefficient of the interaction term between the business customers and LCC presence (BUSI_LCC) is negative and significant (p-value 0.008) indicating that business passengers are more likely to choose the airport without LCC service on a route. The interaction term between business customers and nonstop flight frequency (BUSI_FQ) is positive and implies that business customers are more likely to choose the airport that offers more nonstop flights. However, the coefficient is statistically insignificant (p-value 0.259). The interaction term between business customers and airport access time (BUSI_ACC) is negative and significant (p-value 0.000) indicating that the closest airport that is more likely to be chosen by business customers. This makes sense since business customers generally have a higher value of time and hence prefer a shorter access time to airports than leisure customers.

This study is also interested in testing the relationship between the airport choice variables and the distance to the next closest airport. As discussed earlier, I have created two distance gap variables. The first distance gap variable (G3045) is set equal to one if the additional distance to the next closest airport is between 30 and 45 minutes. A second distance gap variable (G45) is set equal to one when the distance gap to the next closest airport is more than 45 minutes.

The interaction term between nonstop flight frequency and the first distance gap variable (G3045_FQ) is negative and insignificant. The interaction term with airport access time (G3045_ACC) is negative and insignificant as well. However, the fare interaction term (G3045_FARE) is negative and significant and the LCC interaction term (G3045_LCC) is positive and significant. This indicates that lower fares and the presence of an LCC have a larger impact for those customers with an alternative airport located between 30 and 45 minutes away from their first closest airport compared with those customers for whom the closest additional airport is less than 30 minutes away.

However, when the distance gap between the first closest and the second closest airport is longer than 45 minutes, the fare interaction term (G45_FARE) and the LCC interaction term (G45_LCC) become insignificant. The nonstop flight frequency interaction term (G45_FQ) remains consistently insignificant. This indicates that air fare, LCC presence and nonstop flight frequency at an airport have no additional impact on those customers whose alternative airport is located further than 45 minutes away. On the other hand, the airport access time interaction term (G45_ACC) is significant and negative. This indicates that the importance of airport access is larger for those customers with no realistic alternative airport.

4.6.2.3 Correlation between Customer Characteristics (Income and Business)

The correlation table (Table 26) hints that there might be some correlation (0.26) between the income variable (INC) and the business travel variable (BUSI). Thus, this study tested the income interaction terms and the business interaction terms separately in Model 4 and Model 5. Model 4 includes all variables in Model 3 except for the business purpose interaction terms. Model 5 includes all variables in Model 3 except for the income interaction terms.

In Model 4, the interaction term between the income variable and LCC presence (INC_LCC) still remains insignificant. However, the coefficient of the interaction term between income and nonstop flight frequency (INC_FQ), which was insignificant (p-value 0.125) in Model 3, is now significant (p-value 0.019) and positive indicating that high income customers are more likely to choose an airport that has more nonstop flights.

In addition, the interaction term between income and airport access time is also now significant (p-value 0.597 to 0.079) with a negative sign indicating that customers are more likely to choose the airport that has a shorter access time as their income rises. The interaction term between income and fare (INC_FARE) remains consistently positive and significant as it was in Model 3.

Model 5 tests the business interaction terms without the income interaction terms. Notably, the interaction term between the business customer and nonstop flight frequency (BUSI_FQ), which was insignificant (p-value 0.259) in Model 3, has become significant and positive (p-value 0.080). This indicates that business customers are more likely to choose an airport that has higher nonstop flight frequency. The interaction terms that were significant in Model 3 (BUSI_LCC, BUSI_FARE and BUSI_ACC) maintain the same sign and statistical significance in Model 5.

Based on the results of Model 3, Model 4 and Model 5, the correlation between the income variable and the business purpose variable may be responsible for the insignificant interaction terms in Model 3.

4.7 Discussion

4.7.1 Hypothesis Results

This section will discuss whether the results that are described in the previous section support the proposed hypotheses of this study.

The first proposed hypothesis tests the positive relationship between LCC presence at an airport and customer's choice of airport above and beyond the fare and frequency impact of the LCC. The LCC presence (LCC) variable is positive and statistically significant throughout all models indicating that customers prefer an airport with an LCC presence even after controlling for frequency and fare. This result supports the first hypothesis. The empirical test results of the hypotheses are summarized in Table 29 below.

Table 29 Summary of Hypotheses Testing

Hypothesis		Testing variable		Hypothesized effect on customer choice	Finding	Empirical support for hypothesis
H1		LCC presence (LCC)		+	+	Yes
H2	a	Income level (INC)	Nonstop frequency	+	+	Yes
	b		Fare	+	+	Yes
	c		Airport access time	-	-	Yes
	d		LCC presence	-	Insignificant	Unexpected sign
H3	a	Business purpose (BUSI)	Nonstop frequency	+	+	Yes
	b		Fare	+	+	Yes
	c		Airport access time	-	-	Yes
	d		LCC presence	-	-	Yes
H4	a	Additional access time to the closest alterative airport (G45)	Nonstop frequency	-	Insignificant	Expected sign
	b		Fare	+	Insignificant	Expected sign
	c		Airport access time	-	-	Yes
	d		LCC presence	-	Insignificant	Expected sign

The second hypothesis tests the moderating effect of the customer's income level. The proposed hypothesis asserts that customers with a higher income level are more sensitive to nonstop flights and shorter airport access time and less sensitive to fare levels and the presence of an LCC.

The results of Model 4 suggest that higher income customers place more importance on nonstop service and shorter access time, but are less sensitive to fare levels. These are consistent with the proposed hypotheses (H2a, H2b and H2c). This suggests that customers with a higher value of time prefer to minimize the time components of travel and are less concerned with the monetary aspects. However, the statistically insignificant interaction term between income and the presence of an LCC indicates that LCC presence has no additional impact for high income passengers. This does not support the proposed hypothesis (H2d).

The third hypothesis is similar to hypothesis 2 and tests the notion that business customers place a higher value on time than leisure passengers. The hypothesis asserts that business customers are more sensitive to nonstop flights and access time and less sensitive to fares and the presence of an LCC. The coefficients of all the interaction terms are significant in Model 5. The results of Model 5 support the third hypothesis.

The fourth hypothesis tests the moderating effect of the additional access time gap to the closest alternative airport. The hypothesis asserts that customers without a viable airport alternative are less sensitive to nonstop flight frequency level (H4a), fare level (H4b) and

LCC presence (H4c). On the other hand, customers without a viable airport alternative are more sensitive to airport access time (H4d).

The results of Model 5 suggest that customers with an alternative airport located an additional 30 to 45 minutes away are more sensitive to fares (G3045_FARE) and the presence of an LCC (G3045_LCC). The flight frequency (G3045_FQ) and the access time (G3045_ACC) interaction terms are insignificant. None of these results support hypotheses H4a, H4b, H4c and H4d. It may be that the closest airport needs to be even further away for our interaction effects to take hold. When the closest alternative airport is further than 45 minutes away, the interaction terms with nonstop flight frequency (G45_FQ), fare (G45_FARE) and LCC presence (G45_LCC) all show opposite signs to the main terms indicating that the relative importance of these variables becomes weaker, although none of the coefficients is statistically significant. The results partially support H4a, H4b and H4c. The interaction term with airport access time (G45_ACC) is the only interaction term that is statistically significant. It shows the same sign as the main term (ACC) indicating that longer access time to the alternative airport increases the sensitivity of customers to access time. This supports H4d for those customers with a competitive airport that requires at least an additional 45 minutes of travel time. For those customers without a viable airport alternative airport access time becomes a more important factor while the relative importance of the other airport choice determinants becomes smaller. In the next section, I will show how these empirical results are of practical import.

4.7.2 Predicted Probability

In order to clearly understand the impact of the airport choice determinants on customer's choice of airport, this section will discuss the meaning of the results by interpreting the changes in predicted probability when there are changes in the airport choice determinants and in the customer characteristics. The predicted probability is defined as the probability of choosing one airport as a function of each airport's expected utility among the summation of expected utility for all airports for a specific route (refer to the generic form of a multinomial logit model (Equation (3)).

The models run in the previous section are used to estimate the probability that an airport is chosen by customers. I will use Model 5 for all predictions.

4.7.2.1 Base Case

The base case for the customer characteristics is defined as follows:

1) A customer travels for leisure purposes
2) The distance gap that the customer has between the first closest airport and the second closest airport is zero minutes (all airports are located at equal distance).

The base case for the airport choice variables is defined as follows:

1) There are three airports (Airport A, B and C).
2) Each airport's nonstop frequency is set at the sample mean (85.30 weekly flights).
3) Each airport's fare is set at the sample mean ($197.80).
4) There is no LCC presence on the route for any of the airports.

5) The access time to each airport is set at 25 minutes. In other words all three airports are equidistant from the customer to begin.

With the base case defined above each airport has a 33% chance of being selected by the customer. From the base case I will look at how the predicted probabilities change when one of the airport choice determinants improves across a series of different customer characteristics.

4.7.2.2 The Impact of Customer Characteristic Change

- **Change in Airport Access Time**

I begin by testing the impact of a change in the airport access time on the change in the probability of choosing an airport. The base case airport access time is 25 minutes for the all three airports (Cases 1 and 2) indicating that the additional access time from the first closet to the second closest airport is zero minute. The first alternative is to increase the access time of airports B and C to 45 minutes, while holding the access time of airport A to 25 minutes. The second airport access time alternative decreases the access time of airport A to ten minutes and holds the access time of airport B and C at 45 minutes. The third airport access time alternative holds the access time to airport A at 10 minutes and increases the access time to airports B and C to 60 minutes. There are two possible trip purposes: business and leisure and the impact of these access time changes will be computed for each customer type separately. The cases and the associated probabilities are presented in Table 30.

Table 30 Cases of Customer Characteristics and Associated Probabilities

Case						Probability to be chosen		
No.	Trip Purpose	Access time (driving min.)				Airport A	Airport B	Airport C
		Airport A	Airport B	Airport C	2nd closet - 1st closest	(Based on Model 5)		
1	Leisure	25	25	25	0	33.33%	33.33%	33.33%
2	Business	25	25	25	0	33.33%	33.33%	33.33%
3	Leisure	25	45	45	20	63.16%	18.42%	18.42%
4	Business	25	45	45	20	67.97%	16.01%	16.01%
5	Leisure	10	45	45	35	82.34%	8.83%	8.83%
6	Business	10	45	45	35	87.14%	6.43%	6.43%
7	Leisure	10	60	60	50	97.16%	1.42%	1.42%
8	Business	10	60	60	50	98.32%	0.84%	0.84%

The changes in the airport access time for a leisure customer (Cases 1, 3, 5 and 7) are compared. According to Model 5 when airport access time of the three airports changes to 25, 45 and 45 minutes for the three airports respectively (Case 3), the probability that a leisure customer chooses Airport A (the first closest) increases from 33.33% to 63.16%, while the probabilities that the same leisure customer chooses Airport B and Airport C decrease to 18.42% from 33.33%. Similarly, in Case 5 where the airport access times of the three airports change to 10, 45 and 45 minutes, the probability that a leisure customer chooses Airport A (the first closest airport) whose access time is 10 minutes increases to 82.34% while the probabilities of choosing Airports B and C with 60 decreases to 8.83%. Finally, in case 7 where the access times for airports A, B and C are 10, 60 and 60 minutes, the probability of choosing airport A rises to 97.16% while the probabilities of choosing either airport B or C fall to 0.84%.

- **Change in Trip Purpose (Leisure and Business)**

Table 30 also looks at the change in probabilities for a business customer. The probabilities remain the same (33.33%) for the three airports in both Case 1 and Case 2 because there is no change in any of the variables.

The probability that a leisure customer chooses Airport A is 63.16% in Case 3 while the probability that a business customer chooses Airport A is 67.97% in Case 4. This is due to the preference of business travelers for shorter access times as reflected in the interaction term (BUSI_ACC). The same logic applies in comparing Case 5 and Case 6, as well as Case 7 and Case 8. In both instances the business customer has a higher probability of choosing the closest airport as compared to a leisure customer.

4.7.2.3 The Impact of Airport Choice Determinants

Table 31 examines the changes in probabilities resulting from changes in frequency, fare and the presence of an LCC for differing access times and customer trip purposes. Details of these calculations are attached as Appendix 12.

Table 31 Impact of Changes in Airport Choice Determinants on Predicted Probability across Customer Characteristics

1	2	3	4	5	6	7	8	9	10	11	12	13
Case						Probability to be chosen			% point change on the probability at the 1st closest airport			
No.	Trip Purpose	Access time (driving min.)				Airport A	Airport B	Airport C	FQ 10% ↑ (weekly flight)	FARE 10% ↓ (average fare $)	Access 1min.↓ (driving min.)	LCC presence binary change
		Airport A	Airport B	Airport C	2nd closet - 1st closest	(Based on Model 5)			85.30 → 93.83	$197.80 → $169.02	Access time to Airport A minus 1min.	No → Yes
1	Leisure	25	25	25	0	33.33%	33.33%	33.33%	2.36% ↑	6.32% ↑	1.38% ↑	28.64% ↑
2	Business	25	25	25	0	33.33%	33.33%	33.33%	2.69% ↑	2.38% ↑	1.63% ↑	23.18% ↑
3	Leisure	25	45	45	20	63.16%	18.42%	18.42%	2.39% ↑	6.10% ↑	1.42% ↑	21.66% ↑
4	Business	25	45	45	20	67.97%	16.01%	0.00%	2.53% ↑	2.24% ↑	1.55% ↑	16.68% ↑
5	Leisure	10	45	45	35	82.34%	8.83%	8.83%	1.32% ↑	5.25% ↑	0.91% ↑	14.28% ↑
6	Business	10	45	45	35	87.14%	6.43%	6.43%	1.17% ↑	2.52% ↑	0.81% ↑	9.93% ↑
7	Leisure	10	60	60	50	97.16%	1.42%	1.42%	0.23% ↑	0.40% ↑	0.22% ↑	1.79% ↑
8	Business	10	60	60	50	98.32%	0.84%	0.84%	0.16% ↑	-0.02% ↓	0.15% ↑	0.91% ↑

- **Change in Nonstop Flight Frequency (FQ)**

Table 31 considers four changes in airport choice variables: a 10% increase in frequencies, a 10% decrease in fares, a one minute decrease in access time to the closest airport (Airport A in the table) and the addition of a low cost carrier on the route. Row 1 represents changes from our base case (described above). Rows 2 through 8 represent alternative base cases as specified in columns 2 through 6. Columns 7 through 9 indicate the initial probabilities of choosing airports A, B and C based on the specified base case. Columns 10 through 13 indicate the change in probabilities from the base case based on the four changes specified above.

