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Impacts of Airport Value-added on Passenger Traffic

A quantitative analysis of hub airports at the aggregate level

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Abstract

With the emergence of intensified competitive market and commoditization of the airport offering, Air passengers' perception towards the different quality of airport service and amenity provided by a certain airport are one of the significant determinants of airport choice. Many airport authorities have been concentrating on delivering the best customer experience to their passengers. One of those strategies is to add value to the airport through the enhancement of airport service and amenities. Such strategies are found to enlarge customer experience, satisfaction, and attract more passengers. This paper, consequently, has tried to scrutinize the effects of airport value-added on passenger traffic at the aggregate level by using the OLS estimator of a multiple linear regression with employing the differences in airport rating stars as a proxy of the different level of airport value-added, and passenger traffic as a proxy of the airport which is selected by passenger from their airport choice. The results suggest that adding value to the airports significantly increases passenger traffic. Besides, this study found that terminal comfort and cleanliness significantly influence passenger's airport choice the most by showing through the highest incremental of passenger traffic.

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Table of Abbreviations

B	
B2B	Business-to-business
B2C	Business-to-consumer
C	
CDG	Paris Charles de Gaulle Airport
G	
GDP	Gross domestic product
H	
H0	Null hypothesis
HA	Alternative hypothesis
J	
JFK	John F. Kennedy International Airport
L	
LCC	Low-cost carriers
M	
MNL	Multinomial logit choice model
O	
OLS	Ordinary Least Squares regression
OVB	Omitted variable bias

1. Introduction

Since the success of the world's first sustained heavier-than-air flight was invented by the Wright brothers in 1903, this breakthrough has laid the foundation for what recently is one of the essential means of transport in the 21st-century transportation industry—air transport. Especially the leapfrogged success in invention and development of transport capabilities of the Funkers F.13—the world's first all-metal transport aircraft—produced by the Dutch Fokker company in 1919 and a usage of airliner, a type of aircraft intended for transporting passengers or cargo in commercial service, by KLM Royal Dutch airline in the following two years have had a significant impact on global society, politics and world economic prosperity (Bernado, 1968).

Over a century, the aviation industry has grown remarkably. From a long-term historical perspective, aviation has doubled in size every fifteen years. In 2016, there are approximately 3.8 billion passengers annually carried by airlines worldwide in about 35 million scheduled commercial flights on 54,000 routes. Generating USD 7.1 trillion revenue passenger kilometers and creating the total economic impact of the global aviation industry of USD 2.7 trillion or approximately 3.5 percent of the world's gross domestic product (GDP) in 2014 (International Civil Aviation Organization [ICAO], 2017). Every day, around 100,000 flights are carrying more than 10 million passengers to over 3,900 destinations worldwide. According to the International Air Transport Association (IATA), by 2034, increasing demand for air transport volumes is estimated to more than doubled, which are characterized by 4.5 percent annual growth of air passenger and 4.2 percent yearly expansion of cargo. If this projected growth is achieved, in the next 15 years, the aviation industry will generate a total economic value of USD 5.9 trillion, and this can account for 122 percent increases in the world's GDP from 2014.

Moreover, since 2008, air travel fare has been steadily decreased by approximately 0.9 percent annually, mostly due to the impact of low-cost carriers (LCC) on market competition, especially in an emerging market that is driven by the LCC segment. This decrease in cost has transformed aviation from a luxury commodity to an affordable means of transport, enabling more accessibility of air travel and a more significant number of air passengers (ICAO, 2017).

Because of the exponential projected growth of aviation, the air transport industry competition has intensified than it has ever been (Spicer, 2018). Thus, not only airlines strategically compete in attracting more passengers and gaining the market share but also airports.

Airports are an essential center of the air transport industry. It serves air passengers a terminal for departure and arrival. Airports, as similar to general firms in other sectors, have to strategically manage their business by attracting and accommodating sufficient passengers to at least break-even point to existing in the market. Airports compete in origin, destination as well as transfer passengers—who contribute a large portion of the airport's profit (Chung, Lee, & Jang, 2017). One of many strategies airport authorities has focused on is to become a competitive hub in the region—particularly in the multi-airports area where the degree of competition in becoming a leading hub airport has become increasingly intensified as hub airports are such powerful platforms that enable airlines to enlarge their networks and hence attract customer recognition easily. Consequently, it leads to an increase in the number of origin, destination, and transfer passengers. The examples are in Dubai, Abu Dhabi, and Doha—these hub airports are all located in low population countries. However, these airports are categorized as the world's busiest airports, which are built upon the idea of the hub in attracting transfer passengers (ACI Europe Airport Business, 2019). Besides the geographical comparative advantage that supports those airports to become regional air transport hubs, i.e., Persian Gulf hub (Dubai, Doha, and Abu Dhabi), Turkey hub (Istanbul), European hub (Frankfurt, Paris-CDG, Amsterdam-Schiphol, London Heathrow, and Munich), and North East Asian hub (Incheon, Tokyo-Narita, Hong Kong, and Pudong). Many leading hub airports emphasize the reputation of their brand as a distinctive instrument in influencing customer recognition. A greater airport brand recognition from customers, therefore, enhances larger airport's competitive advantage, customer experience, and profitability (Chung, Jang, & Han, 2013).

Every year Skytrax, an international aviation rating organization, announces the world's best airports with the airport rating, which is derived from the airport customer satisfaction survey. The survey was conducted among 13.73 million passengers covered over 100 customer nationalities on 550 airports worldwide. It evaluates traveler experiences covering

different airport products and services attributes—from the accessibility of public transportation to the airport, check-in process, immigration, transfers, security, arrivals, shopping, cafeterias, through departure at the gate. The evaluation of satisfaction survey is finalized in certified airport ratings ranging from 1-star through to the prestigious 5-star rating in which it reflects customer experience, customer value, and underlines the performance of airport service and amenity quality provided by the airport (Skytrax, 2019).

Many airport authorities see the importance of this certified airport rating in becoming a leading world-class airport in the industry. To achieve that, the airport authorities have delivered the best customer experience through the enhancement of the quality in their services and amenities, i.e., infrastructure improvements, ground transportation accessibility improvements, availability of internet access, variety and quality of concessions, airline lounges, terminal comfort and cleanliness, and security issues (Graham, 2003). These enhancements in the airport's services and amenities quality are described as *'value-added'* to the airport, such that it has a significant effect on customer recognition and customer satisfaction that may influence passengers' determining choices to select one airport or another. This consequence can be observed from the changes in the passenger traffic (Parrella, 2013). Some airport authorities go beyond the airport's core value[1] by developing unique airport services and amenities with the extraordinary airport's features that aimed to create a differentiated customer experience, which consequently enhances customer recognition and satisfaction. Singapore Changi Airport, for example, has recently opened its architectural masterpiece complex named the Changi Jewel. The complex responds to the customer's modern lifestyle, with attractions including the world's tallest indoor waterfall, multi-screen IMAX cinema, butterfly garden, and 280 retail spaces. Korea's Incheon International Airport offers a global shopping destination. Munich Airport offers a unique Bavarian experience to its passengers at the airport beer-garden, which reflects German drinking culture. These airports have embodied their unique city characteristics in enhancing airport brand value through services and amenities, thus attracting customer recognition and improving customer satisfaction. Hannah Powlesland (2018), a design's

[1] The core value is the fundamental level of product where it encloses the essential benefits the customer is seeking for when purchasing the product. The airport industry provides the core value to its customers, as the ability to board and debark the aircraft safely (Halpern & Graham, 2013).

general manager of Hamad International Airport, Doha, Qatar, pointed airport brand recognition out that "An airport that concentrates on the physical environment and services within the airport will enjoy greater levels of positive brand recognition." (Airport technology, 2018). As a result of airport enrichment, making such airports ranked on both the world's best airport and the world's most influential airport brand in 2019 (Brand Finance, 2019; Skytrax, 2019). The achievement in adding value to the airport through the enhancement of the quality of airport's services and amenities seems to have substantial impacts on customer recognition, experience, and satisfaction that is further likely to influence customer choice of choosing one airport or another. The emphasized studies towards the effects of airport value-added on passengers' behavior of choosing airport have not yet been explored extensively, compared to the studies regarding passengers' airport choice factors. Therefore, there is a need for more research on such a topic. Thus, the central question of this research is

"How does value-added to airports through the enhancement of the quality of airport's services and amenities, presented in 1-star to 5-star airport rating, affect the passenger traffic of hub airports at the aggregate level?"

As many research studies have argued and suggested that the perceptions of airport value-added affect customer experience and customer satisfaction, which consequently impacts the behavior of passengers. Therefore, the evaluation of airport value-added has become an essential issue for airport authorities in perceiving passengers' perspective towards airport choice and assigning proper strategies (Anderson, 1993; Yeh & Kuo, 2003).

The purpose of this research is to examine the impacts of airport value-added, through the enhancement of the quality of airport services and amenities, on passenger traffic. The research also investigates the effects of airport service and amenity attributes on the number of passengers. It is most likely to assume that airport value-added positively relates to passenger traffic. Accordingly, it would provide practical information regard to airport value-added to airport managers in adjusting their operational strategies to sustain competitive advantage, including enhancing airport brand value, customer experience, and profitability. This research is structured as follows; the discussion of the relevant theories and previous studies that have dominated this paper is in Chapter 2, Chapters 3 provides information regarding data and methodology, Chapter 4 presents the findings, Chapter 5 is the

interpretation and the discussion of the finding, and lastly, Chapter 6 is the conclusion of this study with limitations and suggestions for further research.

2. Theoretical framework

Numerous studies argue that the primary drivers behind an individual's choice of the airport are services offered by the airport (Graham, 2003). In a decision-making process of airport choice, air passengers select an airport that provided them the most customer value, where the customer value is the satisfaction customer experiences at the airport relative to costs (Woodruff, 1997). One of the most extensive tools that have been executed by many airport authorities and directly enhances customer satisfaction is to deliver the best airport experience to its passengers (Graham, 2003). Such a tool has been performed by adding extraordinary attributes to the product and service of the airport called '*airport value-added.*' The studies show that adding value to the airport will raise customer satisfaction, such an achievement enlarges customer value, increases airport competitive advantages, and attracts more passengers (Halpern & Graham, 2013). Therefore, the conceptual framework of this research is proposed as follows:

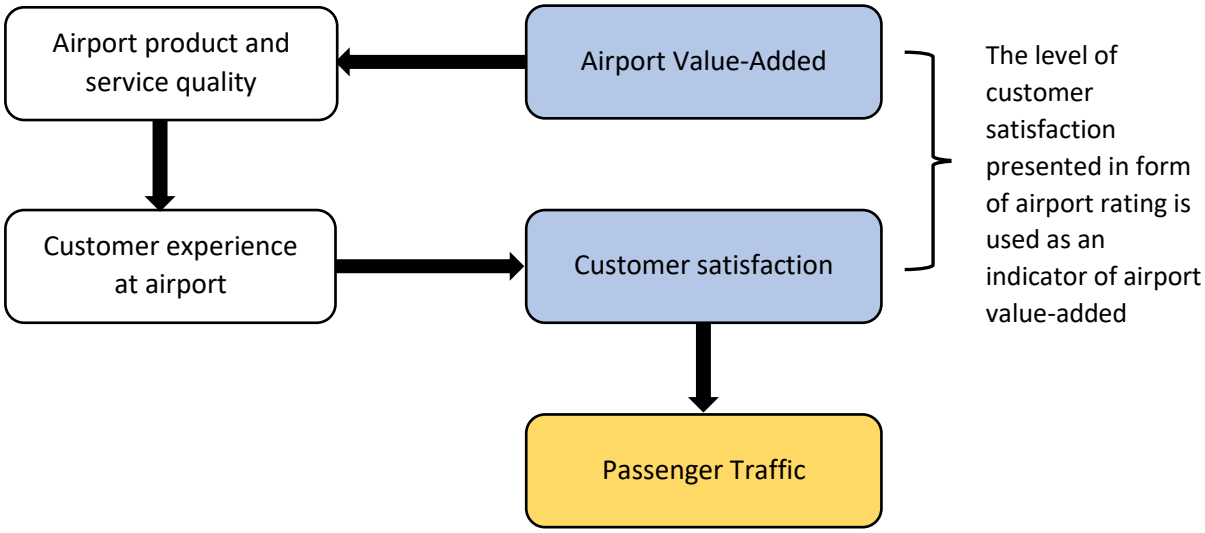

Figure 2.1 Conceptual framework. Adding value to the airport product and service quality positively increases the customer experience at the airport. Positive or excellent customer experience results in a high or satisfied customer satisfaction level, whereas negative or bad experiences customers received leads to a lower or dissatisfied customer satisfaction level. An increase in customer satisfaction enlarges customer value, resulting in attracting more passengers. Therefore, airport value-added leads to a rise in customer satisfaction, customer value, and passenger traffic (Halpern & Graham, 2013).

