The effect of the Dutch flight ticket tax on the demand for flight tickets in the Netherlands: a look at the price elasticity of flight tickets.

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Preface

From the start of the exciting Master's course 'Air Transport Economics', by Floris de Haan and Yannis Kerkemezos, I was immediately interested by the air transport industry. So, when I heard I could choose a Master Thesis subject in Air Transport Economics, I instantly knew that my thesis would be on this subject. In May of this year, I chose to write my thesis on the subject 'Flight ticket tax', since I thought it would be a very current topic. Since then, the flight ticket tax has been getting more and more attention in the National media. After an internship of five months at Royal Schiphol Group, my thesis is finished. The five month process was not always easy, but I learned a lot about the aviation industry, my subject and the research process.

First, I want to thank my supervisor, Floris de Haan, for his guidance in the process and his help with getting me in contact with experts in the air transportation subject. I want to thank Schiphol Group and my supervisor at Schiphol Group, Berend Onnes, for their opportunity to let me write my thesis within the company. Furthermore, I want to thank Berend Onnes for his guidance in the process. Additionally, I want to thank the people at Schiphol Group, and the TAF team, that put time in me and helped me with their knowledge about the industry. Also, I want to thank Jeroen van Haaren, from the UPTE department at the EUR, for his guidance with my statistical issues. Last but not least, I would like to thank my family and friends, for their support and motivation.

I hope you enjoy your reading,

Iris Schouten

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Abstract

The flight tax has been extensively in the National media for the last couple of months, because the Dutch government wants to implement a flight tax in 2021. This tax will either be a flight ticket tax or a tax based on emission or noise pollution. The flight ticket tax had been implemented earlier in the Netherlands, in July 2008. Following the implementation of this ticket tax, there was a fall in passenger demand of 4% in 2008. However, the fall in passenger demand was a combined effect of the ticket tax, the economic crisis, the evolution of low cost carriers (LCCs), the trend that travellers from eastern and southern parts of the Netherlands made more frequently use of airports near the border in Germany and Belgium, and rising oil prices.

This research tries to examine the effects of the implementation of a flight ticket tax on the number of passengers travelling from and to the Dutch airports. We assume that the flight ticket tax will be levied only for passengers departing from an airport in the Netherlands. These effects will be estimated by examining the price elasticity of demand for air travel from and to Dutch airports. Price elasticity of demand for air travel will be estimated by estimating a panel data fixed effects two-stage least squares model.

This research shows that air travel demand is inelastic, which means the elasticity is closer to zero than to -1. Air travel demand is more elastic on the leisure segment than on the business segment, and it not significantly different between the short-haul and long-haul segment. Furthermore, the research shows that there will be a small decline in passenger numbers (approximately 0,99% to 1,64%) when a flight ticket tax would be implemented. Our conclusion is that the implementation of a flight ticket tax will not have an huge effect on the number of passengers, therefore it will not influence the number of flight movements, which implicates that the implementation of a flight ticket tax will have no positive environmental effect. However, the flight ticket tax will provide revenue for the State treasury.

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1. Introduction

The flight tax has been extensively in the Dutch media in the past couple of months. The Dutch Ministry of Finance has announced that the flight tax will be implemented again in the near future. The Ministry's main goal is to earn €200 million for the State's treasury (De Telegraaf, 2018). Furthermore, the Ministry wants to stimulate (Dutch) air travellers to take the negative environment impacts of air transport into account in their travel choices (NOS, 2018). The airlines are not amused with the news, and think the flight tax will cost them millions (De Telegraaf, 2018). There are several countries in Europe, such as Austria, Germany, France, Italy, Norway, the UK and Sweden, that have been implementing an air passenger tax in their tax system in the past years (CE Delft, 2018).