Column 10 indicates that the increased probability of choosing airport A when the number of weekly nonstop frequencies is increased by 10% (85.3 to 93.8) at airport A. In Case 1 where a customer travels for leisure and all three airports are equal distance this 10% increase results in a 2.36% point increase in the probability of choosing airport A. When a customer travels for business (Case 2), the probability increases by 2.69 % points. The larger increase is due to the increased importance of nonstop flight frequency for business customers. However, the additional impacts of the nonstop flight frequency become smaller as the distance between the airports grows in cases 3 through 8 and access time dominates the choice decision.

- **Change in Fare (FARE)**

Column 11 investigates the impact of a 10% decrease in fare (from $197.80 to $169.02) at airport A. In Case 1 (leisure passenger, equidistant airports) the probability of choosing airport A increases by 6.32 % points. When a customer travels for business purposes (Case 2), the probability of choosing airport A increases by only 2.38% points. This is a smaller increase due to the fact that business customers are less sensitive to the fare reduction. The additional impacts of the fare reduction become smaller in Cases 3 through 8 where access time differences increase.

- **Change in Airport Access Time (ACCESS)**

Column 12 investigates the impact of a one minute improvement in access time at airport A. In Case 1 (leisure passenger, equidistant airports) the probability of choosing airport A increases by 1.38 % points with a one minute improvement in access time. When a customer travels for business purposes (Case 2), the probability increases by 1.63% points. This is a larger increase than the increase for a leisure customer due to the higher value that business passengers place on access time. The impact of a one minute reduction in access time becomes smaller in Cases 3 through 8 as the initial distance between airports becomes larger. In these cases access time is already the primary determinant of which airport to choose and as a result further improvements in access time provide smaller increases in the probability of choosing airport A.

- **Change in LCC Presence (LCC)**

Column 13 looks at the change in the probability if choosing airport A if we go from a case where there are no LCCs on the route to the case when there is at least one LCC on the route. This change results in an increase in the probability of choosing airport A of 28.64% points in the case of a leisure passenger with equidistant airports (Case 1). When a customer travels for business (Case 2), the probability increases by 23.18% points. This is a smaller than the probability change in Case 1 since Model 5 indicates that business customers are less impacted by the presence of an LCC. This represents a large change in probability relative to the previous three changes, but it should be kept in mind that the presence of a LCC is an all or nothing affair, unlike the previous changes where a discrete increase in the variable is selected. The impact of LCC presence becomes smaller in Cases 3 through 8 as the access time difference increases.

Overall, it is observed that the changes in the probability become very small when the alternative airport is located far away (Cases 3 through 8). This indicates that none of the airport choice determinants is particularly influential if a customer lacks a competitive airport alternative. But, when the annual passenger volume of these airports is taken into account, the economic value of these small changes is meaningful. For instance, if the probability of choosing airport A decreases by just 1% point across the board and airport A serves 10,000,000 passengers annually then this will result in a loss of 100,000 passengers per year. For reference BWI had 10,766, 000 departing passengers during 2011[33]. A 1% point change therefore impacts 107,660 passengers per year. As a result, even small probability changes may have large economic effects.

4.8 Conclusion

The lack of the research investigating the factors that airport managers can use to attract customers motivated me to initiate this study. Previous airport choice literature focuses

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[33] USDOT http://www.transtats.bts.gov/airports.asp?pn=1

on three main airport choice determinants (flight frequency, fare and airport access time). None of these factors are directly controllable by airport managers. Previous studies had suggested that the presence of a LCC increased customer demand through low fares and high frequencies. This study argues that the presence of LCCs may help attract additional customers above and beyond the impact generated by their low fares and high frequencies. This means that airport managers may want to encourage LCCs to serve their airport to improve its attractiveness. A major finding of this study is to show that the presence of a LCC service presence at an airport influences customer's choice of airports even after controlling for fare and frequency impacts.

In addition, this study tested how the impact of airport determinants may impact different customers in different ways. In particular, this study tested the relative importance of airport choice determinants when some customers have better access to an alternative airport. As the availability of an alternative airport lessens, flight frequencies, fares and the presence of a LCC become less important and access time becomes more important.

This study provides two improvements over previous studies. First, it includes the presence of LCC service in the empirical model and finds that this presence provides a halo effect. That is, even after controlling for the lower fares and higher frequencies provided by LCCs, there is an additional positive impact on customers that seems to occur when a LCC is present on a route. Second, this study takes into account the distance gap between the first closest airport and the second closest airport. This is essentially a measure of the attractiveness of the alternative airport. In this study, customers are segmented by how far their closest alternative airport is located. The impact of the airport choice determinants (other than access time) decrease as the alternative airport becomes less attractive.

The primary limitation of this study is that it does not have access to the actual fares that customers had available when they made their airport choice. This problem is not unique to this study and has been a problem in previous studies (Windle and Dresner, 1995). This study used average fare data by route and the lack of the actual fare information weakens this study. Particularly, the effect of LCCs may be somehow exaggerated as the LCC presence variable may partially pick up the effect that would have been captured by the actual fare variable if it was available. Another limitation is that the sample that this study used differs from the whole domestic survey population. Some of the observations are not included in the sample due to missing values, resulting in fewer business customers in the sample.

For future research, this study is motivated by the lack of the studies examining what airport managers (in multiple-airport regions) can do to attract more customers. Unfortunately, most of the existing studies (including this study) do not include the service factors that are directly controlled by airports. While this study argues that airports can initiate and expand LCC service at an airport, this decision is still significantly driven by airlines. Other airport factors, such as parking easiness, terminal congestion, mobile equipment, staff friendliness, etc., clearly have an impact on a customer's choice of airport. Airport managers can directly control the quality of these factors. Unfortunately, the examination of the impact of these factors requires variation across airports. Since most regions have at most two or three airports, there is too little variation in these factors to do statistical analysis of their impact. The impact of these factors may need to be conducted on a case by case basis or with a survey based methodology.

Chapter 5 Summary and Conclusion

The impact of operational quality on customers has been extensively discussed in previous airline industry literature (Dresner and Xu, 1995; Proussaloglou and Koppelman, 1995). The basic idea is that customers prefer the service provider that offers higher operational quality (reliability and convenience), resulting in an increase in the market share and the profit for the service provider with higher operational quality. The relationship between operational quality and customer choice also may vary depending on various customer characteristics. One of the customer characteristics overlooked by previous researchers was a customer's exposure to service. The first essay of this dissertation addresses this gap in the literature by investigating the following research questions:

(1) Does operational quality influence a customer's choice of airlines?

(2) Does the extent of the customer's exposure to airline operations moderate the relationship between operational quality and a customer's choice of airline?

(3) Do different customers react differently to these operational quality variables?

The primary finding of the first essay is that operational quality positively influences a customer's choice of airline. Increased customer exposure to service positively moderates the relationship between operational quality and a customer's choice of airline. Customers who place higher importance in time and convenience utility prefer airlines that offer higher operational quality.

Airline managers may benefit from the findings in the first essay. The results suggests to segment customers that are more sensitive to operational quality and who, thus, have a stronger demand for a higher quality service product. Using the recent baggage fee example, the essay supports that airlines may need to take into account the service operational quality level that might influence customer demand in determining fees that are charged based only on the costs of handling checked bags. The key message is that airlines may want to charge customers selectively to increase their revenue.

The second essay examines the impact of LCC presence on airport choice. LCCs have made a significant impact through their unique operational strategy of low cost and more point-to-point services (Windle and Dresner, 1999; Doganis, 2006). Beyond the low cost and high frequency characteristics studied in previous literature, the second essay argues that LCC presence additionally influences a customer's airport choice with other LCC service characteristics such as on-time performance, staff attitude and a low-fare brand image. These additional factors are tested to see if they attract customers even after controlling for fares and flight frequency. Further, this study is interested in investigating the moderating effect of different customer characteristics and a customer's geographical location on the customer's airport choice. The second essay of this dissertation addresses the following research questions:

(1) Does the presence of an LCC on an airport route influence a customer's choice of airport even after controlling for the fare and frequencies offered by airlines?

(2) Do different customers react differently to airline characteristics at airports?

(3) Does a customer's geographical distance to an alternative airport moderate the relationship between airline characteristics at airports and the customer's choice of airport?

Regarding the findings in the second essay, airports that have LCC presence at a route are more likely to be chosen by customers even after the fare and the nonstop frequency are controlled. The customers who have relatively higher importance in time and convince utility (i.e., higher income and business customers) are more sensitive to quality variables such as nonstop flight frequencies but less sensitive to fares and LCC presence. The additional impact of airline characteristics on airport choice becomes smaller when the customer's closest airport is not easily accessible.

Airport managers may find the result of the second essay useful in attracting additional customers, leading to an increase in revenue. The finding of the second essay suggests that the overall impact of LCC presence may be greater than it was previously thought due to the halo effect of its low-fare brand image. As a consequence, the extra efforts of airports in encouraging LCCs to provide service at an airport may better be justified to generate more business at an airport located in a multiple airport area. Additionally, the impact of airline characteristics is not uniform across customers but varies by geographic availability of alternative airports.

By using the more than 4,000 customer observations for airline choice and 9,000 for airport choice over the recent three survey years (2005, 2007 and 2009) thanks to the regional passenger survey data provided by MWCoG, I was able to run large-scale empirical analyses to address the research questions in this dissertation. This survey data provides a unique opportunity to measure customer's operations exposure, which is hardly available in other data sets.

The major limitation of these two essays is lack of the actual airfare information. The fare is the key determinant of customer's choice of both airline and airport. This problem is not unique to this study and has been a problem in previous studies (Windle and Dresner, 1995). As an effort to better capture the fare effect, the first essay uses the different sensitivity of the different customers (i.e., business customers and leisure customers). However, the actual fare information that customers paid is still very desirable in examining customer choice studies.

As to the future research, the first essay can be extended by testing the moderating effect of different airline operations on customer choice. Different airlines use different operation strategies, resulting in different service strengths (Tsikriktsis, 2007). When customers want to use an airline for its unique service strengths, customers may be more sensitive to those service strengths. It means that customers have different expectations toward differently operated airlines, which may moderate customer's choice of airlines.

Regarding the future research for airport choice, the factors that airport managers can directly control to attract more customers can be further examined. Most of the existent studies (including this study) do not include the service factors that are directly operated by airports. But, it is quite known that the other factors such as parking easiness, terminal congestion, mobile equipment, staff friendliness, etc., clearly affect customer's choice of airport. These factors are directly controllable by airport managers. Unfortunately, the examination of the impact of these factors requires the data to have a good amount of variations across different airport observations, which is not easily available. Thus, studies on a case by case basis may be more desirable to test the impact of these factors.

Appendices

Appendix 1 List of the Most Annoying Things about Flying

1. Luggage charges (8.4)
2. Added fees (8.1)
3. Rude or unhelpful staff (7.7)
4. Can't reach a live service rep (7.6)
5. Poor communication about delays (7.1)
6. Seatmates who hog your space (7.0)
7. Flight delays (6.8)
8. People who hog carry-on space (6.7)
9. Long waits at baggage claim (5.9)
10. Long lines for security or check-in (5.2)
11. Puny/no snacks (5.1)
12. Crying babies, unruly kids (4.9)

Source: US Consumer Reports (2010, 5)
http://www.consumerreports.org/cro/magazine-archive/2010/june/money/top-travel-gripes/what-annoys-travelers-most/index.htm

Appendix 2 Summary of Airline Choice Literature

Author	Year	Research Question	Model	Data	Variables
Proussaloglou, and Koppelman	1995	Airline service quality and pax (passenger) customer choice	Multinomial (MNL)	Mail survey; airline service quality for the four major carriers in the studied markets (Dallas and Chicago)	Traveler's perception of airline service quality (marketing effect considered), market presence, schedule, on-time, in-flight amenities, fare level, seat allocation rule
Proussaloglou and Koppelman	1999	Carrier, flight and fare classes.	Multinomial (MNL)	Mail and phone survey – nonstop market in Chicago (4 carrier) and Dallas (2 carrier) where there is a range of market presence	Schedule, price, FFP, market presence, carrier preferences: free from travel restriction with high fare classes
Pels et al.	2001	Nested choice of Airport and airline	Nested Logit, sequential choice of airline and airport	San Fran Pass Survey (1995)	FQ, Access for choice, small difference between Busi and Leisure pax
Coldren et al.	2004	Itinerary choice by connection, fare ratio, code share using aggregate itinerary share	Aggregate MNL methodology	Itinerary choice generated by United itinerary engine	DV: number of passengers who booked each itinerary
Adler et al.	2005	Itinerary choice by airline and airport quality. Examination of the effect of preference heterogeneity	Mixed Logit, Stated Preference	Multiple Data	On-time (not revealed at the reservation), by FFP, Aircraft type, flight time, arrival time, on-time

Appendix 3 Summary of Airport Choice Literature

Author	Year	Research Question	Model	Data	Variables
Windle Dresner	1995	Airport choice	Multinomial (MNL)	Wash DC Passenger Survey	Frequency (FQ), access, Fare
Pels et al.	2001	Airport choice	Nested Logit, sequential choice of airline and airport	San Fran Pass Survey (1995)	FQ, Access for choice, small difference between Busi and Leisure
Basar, Bhat	2004	Importance of Choice set generation for Business passengers	MNL Probabilistic Choice set Logit (PCMNL); compare two model	Passenger Survey San Fran Bay area	AccessTime, traveling alone or group, female, weekday, income
Pels et al.	2003	Access time, Access cost elasticity for Business and Leisure Passengers	Nested Logit: access mode – airport choice	Passenger Survey San Fran Bay area,	Access cost, time
Hess, Polak	2006	Potential for Cross nested model	Cross nesting (airport – airline – access mode); better than simple Nested and MNL	Passenger Survey London (CAA), OAG fare, stated reason	Access time, Access cost (Limo, private car, Public)
Suzuki	2007	Two step (1) Choice set elimination (2) Choice	Nested logit for airport (marginal utility) and airline (conditional)	Des Moines passenger survey	Access time, Airport Experience, Perceived airfare, LCC, FQ, FFP; disjunctive & conjunctive
Hess, Polak	2005	Significant heterogeneity in taste across pax	Mixed Logit (random dist.)	San Fran Bay Passenger Survey area (1995);	Busi/Leisure, Resident/Non, Random variation is larger between Busi, than btw leisure