To fully understand the impacts of airport value-added on passenger traffic, the structure of theoretical framework begins with relevant literature reviews regarding the influential determinants of airport choice and decision-making process, followed by passengers' perception of airport service quality, the notion of customer value hierarchy, and the definition of airport value-added, as well as the proposed hypotheses, respectively.

2.1 Passengers' determinants of airport choice and decision-making process

Despite the influential determinants of airport choice are different and vary according to each passengers' unique consideration. Many current studies demonstrate that there are common determinants of airport choice that heavily influence each individual's decision of selecting to use one airport or another. These common determinants of airport choice, which dominate numerous literatures such as an empirical analysis of airports and airlines choice in multiple-airport region of the San Francisco bay area by Pels, Nijkamp, and Rietveld (2001), a study of determinants of airport choice in a multi-airport area by Blackstone, Buck, and Hakim (2006), an application of mixed logit modeling of airport choice in multi-airport regions by Hess and Polak (2005), and a research of multi-airport choice models for the New York Metropolitan area by Luken and Garrow (2011), can be categorized into two fundamental airport choice factors; (1) Air service quality-related factors (i.e., flight frequency, accessibility to the airport, availability of flight, travel destinations and routing, frequent flyer membership, aircraft type, and airport service quality), and (2) Price-related factors (i.e., airfares, airport landing charges, airport charge to passenger, and taxations).

In making such decisions of airport choice, passengers always compare their perceived benefit or expected value that they will obtain from choosing one airport to other similar airport choices. The perceived benefit or expected value is the level of satisfaction passengers experience or expect to receive when purchasing airport products or services relative to the costs of purchasing. The factors that influence airport choice could be seen as the costs of purchasing, such as price-related factors. Besides, air service quality-related factors are also considered as costs because of the time and the convenience that each passenger must forfeit in order to complete a trip. Thereby among the potentially available airport choices, rational passengers will select the airport, which provides them the most perceived benefit or the highest expected value (Woodruff, 1997). Parrella (2013) indicates that the air passengers'

decision-making process starts with an evaluation of travel choices via various available sales channels offered in the market. These sales channels include, for example, official airline websites, third-party websites, and travel agencies. In general, the determination of sales channels is made together with the availability of service options (i.e., carriers, routing, and airport(s) available for departure and travel destination) provided by each sales channel. Once a decision of sales channels along with service options is made, the customer will start making fare comparisons followed by perceived benefit or expected value comparisons. Figure 2.2 demonstrates the customer's airport choice decision-making process.

Figure 2.2. Customer's airport choice decision-making process. Reprinted from Understanding Airline and Passenger Choice in Multi-Airport Regions (p. 13), by B.C. Parrella, 2013, Washington D.C.: The National Academy of Sciences. Copyright 2013 by the National Academy of Sciences.

Price-related factors are generally understood to be the primary determinant of passengers' airport choice, particularly in a multi-airport region. However, when making such a decision, price-related factors are not solely taken into consideration. Customers also consider other air service quality-related factors—including air service availability, itineraries, schedules, airport convenience, airport and airline quality, and loyalty programs—together with price-related factors, and often do not weigh these determinants equally and isolated from each other (Parrella, 2013). The following are the main five common determinants of airport choice summarized from various literature:

2.1.1 Airfares

Several pieces of research show that airfares are known to be the most direct influential determinants for passengers in choosing to use one airport or another. Blackstone et al. (2006) have conducted 1,100 phone surveys about air travel behavior and airport usage from participants in the market region of Philadelphia International Airport. The empirical study indicates that among eight important factors in airport choice, airfares significantly influence passengers' consideration. The significant effects of airfares are found to have the most impact on the usage of the four available airport choices (Baltimore-Washington International, Newark International, JFK International, and Philadelphia International Airport), compared to other factors. Such results are also found according to the research by Suzuki et al. (2003). However, Hess and Polak (2005) found that airfares are only significant for leisure travelers and low-income business-purposed passengers. While in the following year, Hess and Polak (2006) argued that airfares were found to have little effect on airport choice when using the data from the greater London area.

2.1.2 Flight frequency and connectivity

In general, passengers have favorable preferences on the airport that provides them greater flexibility in departure and arrival times, multiple flight frequencies, routing, a large number of destinations, and excellent connectivity (Parrella, 2013). Hess and Polak (2005) discovered that larger airports are preferred by some passengers over smaller airports, as the larger airports offer more flight frequency and connectivity. In case of unexpected events, such as missing the flight, passengers can choose alternative flights to the same destination within the same day. Furthermore, passengers can choose alternative nearby destination airports or other flight alternatives that are provided by different airlines. Similar to Harvey (1987) that flight frequency, the number of operating airlines and its connectivity were found to have a significant impact on both leisure and business passengers.

2.1.3 Accessibility

Parrella (2013) defines accessibility as the distance and time in which passengers can access the airport from their residence or business area. Hess and Polak (2005, 2006) and Ishii et al. (2009) found that access time is a significant variable affecting the choice behavior of

passengers in the San Francisco bay area. Passengers energetically sensitive to this factor and are more likely to trade higher airfares for less travel duration.

2.1.4 Nonstop flights

Warburg, Bhat, and Adler (2006) have constructed the model of passengers' flight choice behavior. The study shows that, on average, passengers are willing to pay approximately 69 U.S. dollars more for a nonstop flight compared to a connecting flight itinerary as nonstop flights reduce travel duration and unexpected event of missing a connecting flight. The study, moreover, found that business travelers are more likely to pay a premium with higher airfares traded for nonstop flights. Contrary to leisure travelers, they are willing to exchange an inconvenience of connecting flight schedules for a lower airfares flight.

2.1.5 Airport service quality

A large number of empirical research literature which involved the modeling of airport choice in multi-airport regions does not address whether the quality of airport service is a significant determinant in influencing passenger decisions (Skinner, 1976; Hayvey, 1987; Pels et al., 2001; Hess and Polak, 2005, 2006; Ishii et al., 2009). This is because many of the research does not consider the airport service quality as an influential impact on air travel behavior. Therefore, excluded this factor in the airport choice model. Skinner (1976), one of the first studies conducted a multinomial logit (MNL) for airport choice, included only (1) ground accessibility and (2) level of service associated with the air carrier, in the MNL model. The similar approaches are found in the study of airport choice in the San Francisco Bay area by Hayvey (1987), Pels et al. (2001), Hess and Polak (2005), and Ishii et al. (2009). The studies commonly found that airfares, flight frequency, and access time are significant factors of airport choice. However, Suzuki et al. (2003) argue that when including the airport service quality factor in the model, access time is no longer a significant factor. They further added variables which are associated with passengers' experience at the airport such as facilities, parking fee, quality of concessions and shopping, and restaurants, in the airport choice model. The study shows that such passengers' experience-related variables play an essential role in passengers' airport choice. Similarly, Zhang and Xie (2005) found that airfares, flight frequency, and the experience at the airport are the strongest determinants of airport choice in the Golden Triangle Regional Airport in Mississippi. Lian and Ronnevik (2011) also correspondingly found

that airport service quality plays a part in passengers' airport choice, as they argue that travelers are willing to travel a longer distance and more considerable access time for a higher level of service offered by the larger airport.

2.2 Passengers' perception of airport service quality

Numerous studies have examined that airport service quality has an influential impact on passenger's choice of the airport since passengers' perception of airport service quality positively enhances customer satisfaction. An essential aspect of the airport service quality is the passengers' perception of the servicescape, the physical environment of the building where service can be delivered. To maximize the service quality, the airport, therefore, requires an appropriate design that supports its user's perception of visual attractiveness, functionality, convenience, comfort, and efficiency. Several essential attributes of airport service quality that play a role in both increases and decrease the passenger's satisfaction level are information convenience, efficient security and check-in process, signage and orientation, and terminal amenities and comfort (Chen & Chang, 2005; Correia et al., 2008, De Barros et al., 2007). More specifically, Fodness and Murray (2007) advised that intuitive signage and comfort building amenities are the first two factors considered to accommodate the demand for transfer passengers. Correia et al. (2008) measured the overall satisfaction level of service at San Paulo airport terminals by using walking distance, terminal space, availability of airport information, number of seats at the departure area as an indicator. As a consequence, the study introduces a rubric for measuring the level of service quality at the airport terminal. Mikulic and Prebezac (2008) found that building comfort and availability of various shops and restaurants have a substantial effect on overall passenger satisfaction. Nevertheless, the substantial effect of these factors on overall satisfaction is not comprehensively studied. Bogicevic et al. (2013) underline in the journal of tourism that air travelers are recently revealed to several service attributes that could help them to differentiate the performance of and the expected benefit from the chosen airport. The performance and the quality of airport product or service provision by the airport operators are measured by using passenger's satisfaction level as an indicator.

According to Fuller and Matzler (2008) and the two-factor job satisfaction theory by Herzberg (2017), the notion of customer satisfaction is mainly categorized into two components; (1) *Satisfiers* refer to product or service attributes that generate an intense satisfaction when executed well and lead to a compliment behavior; however, satisfiers does not cause dissatisfaction when the performance is decline. Contrarily, (2) *Dissatisfiers* are the attributes of a product or service that cause dissatisfaction and conduct to a complaining behavior when the performance is reduced. Nevertheless, dissatisfiers do not create complementary behavior when well performed.

Bogicevic et al. (2013) studied the drivers of passenger satisfaction and dissatisfaction from 1,095 traveler comments posted in the airport review website from 2010 to 2013. The study indicates that cleanliness and a pleasant environment in the airport terminal are the essential satisfiers. In contrast, security-check procedure-related factors mainly related to staff behavior such as rudeness and unprofessional are the major dissatisfiers in the airport setting, followed by confusing signage, and inadequate restaurant offers.

2.3 Customer value hierarchy and airport value-added

In the principal of marketing, customer value hierarchy, also known as the levels of product and service, is an advantageous system that is implemented by many both small and large businesses as an instrument of determining customer satisfaction. Many businesses recently have shifted their focus to an evaluation of customer satisfaction in which it provides a means in achieving repeat sales, measuring customer loyalty, gaining more considerable competitive advantages and a portion of market share in the industry, and maximizing profitability (Parasuraman, 1997).

According to Woodruff (1997), customer value is the satisfaction the customer experiences or expects to receive after making an action relative to the costs of the action. The given action generally refers to purchase for goods or services; however, it could be a visit or sign up for a vote. While the costs of action could be anything, customers must give up in order to obtain the desired benefits. The customer does not consider the perceived value or the forfeited cost only in terms of monetary spend, but also consider the time it takes to receive the benefits of any given action. In an airport context, the customer value could refer to the

satisfaction passengers feel, experience or expect to receive after making a purchase for airport products and services, traditionally refers to an airline ticket for traveling, at both landside and airside areas of the airport relative to money and time passengers spend in order to complete a trip. Thereby, adding value to the airport products and services is very important as it provides potential passengers with extra features that enlarge the perception of value and satisfaction, thus, enhances customer value (Halpern & Graham, 2013).