In the year 2008, the air passenger tax had been previously implemented in the Netherlands, however, after disappointing passenger numbers, it had been abolished within a year (KiM Netherlands Institute for Transport Policy Analysis (KiM), 2011). This flight ticket tax was levied for origin-destination (OD) passengers only, departing from an airport in the Netherlands. OD passengers are passengers that do have one of the Dutch airport as their trip origin or destination, and transfer passengers are passengers that have their trip origin and destination at an airport other than the Netherlands, but they travel via the airport in the Netherlands. Transfer passengers did not have to pay the tax. According to Dutch studies on the flight ticket tax implemented in 2008, the structural effects of this flight ticket tax was estimated to be 11%. Because of these numbers, parties involved in the air transport industry, are against the implementation of a flight ticket tax in 2021. This thesis aims to investigate the effects of the implementation of a flight ticket tax in the Netherlands on passenger demand, by investigating the price elasticity of demand for air travel in the Netherlands.

At present, traveling by air is, in contrast to traveling by car, train or bus, not taxed in the Netherlands (NOS, 2018). Since there are negative externalities generated from air travel, such as noise nuisance, aircraft engine and ground access vehicle emissions, it is peculiar that traveling by air is not yet taxed (Lu, 2009). However, according to the State Secretary of the Netherlands, Mr. Menno Snel, there definitely will be a new flight tax on flights from the Netherlands in the near future. State Secretary Mr. Snel mentioned that the flight tax will be implemented in 2021, however, he is not sure yet in what way this tax will be implemented.

The Dutch flight tax, that is planned to be implemented in 2021, will either be a joint EER member states flight ticket tax, a taxation on aircraft based on noise certification, or a flight ticket tax implemented by the Dutch government on departing air passengers (Luitwieler, 2018). The flight ticket tax will be an one-way tax, paid by OD passengers, departing from an airport based in the Netherlands. Because the government wants the tax to be implemented in already 2021, there is a small chance that the tax will be a joint EER member states flight ticket tax. In the last coalition agreement, it was already stated that the flight tax would be implemented in the near future (NOS, 2018).

This research tries to examine the effects of the implementation of a flight ticket tax on the demand on air travel in the Netherlands, by examining the price elasticity of demand for air travel in the Netherlands. Earlier studies have been examining price elasticities of air travel demand, but most of the studies are done for the United States. Little studies have been done for the European air travel market. There is only one study which takes into account flights from Schiphol Airport, but they only look at flights of Low Cost Carrier (LCC) EasyJet (Morlotti et al., 2017). Furthermore, most of the studies on price elasticity are not recent. Since the air transportation market has been going through a lot of changes, and evidence on price elasticities on the European air transportation markets is scarce, the aim of this study is empirically relevant.

This study tries to examine, when the ticket tax would be implemented again, whether the passenger numbers at Dutch airports will decline tremendously again, like in 2008, just as involved parties are afraid of nowadays. Furthermore, we[1] want to know whether the ticket tax can be used for the Ministry of Finance’s goal to earn €200 million for the State’s treasury. Therefore, the main research question of this study is:

> *What are the effects of the implementation of a flight ticket tax on air travel demand in the Netherlands?*

[1] In this research, when ‘we’ is used, the author, Iris Schouten, is meant.

We will research the effects of the implementation of a flight ticket tax on air travel demand by examining the price elasticity of air travel demand in the Netherlands. This will be estimated using data from the DiiO Mii FMg dataset, which consists of monthly passenger data and average fare they paid for their flight ticket. Our dataset consists of data from three Dutch airports, Schiphol Airport, Rotterdam-The Hague Airport, and Eindhoven Airport, to 154 European and Intercontinental destinations. First, we will test whether air travel demand in the Netherlands is price elastic. The first Hypothesis is:

Hypothesis 1: Air travel demand is price elastic

Furthermore, we want to know whether there are market segments, such as the short-haul segment and long-haul segment, that will be impacted more heavily, and whether there will be differences between the business segment and leisure segment in the way that passenger demand will react on the implementation of the ticket tax. Therefore, the second and third hypotheses will test whether there are differences in price elasticity between leisure/business and short-haul/long-haul segments:

Hypothesis 2: Air travel demand is more price elastic in the leisure segment than in the business segment

Hypothesis 3: Air travel demand is more price elastic on short-haul flights than on long-haul flights

In this study, it is assumed that the flight ticket tax will only be levied on OD passengers who start their journey at an airport in the Netherlands, thus, the ticket tax will be one-way only, from flights starting at an airport in the Netherlands (Dutch Ministry of Finance, 2018). We assume that the flight ticket tax will not be levied on transfer passengers, therefore we do not take transfer passenger data into account in our analysis. We will compute the price elasticities of passenger demand for air transportation in the Netherlands for different flight segments.

Furthermore, the effects on the demand for air travel in the Netherlands will be computed according to three different scenarios, that contain three different types of the flight ticket tax.

The remainder of this research is organized as follows: section 2 provides a literature review on price elasticity on the air travel market in the Netherlands, on earlier studies on the price elasticities of air travel and earlier studies on the effects of a flight ticket tax. Section 3 provides the data and methodology used in the study. In section 4, the results of the study will be described, and section 5 provides the conclusion of the study.

2. Literature overview

2.1. The price elasticity of demand

Demand elasticities are a rough and approximate measure of aggregate responses in a market (Goodwin, 1992). The price elasticity of a product is defined as the percentage change in demand D because of a percentage change in price P. If demand of a product increases by one percent because of a price drop by one percent of that product, the price elasticity of demand of this product is one. If the price elasticity of a good is stronger than a negative 1, it is said to be 'elastic', and if it is closer to 0 than 1, it is said to be 'inelastic' (Anderson, McLellan, Overton & Wolfram, 1997). Goods with many substitutes have higher elasticities (Anderson et al., 1997). Low elasticities of travel demand imply that policies to change travel demand seem to be relatively ineffective. Likewise, this implies that if there are high elasticities of travel demand, policy measures to change travel demand seem effective (Goodwin, 1992).

The demand for a particular product, of which the price is p, can be described by the following function (Sydsaeter & Hammond, 2008):

$$x = D(p) \qquad (1)$$

When the price of the product changes with $p + \Delta p$, the demand of the product, x, changes with Δx. The relative change of x is $\Delta x / x$. Thus, the ratio between the relative change in the demand and the relative change in the price is:

$$\frac{\Delta x/x}{\Delta p/p} = \frac{p}{x}\frac{\Delta x}{\Delta p} = \frac{p}{D(p)}\frac{D(p+\Delta p)-D(p)}{\Delta p} \qquad (2)$$

Function 2 is defined as the elasticity of demand D. When the elasticity of demand $D(p)$ is defined with respect to p, the elasticity of demand function is defined as follows:

$$Elasticity\ of\ D(p)\ with\ respect\ to\ p = \frac{p}{D(p)}\frac{dD(p)}{dp} \qquad (3)$$

When we let $\Delta p/p$ be 1/100, meaning the price changes with 1%, we can compute the price elasticity by computing $p\Delta x/x\Delta p$.

One of the key differences between leisure and business travellers is that they value their time differently, therefore, leisure travellers are more price-sensitive and more likely to seek lower fares due to income constraints. Business travellers prefer to have a higher frequency of flights to have more flexible choices, less transit time, and shorter waits in the airport. As the costs of traveling by air are a smaller part of the business travellers total costs, an increase in airfares does have less effect on their travel costs (Granados et al., 2012). As noted, the amount of product substitutes have an effect on the price elasticity of a product. As such, when there are more alternatives to air travel, the price elasticity of flight tickets is higher. On short-haul flights, there are alternatives such as traveling by car or by train, but as the distance gets longer, the amount of alternatives becomes smaller. On long-haul flights, there are basically no alternatives to air travel (Brons, Pels, Nijkamp & Rietveld, 2002).