Ishii et al.	2006	Availability influences choice, Passenger segmentation; Delay in access > delay in travel, Preferred by pass type	conditional logit ↔ Mixed multinomial logit MMNL);	San Fran Bay Passenger Survey area (1995); Choice set, actual choice, time and money costs with the choice alternatives,	Non-price variables, access time, delay, FQ, early arrival or late flight, availability of airport-airline combination
Pathomsiri and Haghani	2005	High FQ negative on other group, lack of information on FQ, Congestion	Mixed Logit; random taste variations across passengers	Wash DC Passenger Survey (1998); alternative airports Choice set (alternative airports with proven flight availability)	residency, price, FQ affects choice decision Passenger segmentation); (DirFQ atTime wasn't considered)
Adler et al.	2005	Realistic 'alternative', passenger segmentation	Mixed Logit, Stated Preference	Multiple Data Aircraft type, Delay	On-time (not revealed at the reservation), by FFP, Aircraft type, flight time, arrival time, on-time
Lijesen	2006	Biased schedule needed (link FQ and Arrival Time)	Mixed Logit, Stated Preference; realistic choice set	conjoint experiment, internet survey	FQ and time of arrival (westbound long haul, arrive earlier is preferred
Hess, Adler, Polak	2007	Airport and Airline choice behavior,	MNL with both SP and RP	Internet survey 600 people (2001); Airport allegiance (rankings)	Not chosen alternatives (leading to insignificant fare), flight availability
Loo	2008		MNL with Stated Preference	Survey at Hong Kong (2003), waiting queue, shopping area not significant	NumAirlines, FQ, NumAccessMode (not sig), Fare, limited information

Appendix 4 Survey Questionnaire Sample

Survey Questionnaire – Page 1 out of 2

A. ABOUT YOUR TRIP TODAY

1. **How did you get to Baltimore/Washington International Airport for this trip ?**
   (Please circle ONE answer.)

   a. I came to this airport by GROUND TRANSPORTATION *(e.g. auto, taxi, Metro, etc.)* *(Please proceed directly to QUESTION #2.)*

   b. I was on this flight when it arrived at this airport. *(STOP . That is all the information we need.)*

   c. I made a connection at this airport from a DOMESTIC FLIGHT with ____________ Airlines. *(Please fill in the name of the airline and STOP. That is all we need to know.)*

   d. I made a connection at this airport from an INTERNATIONAL FLIGHT with ________ Airlines *(Please fill in the name of the airline and STOP. That is all we need to know.)*

If you arrived at this airport by GROUND TRANSPORTATION. Please complete the rest of this survey.

2. **What is the destination of your trip today?**

   ____________ Airport ____________ City

   ____________ State/Province ____________ Country

3. **What type of trip is this?**
   (Please circle the answer for the main purpose of your travel).

   a. Business related to the Federal government *(Including military).*
   b. Business related to state or local government
   c. Business that is not related to government.
   d. Vacation.
   e. Personal or family affairs.
   f. Student or school related
   g. Other purpose (Specify) ______________________

4. **How did you purchase your ticket for this trip?**
   (Please circle one answer)

   a. Ticket Counter
   b. Internet
   c. Telephone
   d. Travel Agent
   e. Corporate Office

B. ABOUT YOUR GROUND TRIP TO BALTIMORE/ WASHINGTON INTERNATIONAL AIRPORT:

1. **Where did you start your ground trip to Baltimore/Washington International Airport ?**
   (Please circle ONE answer.)

   a. Private residence
   b. Hotel/Motel
   c. My regular place of employment
   d. Another Place of business
   e. Other ________ (Specify)

2. **What is the address of the place above ?**
   (If you prefer to provide a less specific geographic location, please indicate the nearest intersection, or building name.)

   ____
   Street Number / Street Name / City Quadrant (e.g. SW, NE)

   ____
   City / State / Zip Code

3. **What time did you begin your trip to the airport today?** (Enter time and circle AM or PM)

   ___ : ___ AM PM

4. **What time did you arrive at the airport today ?** (Enter time and circle AM or PM)

   ___ : ___ AM PM

5. **Did any member of your household, friends, or business associates travel to the airport with you ?**

   a. NO
   b. Yes
      1. How many ? _______
      2. Of this group, how many came to board a plane?___________

6. **How many checked-in bags on this flight are yours ?** *(Enter '0' if no bags were checked.)*______

7. **How did you arrive at this airport ?**
   (Please circle ONE answer)

   a. Private Car
   b. Rented Car
   c. Taxi
   d. Airport bus/limo
   e. Other (Specify) ____________________
   f. Metrorail (National)
   g. Amtrak/MARC (BWI)
   h. Light Rail (BWI)
   i. Hotel/Motel courtesy bus

8. **If you arrived in a private vehicle (excluding rental cars):**

   a. **Were you dropped off at terminal curbside ?**

      Yes _____ No _____

   b. **Where was that vehicle parked (either directly or after dropping you off) ?**

      1. It was not parked
      2. Hourly Parking Garage
      3. Daily Parking Lot B
      4. Daily A Garage
      5. ESP Parking Lot
      6. Long Term A or B
      7. Overflow A or B
      8. B WI Rail Station Garage
      9. Off-Airport Private Parking

      - For How Long (for 3–9)
      a. For a few hours or less
      b. Until you return from this trip

Survey Questionnaire – Page 2 out of 2 (continued)

C. ABOUT YOUR AIRPORT CHOICE

1. **Please rank the three most important reasons for choosing Baltimore/Washington International Airport for your flight today.** *(Please write #1, #2 or #3 in the appropriate spaces.)*
   - ____ Closest airport
   - ____ Easy road access
   - ____ Convenient limo, bus or rail service.
   - ____ Good parking facilities
   - ____ More convenient flight times.
   - ____ Less expensive airfare
   - ____ Only airport with nonstop flights
   - ____ Only airport that serves market
   - ____ Frequent flyer specific airline
   - ____ Other (Specify) ____________________

2. **If you could have arranged the airline schedule for your trip today, which airport would you have PREFERRED to use?** *(Please circle ONE answer)*
   - a. Baltimore/Washington International
   - b. Washington Dulles International
   - c. Ronald Reagan Washington National
   - d. No preference.

3. **Please indicate which other airport(s) you considered using today.** *(Please circle ALL answers that apply.)*
   - a. Washington Dulles International
   - b. Ronald Reagan Washington National
   - c. Other airport (Specify) ____________________
   - d. Did not consider another airport

4. **During the last twelve months, how many flights did you make from each of the following airports ?** *(Please write a number in the appropriate spaces. Count today's trip as one flight.)*
   - ____ Baltimore/Washington International
   - ____ Washington Dulles International
   - ____ Ronald Reagan Washington National

D. ABOUT YOURSELF

1. **Please indicate the location of your current residence:**

   ____

   City/County State Zip Code Country

2. **How many people live in your household ?**

   _____ People *(Enter '1' if you live alone.)*

3. **Please circle your age bracket:**

a. 18 or younger	d. 35–39
b. 19–24	e. 50-64
c. 25-34	f. 65 or older

4. **Please circle the answer that approximates the TOTAL household annual income of all persons in your HOUSEHOLD:**

a. Less than $15,000	e. $50,000-74,999
b. $15,000-24,999	f. $75,000-99,000
c. $25,000-34,999	g. $100,000-149,999
d. $35,000-49,999	h. $150,000 or more

If you were visiting the Washington-Baltimore area Please answer Questions #5 and #6, then proceed directly to section E.

5. **How many nights did you stay in the area?**

   ____ Nights *(Enter '0' if you are leaving the same day you arrived.)*

6. **Approximately how much did you spend PER DAY while you were in the area?** *(Include expenses which are meals, hotels, rental cars, etc. Do not include airfare. Please circle ONE answer.)*

a. Less than $100	e. $400-499
b. $100-199	f. $500-599
c. $200-299	g. $750-999
d. $300-399	h. $1,000 or more

7. **How many nights will you spend away on this trip?**

   ____ Nights *(Enter '0' if you are returning today.)*

8. **How many vehicles are usually available for use at your residence?**

   ____ Vehicles *(Enter '0' if no vehicles are available.)*

E. PLEASE WRITE ANY COMMENTS YOU MAY WISH TO BRING TO OUR ATTENTION BELOW

Again, Thanks For Your Help!

B –

WASHINGTON–BALTIMORE REGIONAL AIR PASSENGER SURVEY

TO DETERMINE LOCAL AIRPORT NEEDS

This survey is being conducted by:
Metropolitan Washington Council of Governments
Metropolitan Washington Airports Authority
Maryland Aviation Administration
in cooperation with the Airlines
serving the Region's Airports.

This survey concerns your trip today.
Please complete this form, even if you have received a form on other days.

All answers are confidential.
Personal identification is not required.
Thank you for your cooperation

Source: 2005Wahshington-Balitimore Regional Air Passenger Survey, National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments in cooperation with Metropolitan Washington Airport Authority and Maryland Aviation Administration.

Appendix 5 Sample Bias Test for Airline Choice

The test compared the means of the customer characteristics between the population (the whole domestic departing passengers) and the sample (the customers who answered all the questions that are required to test the hypotheses among the population).

- Group Population has all domestic departing observations. Some of them are not included in my sample due to missing values for one of the required variables. It has 36,283 observations.

- Group Sample, which is the sub sample of the Group Population, only includes the observations that have the all required information that is needed to test the hypotheses (business dummy, companion number, bag number and income) It has 9,900 observations.

Variable	Group	Obs	Mean	t value
BUSINESS (dummy)	Population	36,026	0.46	25.8032
	Sample	9,900	0.32	
COMPANION (Number)	Population	14,615	1.76	1.9286
	Sample	9,900	1.66	
BAG (Number)	Population	34,758	0.90	-12.922
	Sample	9900	1.11	
INCOME ($)	Population	28,483	93,872.50	6.1121
	Sample	9,900	90,076.01	

The results show that the means are significantly different between two groups. The t values are significant (higher than 1.96) except for marginally significant COMPANION.

Appendix 6 DB1B Analysis for Airline Choice: directional number of passengers and carrier market shares by origin and destination route departing from the airports in the Washington Metropolitan Area (2005 Q1, top 45 routes)

Top 1~6 routes

Pass = Passenger, Mshare = Market share, AvgCpn = Average coupon number

	1			2			3			4			5			6		
	MCO			ATL			FLL			BOS			ORD			LGA		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**101640**	**100.0%**	**1.7**	**55460**	**100.0%**	**1.6**	**67210**	**100.0%**	**1.7**	**47210**	**100.0%**	**1.6**	**37860**	**100.0%**	**1.6**	**4360**	**100.0%**	**1.5**
SouthWest	55890	55.0%	1.1		0.0%		33530	49.9%	1.1		0.0%			0.0%			0.0%	
AirTran	36180	35.6%	1.1	12680	22.9%	1.1	23300	34.7%	1.2	32440	68.7%	1.0		0.0%			0.0%	
American	270	0.3%	2.0		0.0%		160	0.2%	2.0	13110	27.8%	1.0	11510	30.4%	1.0	20	0.5%	2.0
Delta	3020	3.0%	2.1	40090	72.3%	1.1	2820	4.2%	2.0	40	0.1%	2.0	180	0.5%	2.0		0.0%	
United	140	0.1%	2.0	20	0.0%	2.0	140	0.2%	2.0	80	0.2%	2.0	24390	64.4%	1.0	130	3.0%	1.0
US Airways	5270	5.2%	1.8	890	1.6%	2.1	6150	9.2%	1.5	1100	2.3%	2.0	460	1.2%	1.7	4200	96.3%	1.0
Northwest	350	0.3%	2.0	640	1.2%	2.0	100	0.1%	2.0		0.0%		220	0.6%	2.0		0.0%	
Continental	160	0.2%	2.0		0.0%		250	0.4%	2.0	150	0.3%	2.0	80	0.2%	2.0		0.0%	
America West		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
99	340	0.3%	2.4	1130	2.0%	2.1	750	1.1%	2.2	280	0.6%	2.1	1010	2.7%	2.1	10	0.2%	2.0
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Midwest		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**37860**	**100.0%**	**1.9**	**89590**	**100.0%**	**1.6**	**51340**	**100.0%**	**1.8**	**82850**	**100.0%**	**1.3**	**72470**	**100.0%**	**1.5**	**138320**	**100.0%**	**1.2**
US Airways	30540	80.7%	1.2	8560	9.6%	1.3	28430	55.4%	1.2	50830	61.4%	1.1	5610	7.7%	1.3	55310	40.0%	1.0
Delta	3950	10.4%	2.0	63500	70.9%	1.1	2470	4.8%	2.0	11180	13.5%	1.0	360	0.5%	2.0	66990	48.4%	1.0
American	1190	3.1%	2.0		0.0%		170	0.3%	2.0	14600	17.6%	1.0	26190	36.1%	1.0	10650	7.7%	1.0
Northwest	370	1.0%	2.0	580	0.6%	2.0	160	0.3%	2.0		0.0%		200	0.3%	2.0		0.0%	
United	190	0.5%	1.8	10	0.0%	2.0	290	0.6%	2.0	5530	6.7%	1.0	38190	52.7%	1.0	5070	3.7%	1.0
Continental	230	0.6%	2.0	80	0.1%	1.9	440	0.9%	2.0	90	0.1%	2.0	60	0.1%	2.0	10	0.0%	1.0
America West		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Midwest	10	0.0%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
99	320	0.8%	2.6	1530	1.7%	2.1	760	1.5%	2.2	590	0.7%	2.1	1850	2.6%	2.1	270	0.2%	2.0
AirTran	990	2.6%	2.0	15310	17.1%	1.1	1020	2.0%	2.0		0.0%			0.0%			0.0%	
Spirit	10	0.0%	2.0		0.0%		17600	34.3%	1.0		0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
SouthWest		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
IAD	**74220**	**100.0%**	**1.8**	**68340**	**100.0%**	**1.5**	**53730**	**100.0%**	**1.8**	**37380**	**100.0%**	**1.4**	**47270**	**100.0%**	**1.6**	**12700**	**100.0%**	**1.3**
United	40450	54.5%	1.0	8790	12.9%	1.0	20480	38.1%	1.0	24210	64.8%	1.0	30520	64.6%	1.2	12240	96.4%	1.0
Independence	27340	36.8%	1.4	11030	16.1%	1.0		0.0%		12280	32.9%	1.0	9540	20.2%	1.0		0.0%	
Delta	3840	5.2%	2.1	34980	51.2%	1.0	2600	4.8%	2.0		0.0%		170	0.4%	2.0		0.0%	
American	90	0.1%	2.0		0.0%		90	0.2%	2.0		0.0%		5990	12.7%	1.0		0.0%	
JetBlue		0.0%			0.0%		28190	52.5%	1.0		0.0%			0.0%			0.0%	
Northwest	120	0.2%	2.0	110	0.2%	2.0	90	0.2%	2.0		0.0%		290	0.6%	2.0		0.0%	
US Airways	520	0.7%	2.0	300	0.4%	2.0	610	1.1%	2.0	290	0.8%	1.0	370	0.8%	1.3	20	0.2%	1.0
Continental	140	0.2%	2.0	40	0.1%	2.0	270	0.5%	2.0	90	0.2%	2.0	20	0.0%	2.0		0.0%	
AirTran	1240	1.7%	2.0	12400	18.1%	1.0	840	1.6%	2.0		0.0%			0.0%			0.0%	
99	480	0.6%	2.1	680	1.0%	2.0	560	1.0%	2.1	510	1.4%	2.0	330	0.7%	2.5	440	3.5%	2.0
America West		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%		40	0.1%	1.0		0.0%	
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Grand Total	**213720**		**1.8**	**213390**		**1.5**	**172280**		**1.8**	**167440**		**1.4**	**157600**		**1.6**	**155380**		**1.3**