The term *'value-added'* conceptualized from the principal of marketing describes a competitive advantage that a product or service obtains by being enhanced with extraordinary features, aimed at differentiating the product or service from its competitors and making it more attractive to customers. The simplified approach of 'value-added' is furthermore adopted by many firms that compete in product or service, which is considered homogeneous—with small differences from that of competitors (Kotler & Armstrong, 2010). Therefore, the term *'airport value-added'* in this research context is defined as the enhancement of airport products and services—particularly the enhancement of airport operations, services, and amenities with special features—by the airport authorities to increase the value of product or service. The goal of adding value to the airport is to increase competitive edge over its rival airports, attract more passengers, and acquire a more significant portion of market share in the aviation industry. The achievement of adding value to the airport could be measured by an increase in passengers' satisfaction level or a rise in customer value, and a rise in the number of passengers which is the consequence of an increase in passengers' satisfaction level (Halpern & Graham, 2013). Thus in this research, the level of customer satisfaction demonstrated in the form of airport rating is used as an indicator of airport value-added, while passenger traffic is applied as a proxy of the goal of adding value to the airport, which is attracting more passengers.

Philip Kotler (2008), the father of modern marketing, proposed customer value hierarchy into five product levels. In his marketing principle states that every product or service has five different product levels. Each product level enhances customer value. The airport industry provides business-to-consumer (B2C) products to satisfy passengers' needs, while it offers business-to-business (B2B) products to airlines (Dibb, Simkin, Pride, & Ferrell, 2006). The five

product levels with examples of the business-to-consumer product provided by an airport industry comprise as follows (see also Figure A1, Appendix A):

2.3.1 The core benefit

The core benefit is the fundamental level of product where it encloses the essential benefits the customer is seeking for when purchasing the product. The airport industry provides the core benefit to its customers, as the ability to board and debark the aircraft safely (Halpern & Graham, 2013). While Jarach (2017) views the airport core benefit as being to transfer passengers and goods from one place to another place.

2.3.2 Basic or generic product

The basic or generic product is the second product level that the marketer turns the core benefit into a basic product. The basic product contains only those attributes or characteristics that are compulsory for the product to function efficiently. Thus, the airport includes a counter check-in, gate, baggage claims, and other attributes such as customs and immigration control that enables passengers to attain their boarding or to debark the aircraft. The basic airport product also includes sufficient informational provision regarding flight and transport services from and to the airport and other fundamental amenities, for instance, information desk, waiting area, and toilet (Halpern & Graham, 2013).

2.3.3 Expected product

At this third product level, marketer prepares a set of attributes and conditions that customers usually expect and correspond when purchasing products or services. Passengers minimally expect the ease of transfer between aircraft, quick baggage claims, on time and correct announcement information, clean and spacious airport terminal, safety security, comfortable and convenient amenities, and the full range diversity of concessions, shops, restaurants, and other commercial facilities.

2.3.4 Augmented product

The augmented product includes extraordinary features, values, benefits, and attributions or related services that aimed to differentiate products and services from the competitors. Marketers could prepare a service that exceeds customer expectations. The augmented product includes not only the traditional commercial stores such as duty-free shops and

various kinds of catering, but also leisure, entertainment, cosmetic, and wellness amenities. An example of airport augmented product is sleeping space with availability of bed for transit passengers, a provision of city tour, product and service standardization, massage chair, lightness and fragrant terminal, spas and salons, and quality of services such as smile, care, respect, and making feel important of every step of service. At this augmented product level, the airport typically puts much effort in order to gain a competitive edge over its rivals. Therefore, there is a significant number of competitions that take place at this level (Halpern & Graham, 2013). Singapore Changi Airport, for instance, offers several kinds of tours to its passengers at no additional cost. This offer has its goal to attract more transit passengers, which compete with its neighbour airports Kuala Lumpur airport, Malaysia, and Bangkok Suvarnabhumi airport, Thailand (Changi airport group, 2019). This similar approach also adopted by many airports such as in the north-eastern Asian aviation market, Korean Incheon airport, Tokyo Narita airport, and Taipei Taoyuan airport, all of these airports offer city tour and heavily invested extraordinary features that exceed passengers' expectations (Halpern & Graham, 2013). Helsinki Airport, Finland, introduces an open relaxation area, which includes sleeping tubes and comfortable seating pods for passengers to take a rest. Seattle-Tacoma International Airport, Seattle, Washing, initiated 'Experience the city of music,' the result of initiation shows an increase in perception of impressive customer experience at the airport, and a rise in customer satisfaction to 4.14 out of 5 in the airport service quality score (Initiatives, 2014).

2.3.5 Potential product

The last level of the five product levels is the potential product. At this level, marketer includes all the potential augmentations and transformations which the product undertakes in the future. For instance, massage pool, honeymoon space for couple travelers, audio anniversary messages and cakes, souvenirs model, playing area for children, entertainment materials, etc. The empirical airport potential products that have been implemented are the butterfly garden, indoor waterfall, and multi-screen IMAX cinema by Singapore Changi Airport (Changi airport group, 2019).

Among the five product levels, the augmented product level has empirically shown to have the most concentration by the airport authorities worldwide. Halpern and Graham (2013)

demonstrate that adding value to the airport product at this level—augmented product level—overall enhances the most exceptional customer experience and the perception of airport value. However, the extraordinary features added to augmented product level only play a small role in influencing a passenger's choice of airport compared to the expected product level because the augmented product are not considered to be essential. The absence of augmented product does not lower customer value, but the present of it enhances satisfaction (Fuller & Matzler, 2008). Such amenities are significant in generating non-aeronautical revenues for the airport. Besides, when making an airport choice, passengers firstly consider and compare the expected value of the expected product level, he or she will receive. Since most airports mutually provide the product at this product level to its passengers without deficiency, whereas augmented product varies according to each airport and is only provided by some airports. The expected product level can be considered as an essential attribute that serve homogeneous product, thereby, adding value through exclusive features, attributes, designs, and service quality, dramatically increases customer value and significantly influences a passenger's airport choice (Halpern & Graham, 2013; Forsyth et al., 2016; Jarach, 2017). Therefore, the research mainly emphasizes the importance of adding value to the airport attributes, which relate the expected product level.

To recap, this study aims to investigate the impacts of airport value-added—through the enhancement of airport products, services, and amenities—on passenger traffic. Where the level of customer satisfaction demonstrated in the form of airport ratings from 1-star to 5-stars are used as an indicator of the different level of airport value-added, while passenger traffic is used as an impact of adding value to the airport and as a proxy of airport choice that being selected by air travelers. Moreover, the study also examines at which airport service and amenity attribute that affects the passengers' choice of choosing airport the most. As suggested by the relevant literature review, the research proposed two hypotheses as follows:

Hypothesis 1: "Airport rating significantly increases passenger traffic."

The first hypothesis concerns the effects of airport value-added on passenger traffic. As explained in section 2.3, the goal of adding value to the airport is to increase customer satisfaction, and that eventually attracts more passengers.

***Hypothesis 2**: "Airport rating in terminal comfort and cleanliness affects passenger traffic the most."*

The second hypothesis attempts to identify at which airport service and amenity attribute that affects the passengers' choice of choosing airport the most. Refer to section 2.2, Bogicevic et al. (2013) found that cleanliness and pleasant environment in the airport terminal is the essential satisfiers. Therefore, terminal comfort and cleanliness is forecasted to be the attribute that affects passenger traffic the most.

3. Data and Methodology

3.1 Research Data

The purpose of this quantitative research is to scrutinize the impacts of value-added to the airport—through the enhancement of airport products, services, and amenities—on passenger traffic. Furthermore, to examine at which airport service or amenity attributes that affects the passengers' choice of choosing airport the most. To answer the research question and to test the hypotheses, several relevant cross-sectional data were derived from different sources, regarded the information in the year of 2018. Due to the reason that the data in the year of 2018 is the most recent data available for all relevant variables, more importantly, the information of airport ratings—the variable of interest of this research—is published and can be collected only in the year of 2018. In this chapter, the definition of response and explanatory variables are given first, followed by descriptive statistics.

3.1.1 Response variable

Passenger traffic. Passenger traffic is the response or dependent variable of this research; it is defined by the sum of the number of enplaning (embarking) and deplaning (disembarking) passengers at an airport, including transfer passengers; passengers who arriving and departing on a different aircraft, or on the same aircraft carrying different flight numbers which are counted twice: upon arrival and departure. The passenger traffic excludes passengers who remain on-board and are continuing their trip (Airport Council International [ACI], 2012). The cross-sectional data of the passenger traffic is derived directly from the official annual report of 68 hub airports in the year of 2018, where the hub airports are airports that used by one or more airlines as a central transfer point enabled airlines to

concentrate their passenger traffic and flight operations (Stephen, 2008). The selected hub airports are specified based on Skytrax organization (see Table B1, Appendix B).

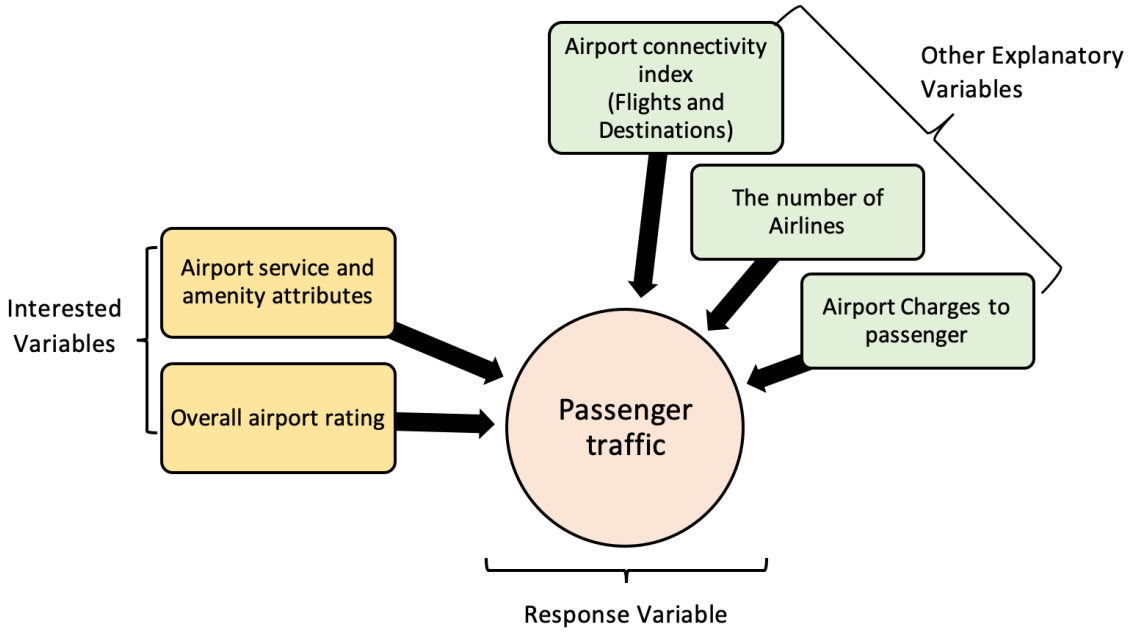

Figure 3.1. Conceptual model of the effect of airport value-added on passenger traffic

3.1.2 Explanatory variables

Airport overall rating. This variable refers to the overall airport rating and is the variable of interest of this research. The cross-sectional dataset of airport rating in the year 2018 was derived directly from Skytrax's official website. The certified airport ratings are a result of the global airport quality ranking program introduced in 2001 by Skytrax organization, indicating the level quality of airport product and service performance. Certified airport ratings are based on 13.73 million airport passenger satisfaction surveys combined with a comprehensive study of over 500 airport products and service attributes covered the accessibility of public transportation to the airport, check-in, immigration, transfers, security, arrivals, shopping, cafeterias, through departure at the gate, as well as covered an official staff (e.g., immigration, police, security, and customs), and more general airport staff such as the staff at shops, restaurants and cafes, help and information desks. The airport ratings demonstrated overall performance of each airport is presented in the form of 1-star to the prestigious 5-star. The differences in the awarded stars indicate the different levels of product and service

quality performance executed by each airport. For instance, the 5-star airport rating is awarded to those airports, which are achieving a very high standard of overall quality performance compared to the 2-star airports, which place a low standard and failed to achieve a satisfactory overall quality performance. The 5-Star Airport rating certifies those airports providing excellent amenities and facilities as well as excellent service quality by airport staff for its customers, while the 2-star airport rating set to those airports serving poor amenities and service quality (Skytrax, 2019). Meanwhile, the differences in the awarded stars furthermore show the different level of airport service and amenity improvement. The 5-star airport, for example Changi Singapore airport, Munich airport, Tokyo Haneda airport, has improved its amenities and services to achieve a very high quality performance, while the 3-star airport such as Bangkok Suvarnabhumi airport, Dubai airport, and Brussels airport, only provides moderate level of amenities and services quality. Improving service and amenity attributes could lead such a 3-star airport to achieve higher standard quality performance. Therefore, the differences in airport rating stars of variable *Airport overall rating* acts as a proxy of the different level of airport value-added. Furthermore, the expected signs for the *Airport overall rating's* coefficients measuring the impacts of airport value-added are positive.