Top 7 ~ 13 routes (continued)

	7			8			9			10			11			12			13		
	LAX			TPA			DFW			DEN			LAS			PHX			MIA		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**39110**	**100.0%**	**1.8**	**56890**	**100.0%**	**1.9**	**53340**	**100.0%**	**1.7**	**30260**	**100.0%**	**1.8**	**57620**	**100.0%**	**1.8**	**41900**	**100.0%**	**1.8**	**22250**	**100.0%**	**1.9**
SouthWest	12350	31.6%	1.4	29920	52.6%	1.1		0.0%		270	0.9%	2.0	25100	43.6%	1.2	21830	52.1%	1.3		0.0%	
AirTran	1440	3.7%	2.1	20600	36.2%	1.3	8000	15.0%	1.2	580	1.9%	2.0	1020	1.8%	2.0		0.0%		880	4.0%	2.0
American	2150	5.5%	1.9	330	0.6%	2.0	40710	76.3%	1.1	1130	3.7%	1.9	3210	5.6%	2.0	1460	3.5%	1.8	16100	72.4%	1.0
Delta	1520	3.9%	2.1	2440	4.3%	2.0	1100	2.1%	1.8	1020	3.4%	2.0	1360	2.4%	2.0	510	1.2%	2.2	1870	8.4%	2.0
United	14700	37.6%	1.4	50	0.1%	2.0	490	0.9%	1.8	13950	46.1%	1.2	1600	2.8%	2.0	1050	2.5%	2.0	30	0.1%	2.3
US Airways	1230	3.1%	1.9	2780	4.9%	2.0	1120	2.1%	1.8	630	2.1%	1.6	2340	4.1%	1.8	1670	4.0%	2.0	2910	13.1%	1.5
Northwest	440	1.1%	2.0	80	0.1%	2.1	320	0.6%	1.8	700	2.3%	2.0	750	1.3%	1.8	450	1.1%	2.0	40	0.2%	2.0
Continental	350	0.9%	2.0	170	0.3%	2.0	460	0.9%	2.1	370	1.2%	1.9	1970	3.4%	1.9	1070	2.6%	2.0	130	0.6%	2.0
America West	3250	8.3%	1.6		0.0%		10	0.0%	2.0	290	1.0%	2.1	19290	33.5%	1.3	13060	31.2%	1.3		0.0%	
99	1230	3.1%	2.5	520	0.9%	2.5	1090	2.0%	2.2	930	3.1%	2.2	580	1.0%	2.3	720	1.7%	2.4	290	1.3%	2.5
Frontier	390	1.0%	2.0		0.0%		20	0.0%	2.0	10250	33.9%	1.0	330	0.6%	2.0	40	0.1%	2.0		0.0%	
Midwest		0.0%			0.0%			0.0%		20	0.1%	2.0		0.0%		30	0.1%	2.0		0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**22880**	**100.0%**	**1.9**	**32090**	**100.0%**	**1.8**	**42910**	**100.0%**	**1.8**	**38330**	**100.0%**	**1.8**	**20680**	**100.0%**	**1.9**	**23850**	**100.0%**	**1.9**	**38810**	**100.0%**	**1.8**
US Airways	1100	4.8%	1.7	26320	82.0%	1.3	5410	12.6%	1.2	730	1.9%	1.8	3220	15.6%	2.0	2350	9.9%	2.0	1480	3.8%	2.0
Delta	2390	10.4%	2.1	2800	8.7%	2.0	1230	2.9%	2.0	720	1.9%	1.9	2530	12.2%	2.0	2330	9.8%	2.0	1420	3.7%	2.0
American	2430	10.6%	2.0	750	2.3%	2.0	32530	75.8%	1.1	4130	10.8%	2.0	1950	9.4%	2.0	1310	5.5%	2.0	34460	88.8%	1.0
Northwest	1130	4.9%	2.0	350	1.1%	2.0	370	0.9%	2.0	2190	5.7%	2.0	1300	6.3%	1.8	1200	5.0%	1.7	100	0.3%	2.0
United	2040	8.9%	2.0	90	0.3%	1.7	640	1.5%	2.0	5170	13.5%	1.4	590	2.9%	2.1	1050	4.4%	2.1	80	0.2%	2.0
Continental	1050	4.6%	2.0	400	1.2%	2.1	140	0.3%	1.9	770	2.0%	2.0	410	2.0%	2.1	580	2.4%	2.0	140	0.4%	2.0
America West	1240	5.4%	2.0		0.0%		30	0.1%	2.0	140	0.4%	2.2	8690	42.0%	1.3	14010	58.7%	1.1		0.0%	
Midwest	30	0.1%	2.0		0.0%		40	0.1%	2.0	20	0.1%	2.0	20	0.1%	2.0		0.0%			0.0%	
99	1590	6.9%	2.6	450	1.4%	2.3	1220	2.8%	2.2	1200	3.1%	2.2	440	2.1%	2.6	680	2.9%	2.4	600	1.5%	2.2
AirTran	1010	4.4%	2.0	920	2.9%	2.0	450	1.0%	2.0	560	1.5%	2.0	540	2.6%	2.1		0.0%		520	1.3%	2.0
Spirit	180	0.8%	1.0		0.0%			0.0%			0.0%		50	0.2%	1.0		0.0%			0.0%	
Frontier	790	3.5%	2.0		0.0%			0.0%		20520	53.5%	1.0	420	2.0%	2.0	190	0.8%	1.9		0.0%	
Alaska	7330	32.0%	1.1		0.0%			0.0%			0.0%		10	0.0%	2.0		0.0%			0.0%	
SouthWest	190	0.8%	2.0		0.0%			0.0%			0.0%		110	0.5%	2.0	50	0.2%	2.0		0.0%	
IAD	**78490**	**100.0%**	**1.6**	**41500**	**100.0%**	**1.8**	**24750**	**100.0%**	**1.8**	**42370**	**100.0%**	**1.8**	**31410**	**100.0%**	**1.9**	**17830**	**100.0%**	**1.9**	**17520**	**100.0%**	**1.6**
United	47750	60.8%	1.4	21620	52.1%	1.0	2890	11.7%	1.4	33120	78.2%	1.3	19480	62.0%	1.3	5200	29.2%	1.4	6950	39.7%	1.1
Independence		0.0%		15350	37.0%	1.3		0.0%			0.0%		3860	12.3%	1.0		0.0%			0.0%	
Delta	1400	1.8%	2.1	1970	4.7%	2.0	1010	4.1%	2.0	500	1.2%	2.0	2060	6.6%	2.0	2090	11.7%	2.0	960	5.5%	2.0
American	19240	24.5%	1.1	30	0.1%	2.0	18730	75.7%	1.1	1950	4.6%	2.0	1150	3.7%	2.0	830	4.7%	1.9	7490	42.8%	1.0
JetBlue		0.0%			0.0%			0.0%			0.0%		130	0.4%	2.0		0.0%			0.0%	
Northwest	320	0.4%	2.1	50	0.1%	2.0	200	0.8%	2.0	1690	4.0%	2.0	170	0.5%	2.0	450	2.5%	2.0	30	0.2%	2.0
US Airways	750	1.0%	1.5	720	1.7%	2.1	630	2.5%	2.0	840	2.0%	1.4	1410	4.5%	2.0	1090	6.1%	2.0	620	3.5%	1.8
Continental	230	0.3%	2.0	170	0.4%	2.1	170	0.7%	2.0	620	1.5%	2.0	80	0.3%	2.0	420	2.4%	2.1	60	0.3%	2.0
AirTran	1180	1.5%	2.0	990	2.4%	2.0	600	2.4%	2.0	1310	3.1%	2.0	590	1.9%	2.0		0.0%		810	4.6%	2.0
99	1960	2.5%	2.6	600	1.4%	2.1	520	2.1%	2.2	720	1.7%	2.6	670	2.1%	2.6	520	2.9%	2.5	550	3.1%	2.1
America West	5200	6.6%	1.3		0.0%			0.0%		40	0.1%	2.5	1760	5.6%	1.5	7230	40.5%	1.1		0.0%	
Alaska	250	0.3%	1.0		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier	100	0.1%	2.0		0.0%			0.0%		1560	3.7%	1.0	50	0.2%	2.0		0.0%			0.0%	
Grand Total	**140480**		**1.8**	**130480**		**1.8**	**121000**		**1.8**	**110960**		**1.8**	**109710**		**1.9**	**83580**		**1.9**	**78580**		**1.8**

Top 14 ~ 20 routes (continued)

	14			15			16			17			18			19			20		
	DTW			SFO			SAN			PVD			MSY			PBI			IAH		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**15630**	**100.0%**	**1.9**	**14040**	**100.0%**	**2.0**	**31630**	**100.0%**	**1.9**	**45200**	**100.0%**	**1.8**	**27590**	**100.0%**	**2.0**	**27670**	**100.0%**	**1.9**	**20340**	**100.0%**	**2.0**
SouthWest	1260	8.1%	2.0	170	1.2%	2.0	15000	47.4%	1.4	44340	98.1%	1.0	12050	43.7%	1.4	22260	80.4%	1.0		0.0%	
AirTran		0.0%		490	3.5%	2.0		0.0%			0.0%		3140	11.4%	2.0	830	3.0%	2.0		0.0%	
American	80	0.5%	2.0	830	5.9%	2.1	2540	8.0%	2.0		0.0%		1040	3.8%	2.0	10	0.0%	2.0	590	2.9%	2.0
Delta	140	0.9%	2.0	730	5.2%	1.9	2180	6.9%	2.1		0.0%		4140	15.0%	2.0	2150	7.8%	2.0	330	1.6%	2.0
United	60	0.4%	2.0	7070	50.4%	1.6	3010	9.5%	1.9	10	0.0%	2.0	270	1.0%	2.0	100	0.4%	2.0	220	1.1%	2.0
US Airways	200	1.3%	2.0	850	6.1%	1.9	2330	7.4%	2.0	550	1.2%	2.0	4040	14.6%	2.0	1900	6.9%	1.9	540	2.7%	1.9
Northwest	13540	86.6%	1.0	430	3.1%	1.9	800	2.5%	1.7		0.0%		730	2.6%	2.0	40	0.1%	2.0	210	1.0%	2.1
Continental	70	0.4%	2.0	140	1.0%	2.2	2140	6.8%	1.9	150	0.3%	2.0	1800	6.5%	2.0	60	0.2%	2.0	17650	86.8%	1.1
America West		0.0%		1700	12.1%	2.0	2330	7.4%	1.9		0.0%			0.0%			0.0%			0.0%	
99	280	1.8%	2.1	1110	7.9%	2.6	910	2.9%	2.5	150	0.3%	2.1	380	1.4%	2.2	320	1.2%	2.2	800	3.9%	2.4
Frontier		0.0%		440	3.1%	2.0	370	1.2%	2.0		0.0%			0.0%			0.0%			0.0%	
Midwest		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%		10	0.0%	2.0		0.0%			0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**36750**	**100.0%**	**1.6**	**14180**	**100.0%**	**2.0**	**16220**	**100.0%**	**2.1**	**11880**	**100.0%**	**1.9**	**23590**	**100.0%**	**1.9**	**21580**	**100.0%**	**1.8**	**31600**	**100.0%**	**1.8**
US Airways	2990	8.1%	1.1	1090	7.7%	1.9	850	5.2%	2.0	11750	98.9%	1.1	18050	76.5%	1.2	15480	71.7%	1.2	4650	14.7%	1.2
Delta	150	0.4%	2.0	1850	13.0%	2.0	5760	35.5%	2.0		0.0%		2330	9.9%	1.9	1490	6.9%	2.0	630	2.0%	2.1
American	80	0.2%	2.0	2140	15.1%	1.9	2650	16.3%	2.0		0.0%		670	2.8%	2.0	150	0.7%	2.0	720	2.3%	2.0
Northwest	26440	71.9%	1.0	1150	8.1%	2.0	750	4.6%	2.0		0.0%		520	2.2%	2.0	80	0.4%	2.0	520	1.6%	2.1
United	30	0.1%	2.0	2070	14.6%	2.0	1410	8.7%	2.0	10	0.1%	2.0	220	0.9%	1.9	3130	14.5%	1.0	320	1.0%	2.0
Continental	60	0.2%	1.8	820	5.8%	2.1	570	3.5%	2.1	40	0.3%	2.0	730	3.1%	2.0	120	0.6%	2.0	23870	75.5%	1.0
America West		0.0%		1290	9.1%	1.8	2490	15.4%	1.6		0.0%			0.0%			0.0%			0.0%	
Midwest		0.0%		10	0.1%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
99	840	2.3%	2.1	1260	8.9%	2.7	920	5.7%	2.7	80	0.7%	2.4	270	1.1%	2.6	440	2.0%	2.3	830	2.6%	2.5
AirTran		0.0%		600	4.2%	2.0		0.0%			0.0%		800	3.4%	2.0	690	3.2%	2.0		0.0%	
Spirit	6160	16.8%	1.0		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%		630	4.4%	2.0	550	3.4%	2.0		0.0%			0.0%			0.0%		30	0.1%	2.0
Alaska		0.0%		60	0.4%	2.2	50	0.3%	2.4		0.0%			0.0%			0.0%			0.0%	
SouthWest		0.0%			0.0%		170	1.0%	2.0		0.0%			0.0%			0.0%			0.0%	
IAD	**24010**	**100.0%**	**1.5**	**41790**	**100.0%**	**1.9**	**21550**	**100.0%**	**1.8**	**11520**	**100.0%**	**1.5**	**12680**	**100.0%**	**1.9**	**11920**	**100.0%**	**1.9**	**7110**	**100.0%**	**1.8**
United	4120	17.2%	1.0	35330	84.5%	1.4	15530	72.1%	1.3	5330	46.3%	1.0	9750	76.9%	1.1	70	0.6%	2.0	420	5.9%	1.6
Independence	6070	25.3%	1.0		0.0%			0.0%		6060	52.6%	1.0		0.0%		8810	73.9%	1.0		0.0%	
Delta	80	0.3%	2.0	730	1.7%	2.1	1500	7.0%	2.0		0.0%		1110	8.8%	2.0	1360	11.4%	2.0	370	5.2%	2.0
American	20	0.1%	2.0	1050	2.5%	2.0	1620	7.5%	2.0		0.0%		220	1.7%	2.0		0.0%		200	2.8%	2.0
JetBlue		0.0%			0.0%		20	0.1%	1.0		0.0%			0.0%			0.0%			0.0%	
Northwest	13640	56.8%	1.0	470	1.1%	2.0	370	1.7%	2.1		0.0%		90	0.7%	2.0		0.0%		160	2.3%	2.1
US Airways	10	0.0%	1.0	480	1.1%	1.4	360	1.7%	1.4	10	0.1%	1.0	380	3.0%	1.9	410	3.4%	2.0	210	3.0%	1.9
Continental	50	0.2%	2.0	260	0.6%	2.0	290	1.3%	2.0	50	0.4%	2.0	240	1.9%	2.0	120	1.0%	1.9	5320	74.8%	1.0
AirTran		0.0%		840	2.0%	2.0		0.0%			0.0%		690	5.4%	2.0	920	7.7%	2.0		0.0%	
99	20	0.1%	2.0	1910	4.6%	2.5	730	3.4%	2.6	70	0.6%	2.6	200	1.6%	2.5	230	1.9%	2.3	420	5.9%	2.3
America West		0.0%		550	1.3%	2.0	1070	5.0%	2.0		0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%		30	0.1%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%		130	0.3%	2.0	60	0.3%	2.0		0.0%			0.0%			0.0%			0.0%	
Grand Total	**76390**		**1.7**	**70010**		**2.0**	**69400**		**1.9**	**68600**		**1.7**	**63860**		**1.9**	**61170**		**1.9**	**59050**		**1.8**