The Skytrax also reveals the performance score of 11 major service and amenity attributes consisting with; (1) ground transportation, (2) security screening, (3) immigration service, (4) wayfinding and signage, (5) arrival, (6) departure, (7) transfer, (8) terminal comfort and cleanliness, (9) terminal facilities, (10) shopping facilities, and (11) food & beverage. Furthermore, each service and amenity attributes is broken down into several sub-categories with different airport quality criteria (see Table C1, Appendix C). From an entire selected 68 airports, however, only the information regarded 27 airports are revealed with a performance score of such service and amenity attributes. Consequently, to investigate hypotheses 2, only the dataset of 27 airports used in the analysis.

As stated in the theoretical framework, section 2.1, when deciding on airport choice, passengers do not solely consider a factor. Instead, many determinants influence passengers' airport choice. Based on the finding of relevant literature reviews, the common determinants of such airport choice are classified into two fundamental airport choice factors, consisting of (1) Air service quality-related factors, and (2) Price-related factors. In order to minimize the

potential omitted variable bias (OVB) in a multiple linear regression analysis, the research identified four factors that have the most influential impact on the passengers' choice of choosing an airport, which are (1) the number of cities connected, (2) the number of scheduled flights arriving and departing at a particular airport, (3) the number of airlines operating at a particular airport, and (4) airport charges applicable to passengers. Such factors are known as 'control variable'—variables that are not particularly interested in, but that is related to the response variable, omitted control variable in the regression model causes OVB. In this research setting, these four control variables are the factors that not the interest of the study, however, it empirically has an impact on the passenger traffic (Suzuki et al., 2003; Hess and Polak, 2005; Loo, 2008; Ishii et al., 2009). Therefore, there is a need to include such variables in the regression model.

The first three control variables concern the air service quality-related factors, while the airport charges applicable to passengers concerns the price-related factors. The number of cities connected is defined by the total number of destinations passengers can fly from and to a particular airport. The number of scheduled flights is defined by the total number of scheduled commercial passenger flights arriving and departing the airport. And the number of airlines is determined by the total number of commercial passenger airlines operating at the airport. Suzuki et al. (2003) and Loo (2008) found that flight frequency, destination connectivity, and the number of operating airlines are critical factors to attract passengers. For the airport charges, Chung, Lee, and Jang (2017) state that airport charges applicable to passengers are considered to be the better measurement of cost aspect than the airplane ticket fare. Because the airplane ticket fare differs according to airlines, sales promotion, schedules, and purchasing time, it is also not practically applied among different airlines, routings, and classes of service on an airplane. However, the airport charges are applied directly to ticket fare; for instance, if the airport charges by a specific airport increases, the ticket fare departure from such airport will rises, regardless of airlines, routing, purchasing time, and classes of service on an airplane.

To account for the number of cities connected and the number of scheduled flights, this research used airport connectivity index to measure such factors. Variable ***Connectivity index*** is the effectiveness connectivity index of the World's leading international hub airports as connecting points. It is defined by the overall level to which an airport is connected to the rest of the World, either by direct flights or indirect connections via other airports. The airport connectivity is the sum of direct and indirect connectivity, where direct connectivity refers to the direct air services available from the airport, it measured not only in terms of destinations, but also in the frequency of flights to the same destination; for instance, an airport with 6 daily flights to another airport, will record a higher score than one with only 5. While, indirect connectivity is the number of destinations passengers can fly to, through a connecting flight at hub airports from a non-hub airport; for example, if passengers fly from Hamburg to a hub airport such as Frankfurt airport, it is a direct flight from destination A to B. However, with the extensive choice of onward destinations, passengers can fly to from Frankfurt hub airport. The great number of destination onward connections from the hub airports enlarged destinations available from the origin regional airport. Moreover, indirect connectivity is weight follow the quality of connecting time and indirect routing e.g., a flight from Phuket to Amsterdam via Doha, will record a higher score than an alternative routing via Tokyo (Airport Council International [ACI], 2018; Official Aviation Guide [OAG], 2018). The cross-sectional data of the *Connectivity index* is collected from the annual report of the OAG organization named 'Megahubs International Index 2018'.

Variable ***Airlines*** is the total number of commercial passenger airlines operating at the airport, derived from 2018 annual reports of each airport. The last control variable is ***Charges*** defined by the total amount of charges to passengers by each airport. The collected airport charges to passengers were initially recorded in local currencies; however, in order to make comparisons, it was calculated into Euro currency by using the exchange rate on December 31, 2018. Variable *Charges* moreover have transformed into natural logarithm form to make distributions of dataset less skewed, and to analyse the change of airport charges in percentage measure. The information regarding airport charges is also collected from the 2018 annual report of each airport. The overview of all relevant variables and its description are displayed in Table D1, Appendix D.

3.1.3 Descriptive statistics

In Table 3.1 below, the descriptive statistics for the data is displayed. A brief description of the variables would be given in this section.

Table 3.1 Descriptive statistics

Variables	N	Mean	Median	Standard deviation	Minimum	Maximum
Passenger traffic	68	45,400,000	44,000,000	23,400,000	8,400,000	107,400,000
Airport overall rating (star)						
3-star	31					
4-star	30					
5-star	7					
Major airport service and amenity attribute (score out of 5)						
(1) Ground transportation	27	4.48	4.13	1.77	3.63	13.25
(2) Security screening	27	3.86	3.92	0.39	3.08	4.42
(3) Immigration service	27	3.71	3.80	0.43	2.60	4.50
(4) Wayfinding signage	27	4.03	4.05	0.51	2.77	4.77
(5) Arrival	27	4.04	4.00	0.42	3.25	4.75
(6) Departure	27	4.25	4.00	1.39	3.17	10.92
(7) Transfer	27	3.92	4.00	0.46	3.08	4.67
(8) Terminal comfort and cleanliness	27	3.90	3.95	0.56	2.73	4.77
(9) Terminal facilities	27	3.97	4.04	0.64	2.29	4.92
(10) Shopping facilities	27	4.09	4.00	0.48	2.80	4.80
(11) Food & beverage	27	4.06	4.11	0.42	3.06	4.72
Airport connectivity index	50	172.70	162.50	60.65	100.00	333.00
Airlines	68	54.21	53.00	23.56	3.00	111.00
Charges (Euro)	68	15.38	16.11	8.12	4.08	36.85

The average passenger traffic on 68 observed hub airports is 45,400,4000 people, with a range between 8,400,000 and 107,400,000 passengers carried in 2018. China hub airports, on average, carried the most number of passengers, followed by American hub airports, eastern and southeast Asian hub airports, European hub airports, and middle east hub airports,

respectively. Out of 68 selected hub airports, there are 31 airports or approximately 45.59 percent awarded as 3-star ratings, 30 airports (44.12 percent) are awarded as 4-star ratings, and the rest 7 (10.29 percent) airports are obtained 5-star airport ratings.

On average, the airports provided satisfactory performance in ground transportation (e.g., public transport options, airport taxi service, and car rental) with an average score of 4.48 out of 5, followed by shopping facility (e.g., selection of shops, and choice of mid-price shops), food & beverage (e.g., choices, cleanliness, and reasonable prices), with an average score of 4.90 and 4.06, respectively. While the service performance regarding immigration (e.g., waiting time, and staff attitude) poorly performed by the selected airports, resulted in the lowest score, only 3.71 out of 5 among 11 airport attributes.

The airport charges applicable to passengers have an average of 15.38 euro; most hub airports charged their passengers approximately 16.11 euro. The American airports all charged their passengers only 4.08 euro or 4.50 US dollar; this is due to the US federal law that allowed airports to charge up to 4.50 US dollar for every embarked passenger at public agency-controlled commercial airports (Federal Aviation Administration, n.d.).

3.2 Research Methodology

To investigate the research question, a quantitative approach is adopted in this study. An ordinary least squares (OLS) estimator of a multiple linear regression with the statistical software, Stata MP 15.0, is used to investigate the effects of airport value-added on passengers' choice of choosing an airport. By taking passenger traffic as a proxy of the airport that is selected by the passenger for the dependent variable, and the differences in airport rating stars as a proxy of the different levels of airport value-added for the independent variable. Additionally, control variables such as those that have explained in detail in chapter 2 and in section 3.1 were included in the OLS estimator of a multiple linear regression model.

The OLS estimator of a multiple linear regression or also known as cross-sectional linear regression is a type of regression analysis that observes the interaction between many subjects at one point of time (Katsenelen-baum et al. 1998). The cross-sectional analysis, although in terms of prediction and causation, is inferior to panel analysis—a combination of cross-sectional and time-series analysis (Andress, 2017). It is adopted for this research

because it is the most preferred method that covers all aspects of the available datasets, particularly the variable of interest—airport rating—that can only be observed in one period, in 2018.

Before performing the cross-sectional linear regression, several fundamental assumptions of the OLS estimator of a multiple linear regression need to be evaluated first.

Firstly, linearity assumption; Multiple linear regression requires the correlation between the independent and dependent variables to be linear. It is also advised to examine for outliers, as multiple linear regression is sensitive to outlier effects. The linearity assumption can best be examined with scatter plots (Osborne & Waters, 2002). A scatter plot matrix was evaluated to check and visualize bivariate relationships between combinations of variables.

Secondly, multicollinearity; A correlation matrix portraying correlation coefficients between variables is first computed. Pearson's correlation has its coefficients ranged between -1 and 1. A positive correlation coefficient indicates that as the value of one variable increases, the value of the other variable increases; and vice-versa as one decreases, the other decreases. Contrarily, a negative correlation coefficient denotes that as one variable increases, the other decreases, and vice-versa. While the zero coefficient correlation indicates that there is no correlation between the two variables, computing the correlation matrix at the initial stage could prevent any potential multicollinearity. Multicollinearity is a situation when one predictor variable in a multiple regression model can be linearly predicted from the others with a considerable level of accuracy. Multicollinearity does not lower the predictive power or reliability of the overall regression model; however, it only affects the coefficient of some individual variables. For example, if two individual variables have a high value of correlation coefficients and are included in the model. The coefficients estimated of such then are less accurate (Johnston, Jones, & Manley, 2017). A rule of thumb indicates that if the magnitude of the correlation coefficients >0.8 (in absolute value), then severe multicollinearity may be present. Therefore, it is advised to exclude such variables in the model (Dormann et al., 2012).

3.2.1 Methodology for investigating hypothesis 1

To investigate the first hypothesis that "*Airport rating significantly increases passenger traffic,"* the OLS estimator of a multiple linear regression model is formulated as follows:

$$Ln\ Passenger\ traffic_i = \beta_0 + \beta_1 * Airport\ overall\ rating_i + \beta_2 * Ln\ Charges_i + \beta_3 * Airlines_i + \beta_4 * Connectivity\ index_i + \varepsilon_i \quad \textbf{(1)}$$

Where i is an observed individual airport, $Ln\ Passenger\ traffic$ is the dependent variable showing the estimated change of passenger traffic in percentage. β_0 is the constant term; β_1 is the coefficient which represents the effect of *airport overall rating* on passenger traffic; β_2 is the coefficient which indicates the estimated change of passenger traffic in percentage when the airport charges applicable to passengers increase by one percentage; β_3 is the coefficient demonstrating the impact of the number airlines operating at an individual airport on passenger traffic; β_4 is the coefficient showing the effect of airport connectivity index on passenger traffic, and the last, ε is a random error term.

Additionally, to investigate whether there are the effects of airport value-added on passenger traffic, joint hypothesis testing was performed by using the F-Statistic. The joint hypothesis testing has its hypotheses as follows:

$$H_0 = \beta_1 = 0, \dots, \beta_k = 0 \qquad for\ a\ total\ q = k\ retrictions$$
$$H_1 = at\ least\ one\ of\ q = k\ restrictions\ under\ H_0\ does\ not\ hold$$

In this research application, β_1,..., β_k is the coefficient of variables *airport overall rating* from 1-star to 5-star, which are estimated from Model 1. The null hypothesis (H_0) that there is no effect of airport value-added on passenger traffic is rejected when the p-value is less than 0.05 or 5%-level significance.

3.2.2 Methodology for investigating hypothesis 2

To examine the second hypothesis that *"Airport rating in terminal comfort and cleanliness affects passenger traffic the most".* A cross-sectional regression models is formulated as follows:

$$Ln\ Passenger\ traffic_i = \beta_0 + \beta_1 * Ln\ Charges_i + \beta_2 * Airlines_i + \beta_3 * Connectivity\ index_i + (\beta_4, \dots, \beta_k) * Airport\ servie\ attributes_{\ 1,\dots,n} + \varepsilon_i \quad \textbf{(2)}$$

The differences between the first and the second model is that Model 2 estimated percentage change of passenger traffic predicted by the effect of major airport service and amenity attributes instead of looking at an overall airport rating as in Model 1. From the equation 2 above, β_1, β_2, and β_3 are the coefficient which demonstrates the effect of airport charges, airlines, and airport connectivity index on passenger traffic, respectively. $\beta_4, \dots, \beta_k$ are the coefficients indicating the effect of airport service and amenity attributes on passenger traffic; n is the total number of service and amenity attributes included in the model, and ε is a random error term.

Besides, the similar methodology approach as Hypothesis 1 has resorted, the joint hypothesis testing by using the F-statistic was also examined in Hypothesis 2 to identify whether the effects of airport service and amenity attributes on passenger traffic are the same across all considered airport attributes. The joint hypotheses are as follows:

$$H_0 = \beta_1 = \beta_2 = \beta_3 = \dots, \beta_k$$
$$H_1 = at\ least\ one\ of\ \beta_1 = \beta_k = \beta_3 = \dots, \beta_k\ under\ H_0\ does\ not\ hold$$

In this research application, β_1,..., β_k are the coefficient of variables airport service and amenity attributes estimated from Model 2. The null hypothesis (H_0) that the effect of airport service and amenity attributes on passenger traffic are the same is rejected when the p-value is less than 0.05 or 5%-level significance.

Lastly, regarding the assumption of a multiple linear regression. It requires the homogeneity of variance of the residual, meaning that the variances of the errors term are the same from observation to observation. When the assumption is violated, heteroscedasticity (the inconstant variations in the error terms) has occurred. Heteroscedasticity indicates that there is more variability in the error term at higher predicted values than at lower predicted values. Hence, there is problematic since heteroscedasticity suggests that the model is more accurate when estimating lower values compared to higher values (Osborne & Waters, 2002). To control potential heteroscedasticity, the STATA command "vce(cluster airport_id)" is

attached in the last part of the regression command. By adding such command, it relaxes the assumption of independence errors and substitutes it with the assumption of independence between airport clusters that allow the errors to be correlated within airports (Stata, 2013). The command only modifies the standard errors, does not affect the model's coefficients. This research used 5% or lower statistical significance.

4. Results

In this results section, the numeric values obtained from the multiple linear regressions are given.

Firstly, a scatter plot matrix was evaluated to check the linearity assumption. The scatter plot matrix clearly shows that the bivariate relationships between combinations of variables are linear, and there are no outliers to be concerned (see Figure E1 and E2, Appendix E). Thus, the linearity assumption of multiple linear regression is not violated.

Secondly, Pearson's correlation matrix demonstrating the bivariate correlation between amalgamations of 17 variables in numerical measure depicts that most of the bivariate relationships has no significant signs of concern except the strong relationships between *Passenger traffic* and *Ln Passenger traffic, Transfer* and *terminal facilities*, *Terminal comfort* and *terminal facilities*, *Terminal facilities* and *Shopping facilities*, *Terminal facilities* and *Food & Beverage*, *Wayfinding signage* and *Arrival*, *Wayfinding signage* and *Transfer*, *Wayfinding signage* and *Terminal comfort*, *Wayfinding signage* and *Terminal facilities, Wayfinding signage* and *Shopping facilities*, as well as *Wayfinding signage* and *Food & Beverage* (see Table F1, Appendix F). All of the bivariate correlation coefficients with its magnitude higher than the absolute value of 0.8, according to the rule of thumb as mentioned earlier in section 3.2; one of such bivariate variables were dropped from the regression model to prevent multicollinearity. Since the models are log-level regressions; therefore, the dependent variable *Ln passenger traffic* was preferred over *Passenger traffic*. Variable *Wayfinding signage* and *Terminal facilities*, furthermore, were dropped because these two variables strongly correlated with other major variables.

The following sections are the results regarding Hypothesis 1 and 2, respectively.

Table 4.2 Multiple linear regression results for investigating the impacts of airport overall rating on passenger traffic (Model 1), and the effects of airport service and amenity attributes on passenger traffic (Model 2)

Dependent variables: Ln Passenger traffic	**Model 1**	**Model 2**
Independent variables	**Coefficient**	**Coefficient**
Airport overall rating		
Dummy 4-star rating	0.316**	
	(0.121)	
Dummy 5-star rating	0.141	
	(0.134)	
Ln Charges	-0.179*	-0.289
	(0.096)	(0.234)
Airlines	0.009***	0.008*
	(0.003)	(0.004)
Connectivity index	0.003***	0.005***
	(0.001)	(0.001)
Ground Transportation		0.189
		(0.268)
Security Screening		0.220
		(0.334)
Immigration Service		-0.077
		(0.277)
Arrival		0.114
		(0.460)
Departure		-0.715*
		(0.379)
Transfer		-0.195
		(0.338)
Terminal Comfort and cleanliness		1.094**
		(0.385)
Shopping Facilities		-0.503
		(0.338)
Food & Beverage		-0.343
		(0.471)
Constant	17.032***	17.804***
	(0.182)	(1.118)
Observations	50	27
R-squared	0.630	0.822

Note. Robust standard errors are in parentheses; ***significant level at 1%-level ($p < 0.01$), **5%-level ($p < 0.05$), *10%-level ($p < 0.1$).

Table 4.2 Joint hypothesis testing results, by using F-statistic, for testing that there is no effect of airport rating stars on passenger traffic (Model 1), and the effects of airport service and amenity attributes on passenger traffic are the same (Model 2)

Model	H_0	H_1	F-statistic	P-value
1	Airport rating 4 star = 0 Airport rating 5 star = 0	At least 1 coefficient ≠ 0	3.96	0.026
2	Ground Transportation – Security Screening = 0 Ground Transportation – Immigration Service = 0 Ground Transportation – Arrival = 0 Ground Transportation – Departure = 0 Ground Transportation – Transfer = 0 Ground Transportation – Terminal Comfort = 0 Ground Transportation – Shopping Facilities = 0 Ground Transportation – Food & Beverage = 0	At least 1 differences ≠ 0	4.22	0.002

4.1 Results regarding hypothesis 1

In measuring the impacts of adding value to the airport on passenger traffic with a multiple linear regression analysis, by employing the differences in airport rating stars as a proxy of the different level of airport value-added. Table 4.1 above provides the numeric result for the first hypothesis.

Overall, the regression results of Model 1 only provide the coefficient of 4-star and 5-star airport ratings instead of providing the coefficient of 1-star to 5-star ratings; this is due to the observed sample airports. Refer to section 3.1.3, descriptive statistics; out of 68 selected hub airports, there are 31 airports or approximately 45.59 percent awarded as 3-star ratings, 30 airports (44.12 percent) are awarded as 4-star ratings, and the rest 7 (10.29 percent) airports are obtained 5-star airport ratings. Thus, there is no observed airport obtained 1-star or 2-star ratings. Moreover, using a categorical variable always implies that one category will be dropped to prevent perfect multicollinearity. Consequently, the 3-star airport rating was dropped and used as a base reference in predicting other categories.

Based on Table 4.1 above, the two coefficients of *airport overall rating* expectedly show a positive sign of the total number of passengers, meaning that airports which are awarded 4-star and 5-star overall, carrying higher passenger traffic in comparison with those obtained 3-star rating. More specifically, the airports with 4-star rating significantly have higher passenger traffic by approximately 31.56 percent compared to those airports awarded with a 3-star rating. While the airports certified with 5-star rating also predicted to carry a growing number of passengers by approximately 13.95 percent compared to those 3-star rating airports; however, the result is insignificant neither at 5%-level nor 10%-level of significance.

The coefficient of *Ln Charges* shows*,* by contrast, a negative sign result as anticipated. An increase in airport charges applicable to passengers by 1 percent would decrease passenger traffic by approximately 17.90 percent. Nevertheless, the coefficient result is insignificant at 5%-level, but significant at 10%-level of significance (p-value 0.067<0.10).

Contrarily to variable *Airlines,* its coefficient portrayed a rising sign of the number of passengers as suggested by empirical results of the previous studies. *Airlines*' coefficient indicates that an increase in the number of airlines operating at the airport by one more airline would result in significant growth in passenger traffic by roughly 0.93 percent. Such result is similar to the coefficient of airport *Connectivity index*. However, only 0.41 percent significantly increases in passenger traffic, when the airport obtained one higher score in its connectivity index that was resulting from an expanding of destinations and flight frequencies.

The R-squared indicates the model's goodness-of-fit that Model 1 explains 63 percent of the variation in the passenger traffic around its mean. Lastly, the joint hypothesis testing, by using the F-statistic, that there is no effect of airport rating stars on passenger traffic depicted the p-value equals 0.026 (Table 4.2).

4.2 Results regarding hypothesis 2

In indicating at which service and amenity attribute that affects the passengers' choice of choosing airport the most, the results regarded the second hypothesis are demonstrated under Model 2 in Table 4.1 above.

Across nine considered airport service and amenity attributes, overall, there are four airport service attributes that its coefficients expectedly portrayed a growth sign of passenger traffic; arrival, ground transportation, security screening, and terminal comfort and cleanliness. The results of Model 2 indicate that an increase in 1 score in the airport service quality of such attributes, on average, would raise passenger traffic by approximately 11.43, 18.93, 22.02, and 109.38 percent, respectively. However, the estimated growth of passenger traffic is significant only when a rise in 1 score in airport service quality of attributes regarded terminal comfort and cleanliness.