Top 21 ~ 27 routes (continued)

	21			22			23			24			25			26			27		
	MSP			STL			OAK			SEA			BDL			MHT			JAX		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**16010**	**100.0%**	**2.0**	**25380**	**100.0%**	**1.8**	**10730**	**100.0%**	**1.9**	**16780**	**100.0%**	**2.0**	**29230**	**100.0%**	**1.8**	**41060**	**100.0%**	**1.9**	**21500**	**100.0%**	**2.0**
SouthWest	210	1.3%	2.0	15250	60.1%	1.1	5770	53.8%	1.4	2320	13.8%	1.6	28470	97.4%	1.0	40090	97.6%	1.0	15660	72.8%	1.0
AirTran	900	5.6%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%		810	3.8%	2.0
American	300	1.9%	2.0	8280	32.6%	1.1	640	6.0%	2.1	1430	8.5%	2.0		0.0%			0.0%		40	0.2%	2.0
Delta	310	1.9%	2.1	250	1.0%	1.9	440	4.1%	2.0	2420	14.4%	1.8		0.0%			0.0%		2610	12.1%	1.8
United	690	4.3%	1.9	290	1.1%	2.0	1600	14.9%	2.0	3440	20.5%	2.0	30	0.1%	2.0	10	0.0%	2.0	120	0.6%	2.0
US Airways	370	2.3%	2.0	630	2.5%	2.0	310	2.9%	2.0	1330	7.9%	2.0	610	2.1%	2.0	790	1.9%	1.9	2000	9.3%	2.0
Northwest	12090	75.5%	1.2	240	0.9%	1.9		0.0%		3660	21.8%	1.8		0.0%			0.0%		80	0.4%	2.0
Continental	170	1.1%	2.1	220	0.9%	2.1	150	1.4%	1.7	480	2.9%	2.0	50	0.2%	2.0	60	0.1%	2.0	60	0.3%	2.0
America West		0.0%			0.0%		940	8.8%	2.0	440	2.6%	1.8		0.0%			0.0%			0.0%	
99	680	4.2%	2.3	220	0.9%	2.2	870	8.1%	2.5	890	5.3%	2.5	70	0.2%	2.2	110	0.3%	2.4	120	0.6%	2.7
Frontier		0.0%			0.0%			0.0%		330	2.0%	2.0		0.0%			0.0%			0.0%	
Midwest	80	0.5%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%		40	0.2%	2.0		0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**31450**	**100.0%**	**1.9**	**20060**	**100.0%**	**1.9**	**4690**	**100.0%**	**2.0**	**21050**	**100.0%**	**1.9**	**10770**	**100.0%**	**1.5**	**4750**	**100.0%**	**1.8**	**12270**	**100.0%**	**2.0**
US Airways	950	3.0%	2.0	690	3.4%	2.0	40	0.9%	1.7	400	1.9%	1.9	10690	99.3%	1.1	4560	96.0%	1.1	9340	76.1%	1.2
Delta	430	1.4%	2.0	390	1.9%	2.0	570	12.2%	2.0	1640	7.8%	1.5		0.0%			0.0%		1850	15.1%	2.0
American	580	1.8%	2.0	16860	84.0%	1.1	1040	22.2%	2.1	1190	5.7%	2.0		0.0%			0.0%		60	0.5%	2.0
Northwest	24500	77.9%	1.1	380	1.9%	1.9	20	0.4%	2.0	1370	6.5%	2.0		0.0%			0.0%		40	0.3%	2.0
United	720	2.3%	2.0	670	3.3%	1.9	600	12.8%	2.1	1380	6.6%	2.0	20	0.2%	1.5	20	0.4%	2.0	10	0.1%	2.0
Continental	50	0.2%	2.0	160	0.8%	2.0	200	4.3%	2.1	460	2.2%	2.1	10	0.1%	2.0	50	1.1%	2.0	60	0.5%	2.0
America West		0.0%			0.0%		1200	25.6%	1.7	630	3.0%	2.0		0.0%			0.0%			0.0%	
Midwest	540	1.7%	2.0	30	0.1%	2.3		0.0%			0.0%			0.0%			0.0%			0.0%	
99	530	1.7%	2.2	480	2.4%	2.1	420	9.0%	2.8	990	4.7%	2.5	40	0.4%	2.0	120	2.5%	2.2	120	1.0%	2.5
AirTran	270	0.9%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%		790	6.4%	2.0
Spirit		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%		590	2.8%	2.0		0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%		30	0.6%	2.0	11850	56.3%	1.1		0.0%			0.0%			0.0%	
SouthWest		0.0%		400	2.0%	2.0	310	6.6%	2.0	120	0.6%	2.0		0.0%			0.0%			0.0%	
IAD	**10020**	**100.0%**	**1.8**	**10660**	**100.0%**	**1.7**	**40450**	**100.0%**	**1.8**	**17430**	**100.0%**	**1.8**	**15210**	**100.0%**	**1.5**	**7450**	**100.0%**	**1.6**	**19110**	**100.0%**	**1.7**
United	3120	31.1%	1.2	4310	40.4%	1.1	13670	33.8%	1.5	11560	66.3%	1.5	8340	54.8%	1.0	1770	23.8%	1.1	4820	25.2%	1.0
Independence		0.0%			0.0%			0.0%			0.0%		6720	44.2%	1.0	5580	74.9%	1.0	10120	53.0%	1.0
Delta	220	2.2%	2.0	190	1.8%	1.8	890	2.2%	2.0	320	1.8%	2.1		0.0%			0.0%		2930	15.3%	1.2
American	180	1.8%	2.0	5250	49.2%	1.1	530	1.3%	2.1	1020	5.9%	1.7		0.0%			0.0%			0.0%	
JetBlue		0.0%			0.0%		23520	58.1%	1.1		0.0%			0.0%			0.0%			0.0%	
Northwest	5500	54.9%	1.1	170	1.6%	2.0	10	0.0%	2.0	720	4.1%	2.0		0.0%			0.0%		30	0.2%	2.0
US Airways	360	3.6%	2.0	360	3.4%	1.5	570	1.4%	1.6	100	0.6%	1.2	30	0.2%	1.3		0.0%		160	0.8%	2.0
Continental	40	0.4%	2.0	130	1.2%	2.0	70	0.2%	2.0	60	0.3%	2.2	40	0.3%	2.0	20	0.3%	2.0	160	0.8%	2.0
AirTran	450	4.5%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%		810	4.2%	2.0
99	150	1.5%	2.3	250	2.3%	2.7	700	1.7%	2.6	620	3.6%	2.5	80	0.5%	2.1	80	1.1%	2.3	80	0.4%	2.4
America West		0.0%			0.0%		450	1.1%	2.0	510	2.9%	2.0		0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%		30	0.1%	2.0	2410	13.8%	1.1		0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%		110	0.6%	2.0		0.0%			0.0%			0.0%	
Grand Total	**57480**		**1.9**	**56100**		**1.8**	**55870**		**1.9**	**55260**		**1.9**	**55210**		**1.6**	**53260**		**1.8**	**52880**		**1.9**

Top 28 ~ 34 routes (continued)

	28			29			30			31			32			33			34		
	BNA			RDU			CLE			SLC			MCI			RSW			CLT		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**28670**	**100.0%**	**2.0**	**19770**	**100.0%**	**1.6**	**27480**	**100.0%**	**1.7**	**19060**	**100.0%**	**1.9**	**14900**	**100.0%**	**1.9**	**17490**	**100.0%**	**1.9**	**9780**	**100.0%**	**1.6**
SouthWest	26470	92.3%	1.0	18810	95.1%	1.0	13500	49.1%	1.0	8310	43.6%	1.2	9330	62.6%	1.1		0.0%			0.0%	
AirTran		0.0%			0.0%			0.0%			0.0%		210	1.4%	2.0	13720	78.4%	1.1		0.0%	
American	130	0.5%	2.0		0.0%			0.0%		780	4.1%	2.0	520	3.5%	2.0	330	1.9%	2.0		0.0%	
Delta	620	2.2%	2.0		0.0%		100	0.4%	2.0	5980	31.4%	1.5	1920	12.9%	1.9	1240	7.1%	1.9	520	5.3%	2.0
United	30	0.1%	2.0		0.0%			0.0%		1370	7.2%	2.0	420	2.8%	2.0	90	0.5%	2.0	960	9.8%	1.0
US Airways	1100	3.8%	2.0	940	4.8%	1.9	120	0.4%	2.0	70	0.4%	2.2	550	3.7%	2.0	1660	9.5%	1.7	7990	81.7%	1.1
Northwest	220	0.8%	2.0		0.0%		70	0.3%	2.0	750	3.9%	2.0	1230	8.3%	1.9	100	0.6%	2.0		0.0%	
Continental	50	0.2%	2.0		0.0%		13470	49.0%	1.0	260	1.4%	2.0	380	2.6%	2.0	130	0.7%	2.0	40	0.4%	2.0
America West		0.0%			0.0%			0.0%		1020	5.4%	2.0		0.0%			0.0%			0.0%	
99	50	0.2%	2.6	20	0.1%	2.0	220	0.8%	2.0	300	1.6%	2.4	220	1.5%	2.5	220	1.3%	2.5	270	2.8%	2.1
Frontier		0.0%			0.0%			0.0%		220	1.2%	2.0		0.0%			0.0%			0.0%	
Midwest		0.0%			0.0%			0.0%			0.0%		120	0.8%	2.0		0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**8390**	**100.0%**	**1.9**	**18410**	**100.0%**	**1.3**	**9080**	**100.0%**	**1.6**	**12930**	**100.0%**	**1.9**	**24340**	**100.0%**	**1.9**	**18210**	**100.0%**	**1.7**	**10690**	**100.0%**	**1.5**
US Airways	7230	86.2%	1.1	5760	31.3%	1.0	2170	23.9%	1.1		0.0%		8070	33.2%	1.1	7310	40.1%	1.2	10170	95.1%	1.1
Delta	510	6.1%	2.1		0.0%		210	2.3%	2.0	7580	58.6%	1.4	380	1.6%	2.0	1380	7.6%	2.0	190	1.8%	1.9
American	210	2.5%	2.0	12580	68.3%	1.0		0.0%		1020	7.9%	2.0	720	3.0%	2.0	620	3.4%	2.0		0.0%	
Northwest	230	2.7%	2.0		0.0%		40	0.4%	2.0	930	7.2%	2.1	460	1.9%	1.9	80	0.4%	2.0		0.0%	
United	50	0.6%	1.6	10	0.1%	1.0		0.0%		580	4.5%	1.7	610	2.5%	1.7	1430	7.9%	1.0	10	0.1%	1.0
Continental	50	0.6%	2.0		0.0%		6480	71.4%	1.0	1330	10.3%	2.0	20	0.1%	2.0	80	0.4%	2.0	30	0.3%	2.0
America West		0.0%			0.0%			0.0%		410	3.2%	2.0		0.0%			0.0%			0.0%	
Midwest		0.0%			0.0%			0.0%			0.0%		13750	56.5%	1.1		0.0%			0.0%	
99	110	1.3%	2.2	60	0.3%	2.0	180	2.0%	2.1	680	5.3%	2.6	140	0.6%	2.6	390	2.1%	2.3	260	2.4%	2.0
AirTran		0.0%			0.0%			0.0%			0.0%		100	0.4%	2.0	6920	38.0%	1.1		0.0%	
Spirit		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%		390	3.0%	2.0		0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
SouthWest		0.0%			0.0%			0.0%			0.0%		70	0.3%	2.0		0.0%			0.0%	
IAD	**14340**	**100.0%**	**1.7**	**13000**	**100.0%**	**1.5**	**12380**	**100.0%**	**1.5**	**14850**	**100.0%**	**2.0**	**6200**	**100.0%**	**1.9**	**9090**	**100.0%**	**2.0**	**22340**	**100.0%**	**1.5**
United	4730	33.0%	1.0	5380	41.4%	1.0	3190	25.8%	1.0	1680	11.3%	2.1	4930	79.5%	1.2	110	1.2%	2.2	4490	20.1%	1.0
Independence	8880	61.9%	1.0	7470	57.5%	1.0	3720	30.0%	1.0		0.0%			0.0%		6090	67.0%	1.0	8650	38.7%	1.0
Delta	360	2.5%	2.1		0.0%		70	0.6%	2.3	9830	66.2%	1.3	250	4.0%	2.0	1510	16.6%	2.0	40	0.2%	2.0
American	40	0.3%	2.0		0.0%			0.0%		860	5.8%	2.0	420	6.8%	2.0	220	2.4%	2.0		0.0%	
JetBlue		0.0%			0.0%			0.0%		10	0.1%	3.0		0.0%			0.0%			0.0%	
Northwest	40	0.3%	2.0		0.0%			0.0%		760	5.1%	2.1	220	3.5%	1.8	40	0.4%	2.0		0.0%	
US Airways	110	0.8%	1.7	100	0.8%	1.8		0.0%		10	0.1%	2.0	120	1.9%	1.9	340	3.7%	2.0	9010	40.3%	1.0
Continental	90	0.6%	2.0		0.0%		5370	43.4%	1.0	670	4.5%	2.1	40	0.6%	2.0	40	0.4%	2.0	20	0.1%	2.0
AirTran		0.0%			0.0%			0.0%			0.0%		120	1.9%	2.0	690	7.6%	2.0		0.0%	
99	80	0.6%	2.4	50	0.4%	2.0	30	0.2%	2.3	570	3.8%	2.6	100	1.6%	2.4	50	0.6%	2.4	130	0.6%	2.0
America West		0.0%			0.0%			0.0%		330	2.2%	2.0		0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%		100	0.7%	2.0		0.0%			0.0%			0.0%	
Grand Total	**51400**		**1.8**	**51180**		**1.4**	**48940**		**1.6**	**46840**		**1.9**	**45440**		**1.9**	**44790**		**1.9**	**42810**		**1.5**