On the other hand, five airport service attributes displayed a decline sign of passenger traffic, which are the services attribute related immigration service, departure, transfer, and shopping facilities. A rise in 1 score in the airport service quality of such attributes, on average, would decrease the number of passenger traffic by about 7.73, 71.51, 19.47, 50.34, and 28.93 percent, respectively. Nevertheless, none of such attributes estimated a significant decline in passenger traffic.

For the coefficient of *Airlines* and airport *Connectivity index* depicted a progress sign of passenger traffic as expected. Operating one more airline at an airport, on average, would increase the total number of passengers by roughly 0.83 percent while having one score higher in the airport connectivity index would also significantly enlarge passenger traffic by about 5.36 percent. It is noticed that the passenger traffic estimated by a rise in the number of operating airlines and connectivity index from Model 2 are nearly the same as those from Model 1.

Ln Charges also predicted a decline in passenger traffic alike in Model 1; however, in Model 2, an increase in passenger charges, on average, would lower passenger traffic by 28.9 percent. The R-squared indicates that Model 2 explains 82.16 percent of the variation in the passenger traffic around its mean. Lastly, the joint hypothesis testing, by using the F-statistic, that the effect of airport service and amenity attributes on passenger traffic are the same depicted the p-value equals 0.002 (Table 4.2).

5. Interpretation and Discussion

In this interpretation and discussion section, the numeric values obtained from the multiple linear regressions were analyzed in-depth with an explanation of expected and unexpected results as well as the supported empirical results from previous studies.

Regarding the results of Model 1 in Table 4.1, the two coefficients of the *airport overall rating* depict a growing sign of passenger traffic as expected and suggested by relevant previous studies. More specifically, the *dummy 4-star rating* indicates that the airports which are certified with a 4-star rating, on average, significantly carry higher passenger traffic compared to those with 3-star rating, keeping other factors constant. While the *dummy 5-star rating* displays that the airports which are classified as the prestigious 5-star rating are also estimated to carry a higher number of passengers compared to 3-star rating airports, however, the estimated result is in an insignificant manner. Since the differences in airport rating stars of variable *airport overall rating* were employed as a proxy of the different level of airport value-added. Therefore, the positive magnitude of the *airport overall rating*'s coefficient indicates the impacts of airport value-added on passenger traffic.

The term 'airport value-added' in this research setting refers to the enhancement of airport services and amenities provided to passengers. The differences in the level of value-added or the level of services and amenities improvement can be measured by observing the passenger's perception of airport service quality, that is, when adding value to the airport, the quality of services and amenities will inevitably increase. The differences in airport service quality are empirically investigated to have an influential impact on passenger's choice of the airport; since passengers' perception of airport service quality positively enhances customer satisfaction (Fodness & Murray, 2007; Correia et al., 2008; Bogicevic et al., 2013). Consequently, the difference in customer satisfaction level, which resulted from passengers' perception of airport service quality, has been observed, analyzed, and demonstrated in the airport rating form by SKYTRAX organization. In contrast, the passenger's choice of the airport is measured by passenger traffic of an individual airport which is selected by passengers. Accordingly, it is clear from the result of Model 1 discussed above, mainly the significant result of the positive magnitude of *dummy 4-star rating*'s coefficient, that a higher level in airport

value-added positively effects on passenger traffic compared to a lower level of airport value-added.

In addition to the regression model, the joint hypothesis testing by using the F-statistic shows a p-value of 0.026, which is lower than 0.05. Thereby the null hypothesis stated that there is no effect of airport value-added on passenger traffic is rejected. The variation in passenger traffic, which is estimated by the different stars of airport rating indicates that airport value-added indeed has a significant impact on passenger traffic.

According to such results and analyses, it can be concluded that the positive coefficient of variable *airport overall rating* of the airports awarded with 4-star indicates a growth change in passenger traffic compared to 3-star airports. As a significant positive difference in passenger traffic between 3-star and 4-star airports implies that adding value to the airports significantly increases passenger traffic. Therefore, the first hypothesis stated that *"Airport rating significantly increases passenger traffic"* is accepted.

By determining which service and amenity attributes affect the passengers' choice of choosing airport the most. The results regarding Model 2 in Table 4.1 show that across nine considered airport service and amenity attributes, terminal comfort and cleanliness is the attribute which significantly estimated the highest incremental of passenger traffic, followed by security screening, ground transportation, and arrival, in descending order. Besides, the multiple linear regression results depict that the coefficients of such airport service and amenity attributes are positive magnitude; this can be interpreted according to Fuller and Matzler (2008) and the two-factor job satisfaction theory by Herzberg et al. (1959) that such attributes are satisfiers. That is when airports have provided and performed well on such service attributes, it consequently generates intense customer satisfaction and leads to a compliment behavior. The results are also compatible with the study by Bogicevic et al. (2013) that cleanliness and a pleasant environment in the airport terminal are the essential satisfiers. Besides, when delving into the details of the criteria for measuring customer satisfaction regarding terminal comfort and cleanliness attribute. The standards comprised of congestion around terminal, air temperature, terminal decoration and condition, seat availability, cleanliness of washrooms, and cleanliness of public areas (see Table C1, Appendix C) in which these criteria relate to servicescape—an essential aspect of the airport service quality (Chen

& Chang, 2005; Correia et al., 2008, De Barros et al., 2008). Consequently, an airport that concentrates on providing an excellent service regarding terminal comfort and cleanliness, either through their outstanding performance or value-added, will achieve a satisfactory level of customer satisfaction (Halpern & Graham, 2013); hence, the incremental highest passenger traffic.

Contrarily, the results from multiple linear regression demonstrate a negative magnitude coefficient of service and amenity attributes that relate to immigration service, departure, transfer, shopping facilities, and food & beverage. Such attributes are dissatisfiers in which it causes dissatisfaction and conducts to a complaining behavior when the airport performs poorly (Bogicevic et al., 2013). The resulting negative coefficient of such attributes are as expected and supported by empirical results from previous studies. Bogicevic et al. (2013) suggested that the service attributes which mainly related to staff behavior (e.g., rudeness and unprofessional) are the significant dissatisfiers in the airport setting, followed by confusing signage, and inadequate restaurant offers, respectively. When considering the criteria used to measure passenger satisfaction on the attributes that relate to immigration service, departure, transfer, shopping facilities, and food & beverage, the research found that the criteria of such service attributes relate to staff behavior. For example, the criteria of immigration service relate staff attitude, staff courtesy, and staff language skill; the criteria for shopping facilities and food & beverage relate staff service-minded. Besides, some criteria in measuring passenger satisfaction on departure and transfer attributes also relate to confusing signage such as the criteria indicating how easy passengers follow the signage to check-in, security, departures, and transfer areas (see Table C1, Appendix C).

Besides, the joint hypothesis testing by using the F-statistic shows a p-value of 0.002, which is lower than 0.05. Consequently, the null hypothesis stated that the effects of airport service and amenity attributes on passenger traffic are the same across all considered airport attributes is rejected. The variation in passenger traffic, which is estimated by the different airport service and amenity attributes indicates that air travelers indeed have different perceptions towards a specific kind of airport service and amenity attributes. It also admittedly suggests that passengers do not weigh determinants of airport choice equally and isolated from each other in their decision making (Parrella, 2013).

According to such results and analyses, it can be concluded that airport service and amenity attributes regarding terminal comfort and cleanliness significantly estimated the highest incremental of passenger traffic. The second hypothesis stated that *"Airport rating in terminal comfort and cleanliness affects passenger traffic the most"* is accepted.

In addition to the results displaying the impacts of the variables of interest (airport rating, service and amenity attributes) on passenger traffic, the results showing the impact of other explanatory variables on passenger traffic are also interesting to discuss.

The coefficient of the number of airlines operating at a particular airport, and airport connectivity index from both Model 1 and Model 2 portray a significant rising sign of the number of passengers as suggested by empirical results of previous studies. Flight frequency and connectivity are one of the influential determinants of passengers' airport choice. Since air travelers have favorable preferences on the airport that provides them greater flexibility in departure and arrival times, multiple flight frequencies, routing, a large number of destinations, as well as excellent connectivity. Besides, having many choices of airlines operating at the airports would attract more passengers and enlarge their alternatives because passengers have different preferences over the airlines and would select an airport that has their frequent-flyer programs[2] (Harvey,1987; Hess & Polak, 2005; Parrella, 2013).

The coefficient of *ln charges* of both Model 1 and Model 2 shows a negative sign results as expected, an increase in airport charges applicable to passengers would decrease passenger traffic. The finding is compatible with a vast number of the literature suggested that price-related factors such as airport charges applicable to a passenger, and airfares have a negative direct influential determinant for passengers in choosing to use one airport or another. A higher airfare that some part is due to a rise in airport charges has seen to deviate air travelers to choose their departure airport that offers lower airfare (Suzuki et al., 2003; Hess and Polak, 2005; Blackstone et al., 2006). Moreover, the research noticed that, based on the datasets of airport charges, the marginal differences of the airport charges among the observed airports are relatively small compared to the average one-way airfare offered by both low-cost and full-service airlines in the market; for instance, a one-way direct flight from Milan Malpensa

[2] Frequent-flyer programs are customer loyalty programs employed by numerous passenger airlines.

airport to Dubai international airport with Emirate airline would cost 550 euro while departing from Rome Fiumicino airport costs 568.15 euro. The marginal difference of 18.15[3] euro is thanks to airport charges applicable to departure passengers. With the marginal of 18.15 euro, passengers would be indifferent or less sensitive to departing from Milan Malpensa airport or Rome Fiumicino airport, keeping other factors constant. Nevertheless, when considering the actual airfares on the different routings, for example, a direct flight from Milan Malpensa airport to Barcelona that costs 40.99 euro and a direct flight from Rome Fiumicino airport to Barcelona, which costs 59.14 euro with Easyjet airline. Passengers would be more sensitive to the difference of airfare between 40.99 and 59.14 euro, and more likely to choose Milan Malpensa over Rome Fiumicino as a departure airport because of a lower airfare. However, 18.15 euro differences in the airfare of Barcelona routing are equal to Dubai routing. It is noticed that the marginal difference of airfares, particularly short-haul[4] flights and operating by low-cost airlines, have a crucial influence on air travelers' behavior as people become less sensitive to changes in wealth as the value of the amounts considered rise, which means that the airfare difference between 550 euro and 568.15 euro in Dubai routing is much smaller than the difference between 40.99 euro and 59.14 euro in Barcelona routing. Such examples of customer behavior in choosing airports based on the differences in price-related factors phenomenally are explained by the cognitive feature of diminishing sensitivity of prospect theory by Tversky and Kahneman (1992) in the principal of behavioral economics.

Lastly, it is interesting to point out the impacts of airport value-added on passenger traffic. Although the impacts of airport value-added on passenger traffic displays a positive correlation; simplistically in this research application when the airport is certified with a superior star rating, the passenger traffic will rise, and vice versa when the airport is certified with an inferior star rating, the passenger traffic will decline. The impacts between the two variables at the aggregate level is nevertheless ambiguous. Firstly, based on the Person's correlation coefficient result from this research setting, it is observed that the relationship between such bivariate variables is positively correlated. However, when considering the

[3] Based on the annual report of Milan Malpensa airport and Rome Fiumicino airport in 2018. The airport charges to departure passengers at Milan Malpensa airport was 17.70 euro, while Rome Fiumicino airport was 35.85 euro. Therefore, the marginal difference of airport charges among such two airports was 18.15 euro.