Top 35 ~ 40 routes (continued)

	35			36			37			38			39			40		
	MDW			EWR			CMH			SAT			LGB			AUS		
Row Labels	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn	pass	Mshare	AvgCpn
BWI	**24940**	**100.0%**	**2.0**	**2380**	**100.0%**	**1.5**	**16570**	**100.0%**	**1.9**	**19080**	**100.0%**	**1.9**	**490**	**100.0%**	**2.4**	**15660**	**100.0%**	**2.0**
SouthWest	24360	97.7%	1.2		0.0%		14930	90.1%	1.0	12810	67.1%	1.2		0.0%		10210	65.2%	1.3
AirTran	160	0.6%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
American		0.0%			0.0%		20	0.1%	2.0	2490	13.1%	1.8	180	36.7%	2.0	2240	14.3%	2.0
Delta	10	0.0%	2.0		0.0%		510	3.1%	2.0	1330	7.0%	2.0		0.0%		810	5.2%	2.1
United		0.0%			0.0%		80	0.5%	2.0	340	1.8%	2.1		0.0%		390	2.5%	2.0
US Airways		0.0%		10	0.4%	2.0	340	2.1%	2.0		0.0%			0.0%		10	0.1%	2.0
Northwest	260	1.0%	2.0		0.0%		220	1.3%	2.0	300	1.6%	2.0		0.0%		210	1.3%	2.0
Continental	80	0.3%	2.0	2370	99.6%	1.0	270	1.6%	2.0	1470	7.7%	1.8		0.0%		1490	9.5%	2.0
America West		0.0%			0.0%			0.0%			0.0%		290	59.2%	2.1	10	0.1%	2.0
99	70	0.3%	2.7		0.0%		200	1.2%	2.1	340	1.8%	2.4	20	4.1%	3.0	280	1.8%	2.6
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%		10	0.1%	2.0
Midwest		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Hawaiian		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
DCA	**15750**	**100.0%**	**1.9**	**13650**	**100.0%**	**1.5**	**13800**	**100.0%**	**1.6**	**12080**	**100.0%**	**2.0**	**1150**	**100.0%**	**2.3**	**9850**	**100.0%**	**2.2**
US Airways		0.0%		10	0.1%	2.0	8680	62.9%	1.0	10	0.1%	2.0		0.0%		30	0.3%	3.0
Delta	100	0.6%	2.0		0.0%		4750	34.4%	1.1	5530	45.8%	1.9		0.0%		1800	18.3%	2.0
American		0.0%			0.0%		60	0.4%	2.0	2290	19.0%	2.0	650	56.5%	2.0	4880	49.5%	1.8
Northwest	90	0.6%	1.9	10	0.1%	1.0	130	0.9%	1.8	960	7.9%	1.5		0.0%		530	5.4%	2.0
United		0.0%			0.0%		40	0.3%	2.0	550	4.6%	2.0		0.0%		310	3.1%	2.0
Continental	30	0.2%	2.0	13560	99.3%	1.0	60	0.4%	2.0	2250	18.6%	2.0		0.0%		1980	20.1%	2.0
America West		0.0%			0.0%			0.0%		30	0.2%	2.0	410	35.7%	2.0	10	0.1%	2.0
Midwest		0.0%			0.0%			0.0%		40	0.3%	2.0		0.0%			0.0%	
99	70	0.4%	2.4	70	0.5%	2.0	60	0.4%	2.3	420	3.5%	2.5	80	7.0%	3.1	290	2.9%	2.8
AirTran	160	1.0%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
Spirit		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%		20	0.2%	2.0
Alaska		0.0%			0.0%			0.0%			0.0%		10	0.9%	2.0		0.0%	
SouthWest		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
IAD	**500**	**100.0%**	**2.1**	**21540**	**100.0%**	**1.3**	**6470**	**100.0%**	**1.6**	**4880**	**100.0%**	**2.0**	**34010**	**100.0%**	**1.8**	**7760**	**100.0%**	**2.0**
United		0.0%		6140	28.5%	1.0	140	2.2%	1.2	600	12.3%	2.0		0.0%		5270	67.9%	1.1
Independence		0.0%		5920	27.5%	1.0	6090	94.1%	1.0		0.0%			0.0%			0.0%	
Delta	110	22.0%	2.0		0.0%		60	0.9%	2.0	860	17.6%	2.0		0.0%		320	4.1%	2.1
American		0.0%			0.0%			0.0%		2340	48.0%	1.9	650	1.9%	2.1	1460	18.8%	2.0
JetBlue		0.0%			0.0%			0.0%			0.0%		33170	97.5%	1.0		0.0%	
Northwest	130	26.0%	2.0		0.0%		80	1.2%	2.0	170	3.5%	1.7		0.0%		170	2.2%	2.0
US Airways		0.0%			0.0%		20	0.3%	1.5	20	0.4%	2.0		0.0%			0.0%	
Continental	80	16.0%	2.0	9250	42.9%	1.0	30	0.5%	1.7	640	13.1%	2.0		0.0%		360	4.6%	2.0
AirTran	150	30.0%	2.0		0.0%			0.0%			0.0%			0.0%			0.0%	
99	30	6.0%	2.3	230	1.1%	2.0	50	0.8%	2.0	250	5.1%	2.6	30	0.1%	2.0	160	2.1%	2.4
America West		0.0%			0.0%			0.0%			0.0%		160	0.5%	2.0	10	0.1%	2.0
Alaska		0.0%			0.0%			0.0%			0.0%			0.0%			0.0%	
Frontier		0.0%			0.0%			0.0%			0.0%			0.0%		10	0.1%	2.0
Grand Total	**41190**		**2.0**	**37570**		**1.4**	**36840**		**1.7**	**36040**		**2.0**	**35650**		**2.1**	**33270**		**2.0**

Top 41 ~ 45 routes

41			42			43			44			45		
SJU			**IND**			**BUF**			**SMF**			**SDF**		
pass	**Mshare**	**AvgCpn**	**pass**	**Mshare**	**AvgCpn**	**pass**	**Mshare**	**AvgCpn**	**pass**	**Mshare**	**AvgCpn**	**pass**	**Mshare**	**AvgCpn**
8710	**100.0%**	**1.9**	**12220**	**100.0%**	**1.9**	**22310**	**100.0%**	**1.8**	**6880**	**100.0%**	**2.0**	**17610**	**100.0%**	**1.8**
	0.0%		8800	72.0%	1.1	21350	95.7%	1.0	1710	24.9%	1.8	16130	91.6%	1.0
	0.0%			0.0%			0.0%			0.0%			0.0%	
6180	71.0%	1.1	190	1.6%	2.0		0.0%		760	11.0%	1.6	20	0.1%	2.0
750	8.6%	2.0	160	1.3%	2.0		0.0%		300	4.4%	2.2	500	2.8%	2.0
	0.0%		380	3.1%	2.0		0.0%		2020	29.4%	2.0	20	0.1%	2.0
1460	16.8%	2.0	1050	8.6%	1.9	520	2.3%	2.0	40	0.6%	2.0	250	1.4%	2.0
10	0.1%	2.0	350	2.9%	2.0	180	0.8%	2.0	430	6.3%	2.0	260	1.5%	1.7
260	3.0%	2.0	1140	9.3%	2.0	220	1.0%	1.9	430	6.3%	1.9	320	1.8%	2.0
	0.0%			0.0%			0.0%		800	11.6%	2.0		0.0%	
50	0.6%	2.4	150	1.2%	2.0	40	0.2%	2.3	350	5.1%	2.6	110	0.6%	2.1
	0.0%			0.0%			0.0%		40	0.6%	2.0		0.0%	
	0.0%			0.0%			0.0%			0.0%			0.0%	
	0.0%			0.0%			0.0%			0.0%			0.0%	
	0.0%			0.0%			0.0%			0.0%			0.0%	
8480	**100.0%**	**1.9**	**10900**	**100.0%**	**1.9**	**3710**	**100.0%**	**1.7**	**5360**	**100.0%**	**2.1**	**5630**	**100.0%**	**1.8**
2320	27.4%	1.8	9660	88.6%	1.1	3570	96.2%	1.2	10	0.2%	2.0	4750	84.4%	1.2
910	10.7%	2.0	50	0.5%	2.0		0.0%		560	10.4%	2.0	470	8.3%	2.0
1800	21.2%	2.0	200	1.8%	2.0	40	1.1%	2.0	1080	20.1%	2.0	30	0.5%	2.0
20	0.2%	2.0	360	3.3%	1.6	50	1.3%	2.0	530	9.9%	1.9	130	2.3%	2.0
80	0.9%	2.1	240	2.2%	2.0	10	0.3%	2.0	1430	26.7%	1.9	180	3.2%	1.2
510	6.0%	2.1	50	0.5%	2.0		0.0%		150	2.8%	2.0	10	0.2%	2.0
	0.0%			0.0%			0.0%		1110	20.7%	2.0		0.0%	
	0.0%			0.0%			0.0%			0.0%			0.0%	
360	4.2%	2.4	120	1.1%	2.5	20	0.5%	2.0	340	6.3%	2.6	60	1.1%	2.3
	0.0%			0.0%			0.0%			0.0%			0.0%	
2470	29.1%	1.0		0.0%			0.0%			0.0%			0.0%	
	0.0%			0.0%			0.0%		140	2.6%	2.0		0.0%	
	0.0%			0.0%			0.0%		10	0.2%	3.0		0.0%	
	0.0%		110	1.0%	2.0		0.0%			0.0%			0.0%	
15030	**100.0%**	**1.7**	**7520**	**100.0%**	**1.8**	**4430**	**100.0%**	**1.6**	**17210**	**100.0%**	**1.9**	**6080**	**100.0%**	**1.9**
5660	37.7%	1.1	380	5.1%	1.4	160	3.6%	1.1	7810	45.4%	1.6	90	1.5%	2.0
	0.0%		6700	89.1%	1.0	4170	94.1%	1.0		0.0%		5520	90.8%	1.0
660	4.4%	2.0	70	0.9%	2.0		0.0%		240	1.4%	2.0	310	5.1%	2.0
6170	41.1%	1.1	60	0.8%	2.0		0.0%		500	2.9%	2.1	10	0.2%	2.0
	0.0%			0.0%			0.0%		7690	44.7%	1.0		0.0%	
10	0.1%	2.0	140	1.9%	1.9	20	0.5%	2.0	140	0.8%	2.0	60	1.0%	2.0
1950	13.0%	1.4	50	0.7%	1.6	30	0.7%	1.7	70	0.4%	1.0	40	0.7%	2.0
240	1.6%	2.0	40	0.5%	2.0	40	0.9%	2.0	70	0.4%	2.0	40	0.7%	2.0
	0.0%			0.0%			0.0%			0.0%			0.0%	
340	2.3%	2.2	80	1.1%	2.1	10	0.2%	2.0	300	1.7%	2.7	10	0.2%	2.0
	0.0%			0.0%			0.0%		350	2.0%	2.1		0.0%	
	0.0%			0.0%			0.0%		20	0.1%	2.0		0.0%	
	0.0%			0.0%			0.0%		20	0.1%	2.0		0.0%	
32220		**1.9**	**30640**		**1.8**	**30450**		**1.7**	**29450**		**2.0**	**29320**		**1.9**

Source: US DOT DB1B

Appendix 7 Routes and Number of Alternative Airlines by Departure Airport

2005	Destination	BWI	DCA	IAD	No.	Destination	BWI	DCA	IAD
1	ATL	2			39	ORD		3	
2	BOS	2			40	PBI		3	
3	CLE	2			41	CLT			3
4	DFW	2			42	DFW			3
5	DTW	2			43	DTW			3
6	ORD	2			44	FLL			3
7	PHX	2			45	IAH			3
8	RDU	2			46	LAX			3
9	STL	2			47	MCO			3
10	CLE		2		48	MSY			3
11	CMH		2		49	ORD			3
12	DFW		2		50	PBI			3
13	MSY		2		51	RSW			3
14	RDU		2		52	TPA			3
15	SDF		2		53	AUS	4		
16	TPA		2		54	FLL	4		
17	BDL	2			55	LAS	4		
18	BNA	2			56	LAX	4		
19	BOS	2			57	SAT	4		
20	IND			2	58	TPA	4		
21	MHT			2	59	BOS		4	
22	PVD			2	60	RSW		4	
23	RDU			2	61	ATL			4
24	SDF			2	62	JAX			4
25	SMF			2	63	MIA			4
26	CLT	3			64	SAN			4
27	IND	3			65	SEA			4
28	JAX	3			66	SJU			4
29	MCI	3			67	SFO	5		
30	MCO	3			68	SLC	5		
31	MIA	3			69	LAS		5	
32	MSP	3			70	SEA		5	
33	PBI	3			71	SLC		5	
34	RSW	3			72	LAS			5
35	SJU	3			73	PHX			5
36	ATL		3		74	SLC			5
37	JAX		3		75	SAN	7		
38	LGA		3		76	LAX		9	

(continued)