[4] Short-haul is a flight lasting anywhere from 30 minutes to 3 hours.

aggregate passenger traffic statistics from the past to the present (1970-2018), it is observed that the aggregate passenger traffic trend has been exponentially increasing throughout the time and is forecasted to double its size by reaching 8.2 billion air passengers in 2037, without any sign of a decline (International Air Transport Association [IATA], 2018). A continuous exponential increase in passenger traffic is driven by a combination of economic growth, improvement in household income, and demographic profile. Consequently, it is challenging for the airport authority to maintain service quality standards that meet the demand of a doubled number of air travelers (IATA, 2018). It might be the case that the airports could not manage to accommodate their passengers satisfactorily, although the airports have added more value through the enrichment of services and amenities, consequently obtaining an inferior star rating. Alternatively, in the case that airports would lower their services and amenities standards due to financial distress. In such both cases, passenger traffic would not be lower as expected, rather keep increasing due to the fact regarding an exponential growth of air travelers instead. Therefore, it is not always that using the differences in airport rating as a proxy of the different level of airport value-added will explain a positive correlation with passenger traffic. Consequently, the impacts of airport value-added on passenger traffic at the aggregate level is ambiguous in some cases. Hence, there needs to be further study towards this regard.

6. Conclusion

With the emergence of intensified competitive market and commoditization of the airport offering, Air passengers' perception towards the different quality of airport service and amenity provided by a certain airport are one of the significant determinants of airport choice. Many airport authorities have been concentrating on delivering the best customer experience to their passengers. One of those strategies is to add value to the airport through the enhancement of airport service and amenities. Such strategies are found to enlarge customer experience, satisfaction, and attract more passengers. This paper, consequently, has tried to scrutinize the effects of airport value-added on passenger traffic at the aggregate level with an attempt in answering the following research question: *"How does value-added to airports through the enhancement of the quality of airport's services and amenities,*

presented in 1-star to 5-star airport rating, affect the passenger traffic of hub airports at the aggregate level?". By using the OLS estimator of a multiple linear regression with employing the differences in airport rating stars as a proxy of the different level of airport value-added, and passenger traffic as a proxy of the airport which is selected by passenger from their airport choice. The results show a significant positive difference in passenger traffic between 3-star and 4-star airports which implies that adding value to the airports significantly increases passenger traffic. Besides, this paper also has attempted to identify the dimensionality of airport service and amenity attributes that has the most impact on passengers' airport choice. The results indicate that among the considered airport service and amenity attributes, terminal comfort and cleanliness significantly influence passenger's airport choice the most by showing through the highest incremental of passenger traffic. Therefore, the conclusion and the answer to the research question is that adding value to the airport through the enhancement of the quality of airport's services and amenities results in a satisfying customer experience, which leads to an increase in customer satisfaction and customer value — consequently, an incremental of passenger traffic.

This study's contributions must be considered in light of its limitations. Firstly, due to the limited data access and availability of data, the data regards overall airport rating published by the Skytrax organization could be observed and retrieved only the data of the year 2018. The unavailability of the time series dataset of airport rating leads to the weak interpretation of this study because the study was unable to observe the changes in airport rating of each airport each year. The fluctuation or variation of airport rating at the individual airport throughout the time indicates the different performance regarding the quality of airport services and amenities provided by each airport each year; besides, it also demonstrates the different levels of airport value-added within individual airports over time.

Secondly, since this study used the differences in airport rating stars as a proxy of the different levels of airport value-added, consequently, the obtained impacts of airport value-added on passenger traffic results might indicate a satisfactory accuracy level. It might not entirely represent a whole aspect of such effects. As the airport rating revealed by Skytrax organization was based on customer satisfaction, which is partly as a result of airport value-added, as a consequence, there might be some other factors that influence customer

satisfaction in addition to airport value-added. Therefore, considering employing other proxies that entirely represent the level of airport value-added by each airport over time, or collecting an insight information regarding how an individual airport has improved their services and amenities over a specific period and investigating such effects based on the insight information within an individual airport would enhance the accuracy and validity.

Thirdly, by using the OLS estimator of multiple linear regression as the methodology in investigating the effects, it is inadequate to entirely identify the impacts of airport value-added on passenger traffic. Therefore, a further advanced methodology is suggested for the investigation.

Lastly, for further research, it is recommended to collect panel data of airport value-added over a specific period and to observe insight information regarding how an individual airport has improved their services and amenities throughout the time. Furthermore, it is suggested to control for more other factors that would significantly affect passenger traffic. Such suggestions would lower OVB and increase accuracy and validity.

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Appendices

Appendix A

The five-product level in the airport application

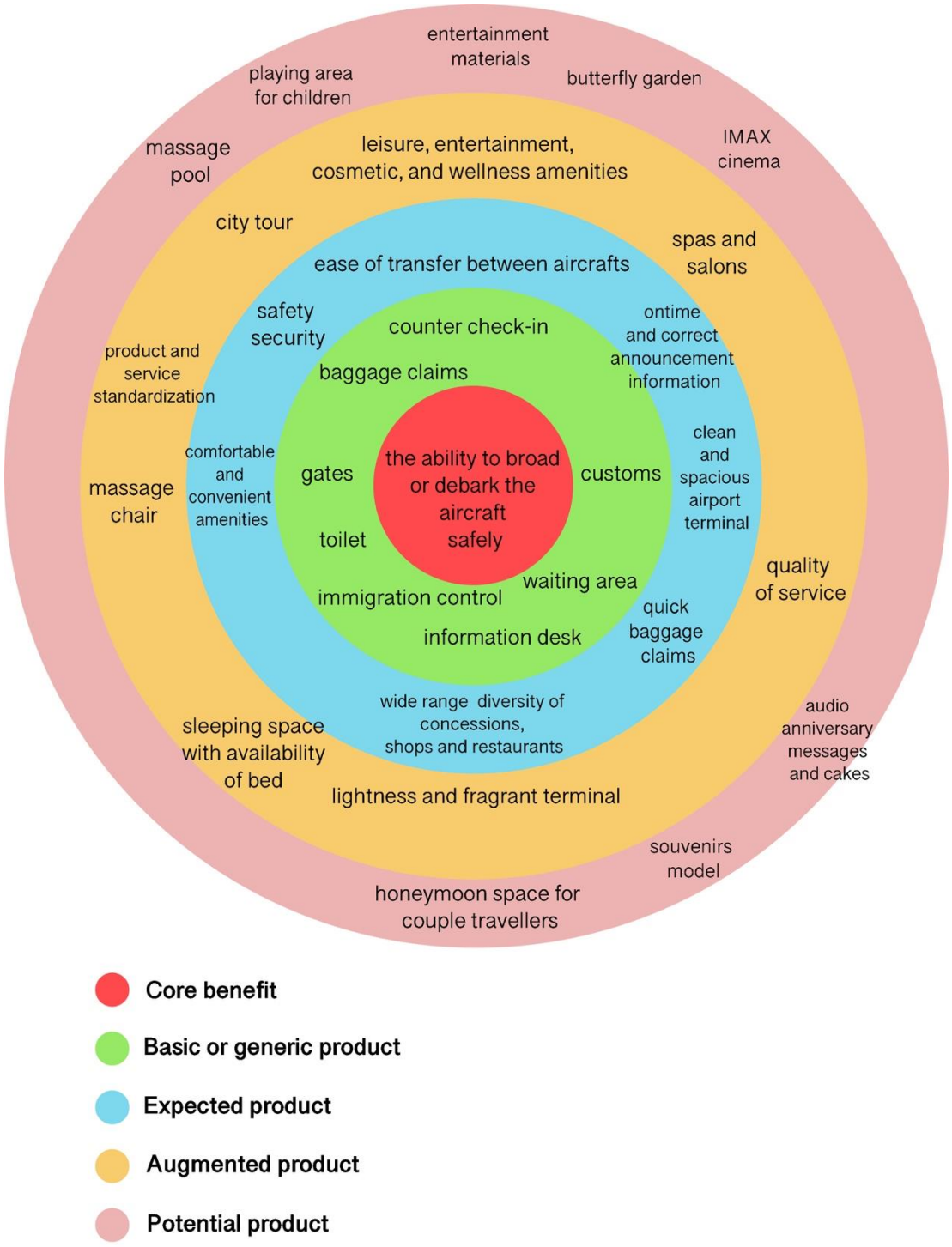

Figure A1. The five-product level in the airport application

Appendix B

List of 68 selected hub airports with overall rating

Table B1: List of 68 selected hub airports with overall rating

List of selected airports		Overall rating (stars)	List of selected airports		Overall rating (stars)
1	Abu Dhabi International Airport	4	35	Kuala Lumpur International Airport	4
2	Amman Airport	3	36	Las Vegas McCarran Airport	3
3	Amsterdam Airport Schiphol	4	37	Lisbon Airport	3
4	Athens Airport	3	38	Los Angeles Airport	3
5	Atlanta Hartsfield International Airport	3	39	Madrid-Barajas Airport	3
6	Auckland International Airport	4	40	Manchester Airport	3
7	Bahrain Airport	3	41	Melbourne Airport	3
8	Bangkok Suvarnabhumi Airport	3	42	Miami Airport	3
9	Barcelona El Prat Airport	4	43	Milan Malpensa Airport	4
10	Beijing Capital Airport	3	44	Montréal-Trudeau Airport	4
11	Boston Logan Airport	3	45	Moscow Domodedovo Airport	3
12	Brisbane Airport	4	46	Moscow Sheremetyevo Airport	3
13	Brussels Airport	3	47	Mumbai Airport	3
14	Cape Town International Airport	4	48	Munich Airport	5
15	Changi Airport Singapore	5	49	Muscat International Airport	4
16	Copenhagen Airport	4	50	New York JFK Airport	3
17	Dallas/Fort Worth Airport	3	51	Newark Airport	3
18	Delhi Airport	4	52	Paris CDG Airport	4
19	Denver International Airport	3	53	Prague Airport	3
20	Dubai Airport	3	54	Rio de Janeiro Airport	3
21	Dusseldorf Airport	4	55	Rome Fiumicino Airport	4
22	El Dorado International Airport	4	56	San Francisco Airport	4
23	Frankfurt Airport	4	57	Seattle-Tacoma Airport	3
24	Gatwick Airport	3	58	Shanghai Hongqiao Airport	5
25	Geneva Airport	3	59	Shanghai Pudong Airport	3
26	Guangzhou Airport	4	60	Stockholm Arlanda Airport	3
27	Hamad International Airport	5	61	Sydney Airport	4
28	Heathrow Airport	4	62	Taiwan Taoyuan Airport	4
29	Helsinki-Vantaa Airport	4	63	Tokyo Haneda Airport	5
30	Hong Kong International Airport	5	64	Tokyo Narita Airport	4
31	Houston George Bush Airport	4	65	Toronto Pearson Airport	4
32	Houston Hobby Airport	4	66	Vancouver International Airport	4
33	Incheon International Airport	5	67	Vienna Airport	4
34	Jeddah Airport	3	68	Zurich Airport	4

Appendix C

Lists of airport service and amenity attributes and its sub-criteria

Table C1. Lists of airport service and amenity attributes and its sub-criteria

Major attributes		Sub-criteria
1	Ground Transportation	1.1 Public Transport options 1.2 Distance to public transport 1.3 Airport taxi service 1.4 Car Rental
2	Security Screening	2.1 Screening guide signage 2.2 Waiting times 2.3 Service efficiency 2.4 Staff attitude and courtesy 2.5 Staff language skills 2.6 FastTrack security
3	Immigration Service	3.1 Waiting times - arrivals 3.2 Waiting times - departures 3.3 Staff attitude and courtesy 3.4 Staff language skills 3.5 FastTrack immigration
4	Wayfinding & Signage	4.1 Ease of wayfinding - arrivals 4.2 Ease of wayfinding - transfer 4.3 Ease of wayfinding - departures 4.4 Clarity of signs & symbols 4.5 Signage language choices 4.6 FIDS: positioning in terminal 4.7 FIDS: clarity of display 4.8 Terminal maps 4.9 Airport "help" staff 4.10 Info Kiosks 4.11 Info or Help counter service
5	Arrival	5.1 Walking distances 5.1 Availability of toilets 5.3 Baggage hall facilities 5.4 Baggage delivery times 5.5 Baggage carts 5.6 Meet and greet facilities
6	Departure	6.1 Signage to check-in 6.2 Congestion around check-in 6.3 Queuing systems 6.4 Seating near check-in 6.5 Premium check-in facility 6.6 Signage to security or departures