2007	Destination	BWI	DCA	IAD	No.	Destination	BWI	DCA	IAD
1	ATL	2			43	ATL		3	
2	BOS	2			44	DEN		3	
3	CLE	2			45	MSY		3	
4	DEN	2			46	RSW		3	
5	DFW	2			47	SAT		3	
6	DTW	2			48	SDF		3	
7	FLL	2			49	ATL			3
8	IAH	2			50	AUS			3
9	MCO	2			51	CLT			3
10	ORD	2			52	IAH			3
11	PBI	2			53	LAS			3
12	RSW	2			54	MCI			3
13	STL	2			55	MSY			3
14	TPA	2			56	OAK			3
15	BNA		2		57	PDX			3
16	DFW		2		58	SLC			3
17	DTW		2		59	AUS	4		
18	IND		2		60	JAX	4		
19	JAX		2		61	LAS	4		
20	MCO		2		62	LAX	4		
21	MSP		2		63	MIA	4		
22	ORD		2		64	MSY	4		
23	PBI		2		65	OAK	4		
24	RDU		2		66	SAT	4		
25	STL		2		67	SLC	4		
26	TPA		2		68	AUS		4	
27	BOS			2	69	BOS		4	
28	BUF			2	70	CLE		4	
29	DFW			2	71	LGA		4	
30	DTW			2	72	SLC		4	
31	IND			2	73	JAX			4
32	LAX			2	74	MCO			4
33	SAN			2	75	MCI	5		
34	SEA			2	76	PHX		5	
35	SJU			2	77	SAT			5
36	TPA			2	78	PDX	6		
37	CLT	3			79	SAN	6		
38	IND	3			80	LAS		6	
39	MSP	3			81	LAX		7	
40	PHX	3			82	SEA		7	
41	SFO	3			83	PHX			7
42	SJU	3			84	SEA	8		

(continued)

2009	Destination	BWI	DCA	IAD	No.	Destination	BWI	DCA	IAD
1	ATL	2			35	SLC		3	
2	CLE	2			36	ABQ			3
3	DEN	2			37	ATL			3
4	FLL	2			38	BNA			3
5	IAH	2			39	CLT			3
6	MCO	2			40	DTW			3
7	MKE	2			41	JAX			3
8	ORD	2			42	LAS			3
9	RSW	2			43	PDX			3
10	SLC	2			44	SAN			3
11	STL	2			45	SLC			3
12	TPA	2			46	AUS	4		
13	ATL		2		47	JAX	4		
14	CLE		2		48	MIA	4		
15	CLT		2		49	MSP	4		
16	IAH		2		50	MSY	4		
17	MCO		2		51	PBI	4		
18	MIA		2		52	PHX	4		
19	ORD		2		53	SFO	4		
20	PBI		2		54	BOS		4	
21	BOS			2	55	DEN		4	
22	BUF			2	56	PHX		4	
23	DEN			2	57	STL		4	
24	OAK			2	58	AUS			4
25	TPA			2	59	MCO			4
26	BOS	3			60	SJU			4
27	CLT	3			61	ABQ	5		
28	DFW	3			62	SAT	5		
29	DTW	3			63	LAS	6		
30	LAX	3			64	SAN	6		
31	MCI	3			65	LAS		7	
32	SJU	3			66	LAX		7	
33	JAX		3		67	PHX			7
34	OAK		3		68	SEA		8	

Appendix 8 List of Airport Codes

Code	Name	City	State
ABQ	Albuquerque International Sunport	Albuquerque	NM
ALB	Albany International	Albany	NY
ANC	Anchorage International	Anchorage	AK
AUS	Austin-Bergstrom International	Austin	TX
BDL	Bradley International	Windsor Locks	CT
BHM	Birmingham-Shuttlesworth International	Birmingham	AL
BNA	Nashville International	Nashville	TN
BOI	Boise Air Terminal	Boise	ID
BOS	Logan International	Boston	MA
BUF	Buffalo Niagara International	Buffalo	NY
BUR	Bob Hope	Burbank	CA
BWI	Baltimore/Washington International Thurgood Marshal	Baltimore	MD
CAK	Akron-Canton Regional	Akron	OH
CHS	Charleston AFB/International	Charleston	SC
CLE	Cleveland-Hopkins International	Cleveland	OH
CLT	Charlotte/Douglas International	Charlotte	NC
CMH	Port Columbus International	Columbus	OH
COS	City of Colorado Springs Municipal	Colorado Springs	CO
CVG	Cincinnati/Northern Kentucky International	Cincinnati	KY
DAL	Dallas Love Field	Dallas	TX
DAY	James M Cox Dayton International	Dayton	OH
DCA	Ronald Reagan Washington National	Washington DC	VA
DSM	Des Moines International	Des Moines	IA
DTW	Detroit Metropolitan Wayne County	Detroit	MI
ELP	El Paso International	El Paso	TX
EWR	Newark Liberty International	Newark	NJ
FLL	Fort Lauderdale/Hollywood International	Fort Lauderdale	FL
GEG	Spokane International	Spokane	WA
GRR	Gerald R. Ford International	Grand Rapids	MI
GSO	Piedmont Triad International	Greensboro	NC
GUM	Guam International	Tamuning	GU
HNL	Honolulu International	Honolulu	HI
HOU	William P. Hobby	Houston	TX
HPN	Westchester County	White Plains	NY
IAD	Dulles International	Dulles	VA
ICT	Wichita Mid-Continent	Wichita	KS
IND	Indianapolis International	Indianapolis	IN
ISP	Long Island MacArthur	Islip	NY
JAX	Jacksonville International	Jacksonville	FL
KOA	Kona International	Kailua Kona	HI
LGB	Long Beach	Long Beach	CA
LIH	Lihue	Lihue	HI
LIT	Adams Field	Little Rock	AR
MCI	Kansas City International	Kansas City	MO
MCO	Orlando International	Orlando	FL
MDW	Midway International	Chicago	IL
MEM	Memphis International	Memphis	TN
MHT	Manchester	Manchester	NH
MIA	Miami International	Miami	FL
Code	Name	City	State
MKE	General Mitchell International	Milwaukee	WI

MSN	Dane County Regional-Truax Field	Madison	WI
MSP	Minneapolis-St Paul International	Minneapolis	MN
MSY	New Orleans International	New Orleans	LA
MYR	Myrtle Beach International	Myrtle Beach	SC
OAK	Oakland International	Oakland	CA
OGG	Kahului	Kahului	HI
OKC	Will Rogers World	Oklahoma City	OK
OMA	Eppley Airfield	Omaha	NE
ONT	Ontario International	Ontario	CA
ORF	Norfolk International	Norfolk	VA
PBI	Palm Beach International	Palm Beach	FL
PDX	Portland International	Portland	OR
PHL	Philadelphia International	Philadelphia	PA
PHX	Phoenix Sky Harbor International	Phoenix	AZ
PIT	Pittsburgh International	Pittsburgh	PA
PNS	Pensacola Gulf Coast Regional	Pensacola	FL
PSP	Palm Springs International	Palm Springs	CA
PVD	Theodore Francis Green State	Providence	RI
PWM	Portland International Jetport	Portland	ME
RDU	Raleigh-Durham International	Raleigh	NC
RIC	Richmond International	Richmond	VA
RNO	Reno/Tahoe International	Reno	NV
ROC	Greater Rochester International	Rochester	NY
RSW	Southwest Florida International	Fort Myers	FL
SAN	San Diego International	San Diego	CA
SAT	San Antonio International	San Antonio	TX
SAV	Savannah/Hilton Head International	Savannah	GA
SDF	Louisville International	Louisville	KY
SEA	Seattle-Tacoma International	Seattle	WA
SJC	San Jose International	San Jose	CA
SJU	Luis Munoz Marin International	San Juan	PR
SLC	Salt Lake City International	Salt Lake City	UT
SMF	Sacramento International	Sacramento	CA
SNA	John Wayne Airport-Orange County	Santa Ana	CA
STL	St Louis International	St. Louis	MO
SYR	Syracuse Hancock International	Syracuse	NY
TPA	Tampa International	Tampa	FL
TUL	Tulsa International	Tulsa	OK
TUS	Tucson International	Tucson	AZ
TYS	McGhee Tyson	Knoxville	TN
ATL	Hartsfield - Jackson Atlanta International	Atlanta	GA
DEN	Denver International	Denver	CO
DFW	Dallas/Fort Worth International	Dallas	TX
IAH	George Bush Intercontinental	Houston	TX
JFK	John F Kennedy International	New York	NY
LAS	McCarran International	Las Vegas	NV
LAX	Los Angeles International	Los Angeles	CA
LGA	La Guardia	New York	NY
ORD	O'Hare International	Chicago	IL
SFO	San Francisco International	San Francisco	CA

Source: FAA

Appendix 9 Probability Calculation Sheet (Airline Choice)

Choice model result		Nonstop flight weekly frequency (FQ) is increased by 7 flights (0 to 7)															
(Model 9)		Case 1				Case 2				Case 3				Case 4			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.9	0.02	0.88	0	0.88	0.02	0.88	0.02	0.9	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0	0	7	0.2	0	0	7	0.18	0	0	7	0.18	0	0	7	0.18
FARE_BUSII	0	0	0	0	0	0	0	0	0	0	0	0	0	179.46	0.88	179.46	0.88
FARE_LEIS	0	179	-0.64	179.46	-0.6	179.46	-0.64	179.46	-0.64	179	-0.64	179.46	-0.64	0	0	0	0
FREEBAG09	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OT_COMD	1.26	0	0	0	0	1	1.26	1	1.26	0	0	0	0	0	0	0	0
OT_BAGD	0.43	0	0	0	0	0	0	0	0	1	0.43	1	0.43	0	0	0	0
OT_BUSI	-0.93	0	0	0	0	0	0	0	0	0	0	0	0	1	-0.93	1	-0.93
FQD_COMD	0.97	0	0	0	0	1	0	1	0.97	0	0	0	0	0	0	0	0
FQD_BAGD	0.73	0	0	0	0	0	0	0	0	1	0	1	0.73	0	0	0	0
FQD_BUSI	0.24	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0.24
Probability		45.56%		54.44%		23.99%		76.01%		28.79%		71.21%		39.81%		60.19%	

Choice model result		Nonstop flight weekly frequency (FQ) is increased by 7 flights (0 to 7)															
(Model 9)		Case 5				Case 6				Case 7				Case 8			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.9	0.02	0.9	0.02	0.88	0.02	0.9	0.02	0.9	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0	0	7	0.18	0	0	7	0.18	0	0	7	0.18	0	0	7	0.18
FARE_BUSI	0	0	0	0	0	179.46	0.88	179	0.88	179	0.88	179.46	0.88	179.46	0.88	179.46	0.88
FARE_LEIS	0	179	-0.64	179	-0.64	0	0	0	0	0	0	0	0	0	0	0	0
FREEBAG09	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OT_COMD	1.26	1	1.26	1	1.26	1	1.26	1	1.26	0	0	0	0	1	1.26	1	1.26
OT_BAGD	0.43	1	0.43	1	0.43	0	0	0	0	1	0.43	1	0.43	1	0.43	1	0.43
OT_BUSI	-0.93	0	0	0	0	1	-0.93	1	-0.93	1	-0.93	1	-0.9	1	-0.93	1	-0.93
FQD_COMD	0.97	1	0	1	0.97	1	0	1	0.97	0	0	0	0	1	0	1	0.97
FQD_BAGD	0.73	1	0	1	0.73	0	0	0	0	1	0	1	0.73	1	0	1	0.73
FQD_BUSI	0.24	0	0	0	0	1	0	1	0.24	1	0	1	0.24	1	0	1	0.24
Probability		13.23%		86.77%		19.97%		80.03%		24.22%		75.78%		10.76%		89.24%	

(Continued)

Choice model result (Model 9)		On-time performance (OT) in increased by 10% (88% to 96%)															
		Case 1				Case 2				Case 3				Case 4			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	179.46	0.88	179.46	0.88
FARE_LEIS	0	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_COMD	1.26	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_BAGD	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.41	0.00	0.00	0.00	0.00
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.90
FQD_COMD	0.97	0.00	0.00	0.00	0.00	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FQD_BAGD	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24
Probability		49.94%		50.06%		47.18%		52.82%		49.01%		50.99%		51.99%		48.01%	

Choice model result (Model 9)		On-time performance (OT) in increased by 10% (88% to 96%)															
		Case 5				Case 6				Case 7				Case 8			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03	0.88	0.02	0.96	0.03
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0	0.00	0.00	0.00	0.00	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88
FARE_LEIS	0	179.46	-0.64	179.46	-0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_COMD	1.26	1.00	1.11	1.00	1.22	1.00	1.11	1.00	1.22	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.22
OT_BAGD	0.43	1.00	0.37	1.00	0.41	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.41	1.00	0.37	1.00	0.41
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.90	1.00	-0.82	1.00	-0.90	1.00	-0.82	1.00	-0.90
FQD_COMD	0.97	1.00	0.97	1.00	0.97	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	1.00	0.97	1.00	0.97
FQD_BAGD	0.73	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	1.00	0.73	1.00	0.73
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24
Probability		46.25%		53.75%		49.22%		50.78%		51.05%		48.95%		48.29%		51.71%	

(Continued)

Choice model result (Model 9)		Airfare (FARE) is decreased by 10% ($179.46 to $161.53)															
		Case 1				Case 2				Case 3				Case 4			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	179.46	0.88	161.52	0.79
FARE_LEIS	0.00	179.46	-0.64	161.52	-0.57	179.46	-0.64	161.52	-0.57	179.46	-0.64	161.52	-0.57	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_COMD	1.26	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_BAGD	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.37	0.00	0.00	0.00	0.00
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.82
FQD_COMD	0.97	0.00	0.00	0.00	0.00	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FQD_BAGD	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24
Probability		48.41%		51.59%		48.41%		51.59%		48.41%		51.59%		52.19%		47.81%	

Choice model result (Model 9)		Airfare (FARE) is decreased by 10% ($179.46 to $161.53)															
		Case 5				Case 6				Case 7				Case 8			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0.00	0.00	0.00	0.00	0.00	179.46	0.88	161.52	0.79	179.46	0.88	161.52	0.79	179.46	0.88	161.52	0.79
FARE_LEIS	0.00	179.46	-0.64	161.52	-0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_COMD	1.26	1.00	1.11	1.00	1.11	1.00	1.11	1.00	1.11	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.11
OT_BAGD	0.43	1.00	0.37	1.00	0.37	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.37	1.00	0.37	1.00	0.37
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82
														-	-	-	
FQD_COMD	0.97	1.00	0.97	1.00	0.97	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	1.00	0.97	1.00	0.97
FQD_BAGD	0.73	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	1.00	0.73	1.00	0.73
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24
Probability		48.41%		51.59%		52.19%		47.81%		52.19%		47.81%		52.19%		47.81%	