Major categories		Sub-categories
7	Transfer (Cont'd)	7.1 Walking Distances 7.2 Signage to transfer areas 7.3 Transfer security screening 7.4 Transfer waiting area 7.5 Rest area for transfer customers 7.6 Ease of transfer process
8	Terminal Comfort and Cleanliness	8.1 Congestion around terminal 8.2 Air temperature 8.3 Decoration and condition 8.4 Seat availability 8.5 Seat types and comfort 8.6 Access to power or charging points 8.7 Cleanliness of seats 8.8 Cleanliness of washrooms 8.9 Cleanliness of public areas 8.10 PRM washrooms 8.11 Baby changing rooms
9	Terminal Facilities	9.1 Clarity of airport PA's 9.2 PA language translations 9.3 ATM availability 9.4 Wi-Fi: ease of log-in 9.5 Wi-Fi: free time allowance 9.6 Internet kiosk facilities 9.7 Children's Play area 9.8 Quiet or relaxation areas 9.9 Dayroom facility 9.10 Terminal hotel 9.11 Other leisure facilities 9.12 Vending machines
10	Shopping Facilities	10.1 Selection of shops: landside 10.2 Selection of shops: airside 10.3 Choice of mid-price shops 10.4 Choice of luxury brands 10.5 Staff service in shops
11	Food & Beverage	11.1 Food and beverage choice: landside 11.2 Fast food choice: landside 11.3 International brands: landside 11.4 Food and beverage choice: airside 11.5 Fast food options: airside 11.6 International brands: airside 11.7 Food and beverage: cleanliness 11.8 Food and beverage: prices 11.9 Food and beverage: staff service

Appendix D

Information about variables

Table D1. Description of variables

Variable		Description
Passenger traffic	continuous variable	The sum of the number of enplaning (embarking) and deplaning (disembarking) passengers at an airport
Airport overall rating	Categorical variable	The overall airport rating categorized in 1-star to 5-stars
Connectivity index	continuous variable	the overall level to which an airport is connected to the rest of the World, either by direct flights or indirect connections via other airports.
Airlines	continuous variable	the total number of commercial passenger airlines operating at the airport
Charges	continuous variable	the total amount of charges to passengers by each airport
Ground Transportation	continuous variable	The score of airport service and amenity quality performance regarding ground Transportation
Security Screening	continuous variable	The score of airport service and amenity quality performance regarding security Screening
Immigration Service	continuous variable	The score of airport service and amenity quality performance regarding immigration Service
Wayfinding & Signage	continuous variable	The score of airport service and amenity quality performance regarding wayfinding & Signage
Arrival	continuous variable	The score of airport service and amenity quality performance regarding arrival
Departure	continuous variable	The score of airport service and amenity quality performance regarding departure
Transfer	continuous variable	The score of airport service and amenity quality performance regarding transfer
Terminal Comfort and cleanliness	continuous variable	The score of airport service and amenity quality performance regarding terminal comfort and cleanliness
Terminal Facilities	continuous variable	The score of airport service and amenity quality performance regarding terminal facilities
Shopping Facilities	continuous variable	The score of airport service and amenity quality performance regarding shopping facilities
Food & Beverage	continuous variable	The score of airport service and amenity quality performance regarding food & beverage
Airport_id	continuous variable	Consisting of 68 selected hub airports

Appendix E

Information about linearity assumption

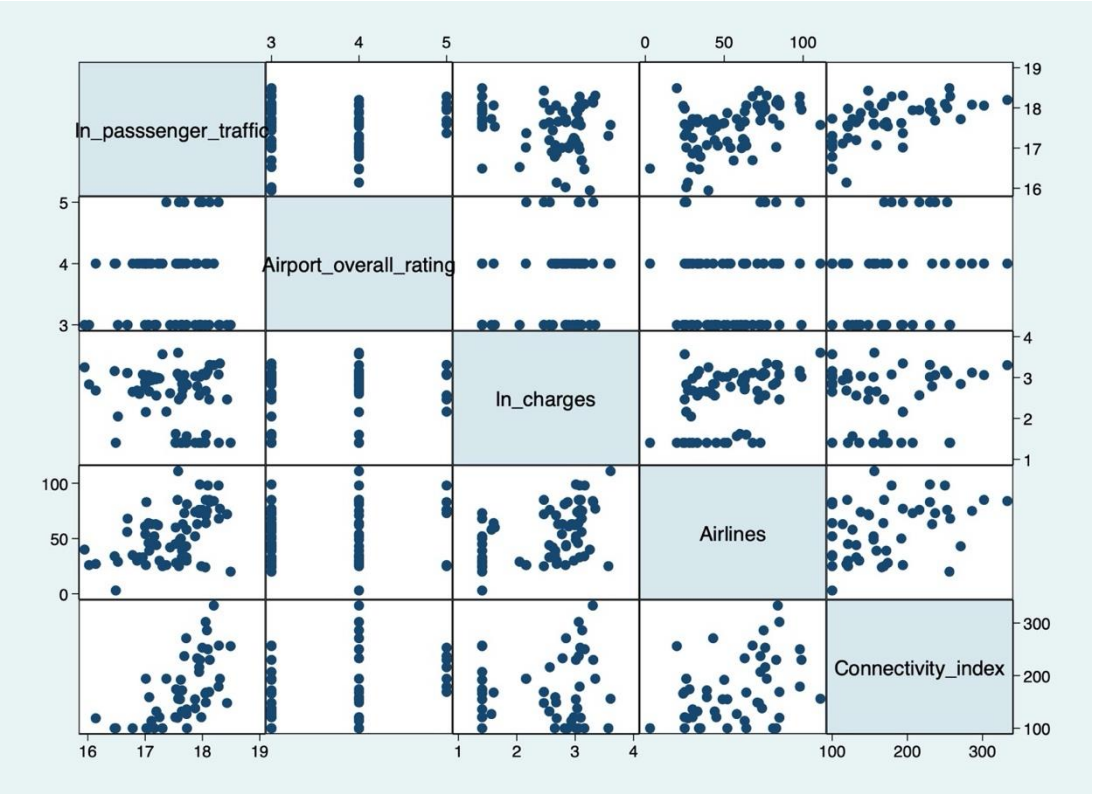

Figure E1. The scatter plot matrix showing the bivariate relationships

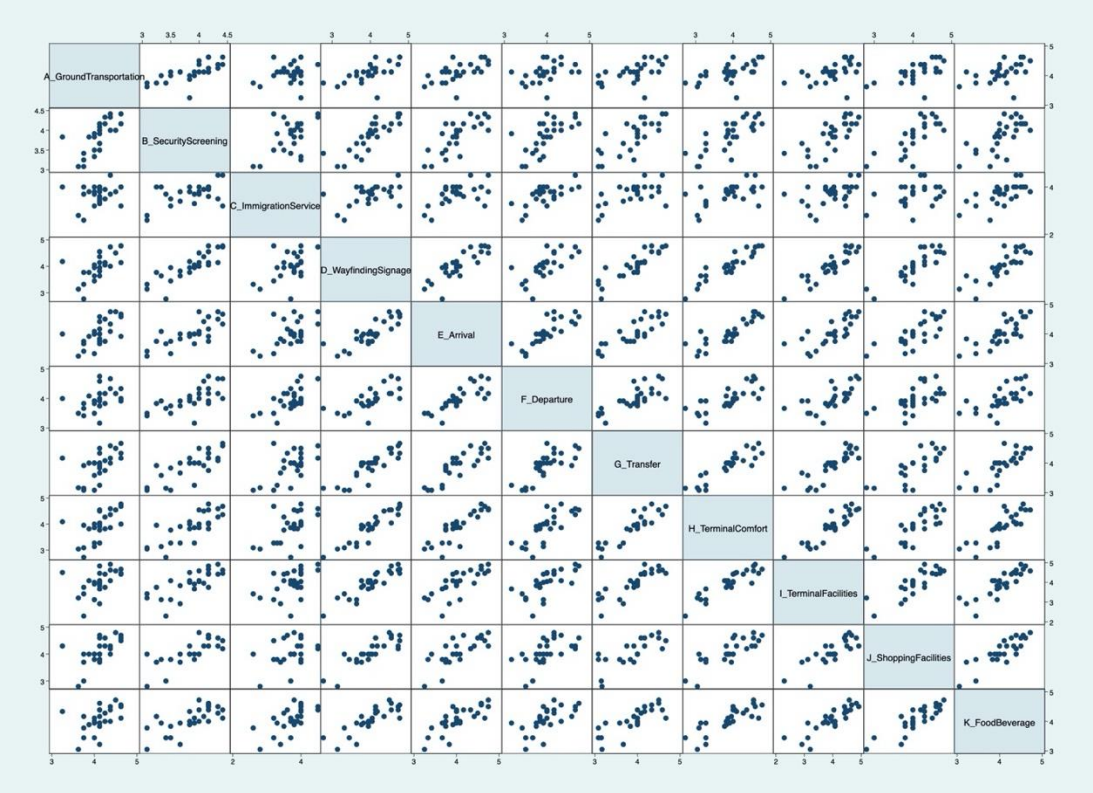

Figure E2. The scatter plot matrix showing the bivariate relationships

Appendix F

Pearson's correlation matrix

Table F1. Pearson's correlation matrix for the variables used

Pairwise correlations	Passenger traffic	Ln passenger traffic	Airport overall rating	Airport connectivity index	Ln Charges	Airlines	Ground transportation	Security screening	Immigration service	Wayfinding signage	Arrival	Departure	Transfer	Terminal comfort cleanliness	Terminal facilities	Shopping facilities	Food & beverage
Passenger traffic	1.000																
Ln Passenger traffic	0.949	1.000															
Airport overall rating	0.046	0.087	1.000														
Airport connectivity index	0.612	0.607	0.222	1.000													
Ln Charges	-0.177	-0.195	0.308	0.090	1.000												
Airlines	0.463	0.482	0.151	0.355	0.438	1.000											
Ground transportation	-0.252	-0.361	0.082	-0.152	-0.470	-0.354	1.000										
Security screening	0.160	0.206	0.702	0.311	0.125	0.158	0.108	1.000									
Immigration service	-0.142	-0.150	0.641	0.165	-0.192	-0.251	0.193	0.523	1.000								
Wayfinding signage	0.109	0.166	0.864	0.417	0.062	0.096	0.178	0.752	0.535	1.000							
Arrival	0.233	0.244	0.905	0.323	0.087	0.068	0.087	0.768	0.563	0.839	1.000						
Departure	0.183	0.195	0.222	0.468	0.071	0.127	0.038	0.339	0.325	0.244	0.170	1.000					
Transfer	0.147	0.170	0.879	0.413	0.010	0.062	0.212	0.768	0.594	0.879	0.742	0.317	1.000				
Terminal comfort & cleanliness	0.080	0.153	0.901	0.347	-0.023	0.052	0.177	0.785	0.544	0.926	0.763	0.252	0.800	1.000			
Terminal facilities	0.015	0.091	0.750	0.477	0.008	0.053	0.267	0.750	0.488	0.906	0.746	0.327	0.856	0.906	1.000		
Shopping facilities	0.112	0.151	0.695	0.436	0.106	0.174	0.204	0.761	0.378	0.842	0.747	0.371	0.766	0.782	0.818	1.000	
Food & beverage	0.043	0.070	0.718	0.416	-0.072	-0.019	0.225	0.693	0.647	0.828	0.770	0.383	0.794	0.786	0.859	0.798	1.000