(Continued)

Choice model result (Model 9)		Free bag policy (FREEBAG09) is changed (No to Yes)															
		Case 1				Case 2				Case 3				Case 4			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	179.46	0.88	179.46	0.88
FARE_LEIS	0.00	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	179.46	-0.64	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.29	0.00	0.00	1.00	0.00
OT_COMD	1.26	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OT_BAGD	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.37	0.00	0.00	0.00	0.00
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.82
FQD_COMD	0.97	0.00	0.00	0.00	0.00	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FQD_BAGD	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24
Probability		50.00%		50.00%		50.00%		50.00%		42.88%		57.12%		50.00%		50.00%	

Choice model result (Model 9)		Free bag policy (FREEBAG09) is changed (No to Yes)															
		Case 5				Case 6				Case 7				Case 8			
		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Variable	Coeff.	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect	Var.	Effect
OT	0.03	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02	0.88	0.02
FQ	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FARE_BUSI	0.00	0.00	0.00	0.00	0.00	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88	179.46	0.88
FARE_LEIS	0.00	179.46	-0.64	179.46	-0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FREEBAG09	0.29	0.00	0.00	1.00	0.29	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.29	0.00	0.00	1.00	0.29
OT_COMD	1.26	1.00	1.11	1.00	1.11	1.00	1.11	1.00	1.11	0.00	0.00	0.00	0.00	1.00	1.11	1.00	1.11
OT_BAGD	0.43	1.00	0.37	1.00	0.37	0.00	0.00	0.00	0.00	1.00	0.37	1.00	0.37	1.00	0.37	1.00	0.37
OT_BUSI	-0.93	0.00	0.00	0.00	0.00	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82	1.00	-0.82
FQD_COMD	0.97	1.00	0.97	1.00	0.97	1.00	0.97	1.00	0.97	0.00	0.00	0.00	0.00	- 1.00	- 0.97	- 1.00	0.97
FQD_BAGD	0.73	1.00	0.73	1.00	0.73	0.00	0.00	0.00	0.00	1.00	0.73	1.00	0.73	1.00	0.73	1.00	0.73
FQD_BUSI	0.24	0.00	0.00	0.00	0.00	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24	1.00	0.24
Probability		42.88%		57.12%		50.00%		50.00%		42.88%		57.12%		42.88%		57.12%	

Appendix 10 Competing Airports within Consolidated Metropolitan Statistical Areas

CSA	Code	Airport Name
BOSTON	BOS	Boston Logan International Airport
	MHT	Manchester Boston Regional Airport
	PVD	Theodore Francis Green Int'l Airport
CHICAGO	MDW	Chicago Midway International Airport
	ORD	Chicago O'Hare International Airport
CLEVELAND	CAK	Akron Canton Regional Airport
	CLE	Cleveland Hopkins International Airport
DALLAS	DAL	Dallas Love Field Airport
	DFW	Dallas Fort Worth International Airport
DETROIT	DTW	Detroit Metro Wayne County Airport
	FNT	Bishop International Airport
HOUSTON	HOU	William P Hobby Airport
	IAH	George Bush International Airport
LOS ANGELES	BUR	Bob Hope Airport
	LAX	Los Angles International Airport
	LGB	Long Beach Airport
	ONT	La/Ontario International Airport
	SNA	John Wayne Airport
MIAMI	FLL	Fort Lauderdale-Hollywood Int'l Airport
	MIA	Miami International Airport
NEW YORK	EWR	Newark International Airport
	HPN	Westchester County Airport
	ISP	Long Island Mac Arthur Airport
	JFK	John F Kennedy International Airport
	LGA	La Guardia Airport
NORFOLK	ORF	Norfolk International Airport
	PHF	Patrick Henry International Airport
PHILADELPHIA	ACY	Atlantic City International Airport
	PHL	Philadelphia International Airport
SAN FRANCISCO	OAK	Oakland International Airport
	SFO	San Francisco International Airport
	SJC	San Jose International Airport
TAMPA	PIE	St. Petersburg-Clearwater Int'l Airport
	TPA	Tampa International Airport
WASHINGTON	BWI	Baltimore-Washington Int'l Airport
	DCA	Ronald Reagan Washington Nat'l Airport
	IAD	Washington Dulles International Airport

Source: Cho et al. (2012)

Appendix 11 Sample Bias Test for Airport Choice

The test compared the means of the customer characteristics between the population (the whole domestic departing passengers) and the sample (the customers who answered all the questions that are required to test the hypotheses among the population).

- Group Population has all domestic departing observations. Some of them are not included in my sample due to missing values for one of the required variables. It has 36,283 observations.

- Group Sample, which is the sub sample of the Group Population, only includes the observations that have the all required information that is needed to test the hypotheses (business dummy, income, airport access time and distance gap between the 1st closest airport and the 2nd closest airport) It has 9,900 observations.

Variable	Group	Obs	Mean	t value
BUSINESS (dummy)	Population	36,026	0.46	7.2022
	Sample	9,231	0.42	
INCOME ($)	Population	28,483	93,872.50	-4.8868
	Sample	9,231	97,001.95	
ACCESS (to the 1st closest airport, driving min.)	Population	14,284	35.17	-0.0505
	Sample	9,231	35.18	
GAP (between the 1st closest and the 2nd closest airport, driving min.)	Population	14,284	19.37	-9.6228
	Sample	9,231	21.69	

The results show that the means are significantly different between two groups (t values are higher than 1.96) except for airport access time.

Appendix 12 Probability Calculation Sheet (Airport Choice)

Impact of change in access time (ACCESS and GAP) and trip purpose (BUSI) on predicted probability

Choice model result (Model 5)		Base																							
		Case 1						Case 2						Case 3						Case 4					
Variable	Coeff	Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	45.00	-2.77	45.00	-2.77	25.00	-1.54	45.00	-2.77	45.00	-2.77
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.27	1.00	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.48	1.00	-0.48
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Probability		33.33%		33.33%		33.33%		33.33%		33.33%		33.33%		63.16%		18.42%		18.42%		67.97%		16.01%		16.01%	

(continued)

Impact of change in access time (ACCESS and GAP) and trip purpose (BUSI) on predicted probability (continued)

Choice model result (Model 5)		Base																							
		Case 5						Case 6						Case 7						Case 8					
Variable	Coeff	Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	60.00	-3.70	60.00	-3.70	10.00	-0.62	60.00	-3.70	60.00	-3.70
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.48	1.00	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.64	1.00	-0.64
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	1.00	-0.02	1.00	-0.10	1.00	-0.10	1.00	-0.02	1.00	-0.10	1.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	-1.38	1.00	-1.38	1.00	-0.23	1.00	-1.38	1.00	-1.38
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Probability		82.34%		8.83%		8.83%		87.14%		6.43%		6.43%		97.16%		1.42%		1.42%		98.32%		0.84%		0.84%	

(continued)

Impact of change in flight frequency (FQ) on predicted probability

Choice model result (Model 5)		FQ 10% up																							
		Case 1						Case 2						Case 3						Case 4					
Variable	Coeff	Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	45.00	-2.77	45.00	-2.77	25.00	-1.54	45.00	-2.77	45.00	-2.77
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.16	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.16	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.27	1.00	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.48	1.00	-0.48
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Probability		35.69%		32.16%		32.16%		36.03%		31.99%		31.99%		65.55%		17.23%		17.23%		70.51%		14.75%		14.75%	

(continued)

Impact of change in flight frequency (FQ) on predicted probability (continued)

Choice model result (Model 5)		FQ 10% up																							
		Case 5						Case 6						Case 7						Case 8					
Variable	Coeff	Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04	93.83	1.15	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	60.00	-3.70	60.00	-3.70	10.00	-0.62	60.00	-3.70	60.00	-3.70
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.16	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.16	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.48	1.00	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.64	1.00	-0.64
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	1.00	-0.12	1.00	-0.11	1.00	-0.11	1.00	-0.12	1.00	-0.11	1.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	1.00	-0.02	1.00	-0.10	1.00	-0.10	1.00	-0.02	1.00	-0.10	1.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.19	1.00	-0.18	1.00	-0.18	1.00	-0.19	1.00	-0.18	1.00	-0.18
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	-1.38	1.00	-1.38	1.00	-0.23	1.00	-1.38	1.00	-1.38
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Probability		83.66%		8.17%		8.17%		88.31%		5.85%		5.85%		97.39%		1.30%		1.30%		98.48%		0.76%		0.76%	

(continued)

Impact of change in fare (FARE) on predicted probability

Choice model result (Model 5)		FARE 10% down																							
		Case 1						Case 2						Case 3						Case 4					
		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
Variable	Coeff	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	45.00	-2.77	45.00	-2.77	25.00	-1.54	45.00	-2.77	45.00	-2.77
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.51	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.51	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.27	1.00	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.48	1.00	-0.48
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Probability		39.66%		30.17%		30.17%		35.71%		32.15%		32.15%		69.26%		15.37%		15.37%		70.22%		14.89%		14.89%	

(continued)

Impact of change in fare (FARE) on predicted probability (continued)

Choice model result (Model 5)		FARE 10% down																							
		Case 5						Case 6						Case 7						Case 8					
		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
Variable	Coeff	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73	169.02	-2.46	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	60.00	-3.70	60.00	-3.70	10.00	-0.62	60.00	-3.70	60.00	-3.70
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.51	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.51	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.48	1.00	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.64	1.00	-0.64
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	1.00	-1.27	1.00	-1.41	1.00	-1.41	1.00	-1.27	1.00	-1.41	1.00	-1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	1.00	-0.02	1.00	-0.10	1.00	-0.10	1.00	-0.02	1.00	-0.10	1.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.04	1.00	1.16	1.00	1.16	1.00	1.04	1.00	1.16	1.00	1.16
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	-1.38	1.00	-1.38	1.00	-0.23	1.00	-1.38	1.00	-1.38
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Probability		87.59%		6.20%		6.20%		89.66%		5.17%		5.17%		97.57%		1.22%		1.22%		98.30%		0.85%		0.85%	

(continued)

Impact of change in access time (ACCESS) on predicted probability

Choice model result (Model 5)		Access 1 minute down																							
		Case 1						Case 2						Case 3						Case 4					
Variable	Coeff	Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	24.00	-1.48	25.00	-1.54	25.00	-1.54	24.00	-1.48	25.00	-1.54	25.00	-1.54	24.00	-1.48	45.00	-2.77	45.00	-2.77	24.00	-1.48	45.00	-2.77	45.00	-2.77
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.26	1.00	-0.27	1.00	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.26	1.00	-0.48	1.00	-0.48
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Probability		34.72%		32.64%		32.64%		34.96%		32.52%		32.52%		64.58%		17.71%		17.71%		69.53%		15.24%		15.24%	

(continued)

Impact of change in access time (ACCESS) on predicted probability (continued)

Choice model result (Model 5)		Access 1 minute down																							
		Case 5						Case 6						Case 7						Case 8					
Variable	Coeff	Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C		Airport A		Airport B		Airport C	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	9.00	-0.55	45.00	-2.77	45.00	-2.77	9.00	-0.55	45.00	-2.77	45.00	-2.77	9.00	-0.55	60.00	-3.70	60.00	-3.70	9.00	-0.55	60.00	-3.70	60.00	-3.70
LCC	1.182	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.10	1.00	-0.48	1.00	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.10	1.00	-0.64	1.00	-0.64
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	1.00	-0.02	1.00	-0.10	1.00	-0.10	1.00	-0.02	1.00	-0.10	1.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.21	1.00	-1.38	1.00	-1.38	1.00	-0.21	1.00	-1.38	1.00	-1.38
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Probability		83.25%		8.37%		8.37%		87.96%		6.02%		6.02%		97.39%		1.31%		1.31%		98.47%		0.77%		0.77%	

(continued)

Impact of change in LCC presence (LCC) on predicted probability

Choice model result (Model 5)		LLC Nonstop service presnece																							
		Case 1						Case 2						Case 3						Case 4					
		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3	
Variable	Coeff	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	25.00	-1.54	45.00	-2.77	45.00	-2.77	25.00	-1.54	45.00	-2.77	45.00	-2.77
LCC	1.182	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.27	1.00	-0.27	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.27	1.00	-0.48	1.00	-0.48
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Probability		61.97%		19.01%		19.01%		56.51%		21.74%		21.74%		84.82%		7.59%		7.59%		84.65%		7.67%		7.67%	

(continued)

Impact of change in LCC presence (LCC) on predicted probability (continued)

Choice model result (Model 5)		LLC Nonstop service presnece																							
		Case 5						Case 6						Case 7						Case 8					
Variable	Coeff	Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3		Alternative 1		Alternative 2		Alternative 3	
		Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect	Variable	Effect
FQ	0.012	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04	85.30	1.04
FARE	-0.015	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73	187.80	-2.73
ACCESS	-0.062	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	45.00	-2.77	45.00	-2.77	10.00	-0.62	60.00	-3.70	60.00	-3.70	10.00	-0.62	60.00	-3.70	60.00	-3.70
LCC	1.182	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00	1.00	1.18	0.00	0.00	0.00	0.00
BUSI_FQ	0.002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.15	1.00	0.15	1.00	0.15
BUSI_FARE	0.009	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.68	1.00	1.68	1.00	1.68
BUSI_ACCESS	-0.011	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.48	1.00	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.11	1.00	-0.64	1.00	-0.64
BUSI_LCC	-0.226	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	0.00	1.00	0.00
G3045_FQ	-0.001	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	1.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_FARE	-0.008	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	1.00	-1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_ACCESS	-0.002	1.00	-0.02	1.00	-0.10	1.00	-0.10	1.00	-0.02	1.00	-0.10	1.00	-0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G3045_LCC	0.632	1.00	0.63	1.00	0.00	1.00	0.00	1.00	0.63	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G45_FQ	-0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18	1.00	-0.18
G45_FARE	0.006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16	1.00	1.16
G45_ACCESS	-0.023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.23	1.00	-1.38	1.00	-1.38	1.00	-0.23	1.00	-1.38	1.00	-1.38
G45_LCC	-0.171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-0.17	1.00	0.00	1.00	0.00	1.00	-0.17	1.00	0.00	1.00	0.00
Probability		96.62%		1.69%		1.69%		97.07%		1.46%		1.46%		98.95%		0.53%		0.53%		99.22%		0.39%		0.39%	

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