Price elasticity level	***Source***
-1.24 to -2.34	Oum, Zhang, & Zhang (1993)
-0.01 to -0.4 for (Australian) business passengers -0.14 to -1.19 for (Australian) leisure passengers -0.16 to -0.62 for (foreign) business passengers -0.5 to -1.86 for (foreign) leisure passengers	Australian Bureau of Transport and Communications Economics (1995)
-0.534	Jorge-Calderon (1997)
-1.7 to -2.1 for leisure passengers	Taplin (1997)
-0.27 for long-haul business -1.04 for long haul leisure -0.7 for short-haul business -1.52 for short-haul leisure	Gillen, Morrison, Stewart (2003)
-0.75 to -1.62	Castelli, Pesenti, Ukovich (2003)
-0.7	Njegovan (2006)
-1.4 to -1.54	InterVISTAS (2007)
-0.64 to -0.66	Granados, Kauffman, Lai, & Lin (2012)
-0.34 to -0.89 for business passengers -1.33 to -1.56 for leisure passengers	Granados, Gupta, & Kauffman (2012)

Table 1. Price elasticity of air travel demand, including sources

Table 1 shows earlier conducted research on the price elasticity of air travel. The results are widely diverged, but research shows that air travel demand is elastic, it is more elastic on short-haul flights than on long-haul flights, and it is more elastic for leisure passengers than for business-passengers. Furthermore, there is clearly a difference between market-level and country-level price elasticities. These findings support our hypotheses. The latest research done on price elasticities of air travel we have found is from the year 2014, which indicates there is not a sufficient amount of research done in price elasticities in the last couple of years.

2.2. The air travel market in the Netherlands

Air passenger demand is still continuously growing (Carmona-Benítez et al., 2016). In the European air transportation market, the within-Europe market has the biggest growth rate, with a growth rate of 10.8% in 2018. In this market, low cost carriers (LCCs) have the highest share in growth rate (IATA, 2018). It is expected that, with the continuing population growth and higher incomes, the passenger numbers are expected to double in upcoming decades (Royal Schiphol Group, 2018). The Dutch air travel industry had total revenues of $6.4 billion in 2017, with an compound annual growth rate of 4.5% between 2013 and 2017. The compound annual growth rate from 2017 to 2022 is forecasted to be 4.9%, which is expected to drive the industry to a value of $8.2 billion by the end of 2022 (MarketLine, 2018).

Year	***Million $***	***Million €***	***Growth in %***
2013	5,384.7	4,768.3	
2014	5,363.7	4,749.7	(0.4%)
2015	5,579.8	4,941.1	4.0%
2016	6,188.6	5,480.2	10.9%
2017	6,417.4	5,982.8	3.7%
Compound Annual Growth Rate (CAGR): 2013-2017: 4.5%			

Table 2. The Dutch air travel industry value in million $ and €, 2013-2017. Source: MarketLine (2018).

The Dutch air travel market on itself is not a large market. The biggest international airport in the Netherlands, Schiphol Airport, is for a great part dependent on transfer passengers (SEO Amsterdam, 2017). Therefore, Schiphol Airport is not only simply a departure, transfer or arrival point, but a multi-modal hub (Royal Schiphol Group, 2018).

Regarding leisure travellers, air traveling is considered as a luxury good and is disposable. Leisure travellers are highly price sensitive (MarketLine, 2018). Business travellers are less likely to respond to price changes than leisure travellers (Mayor & Tol, 2007). Because the airline industry is highly price sensitive, airlines are in constant price wars with each other, especially in more dense markets (MarketLine, 2018).

Because there are different types of passengers, carriers and flight lengths, the price elasticity of airline tickets is different for business, 'visiting friends and relatives' (VFR), and leisure passengers, short- and long haul flights, and different airline operators (Lu, 2009). Business travellers are more time sensitive and are likely to leave the search task to a travel agency. Leisure travellers are more price sensitive, thus are more likely to use online search capabilities. Travellers are able to enjoy lower search costs, whereby they are able to buy a product that better fit their needs at a lower price (Granados et al., 2012).

Because of the number of connections from the airport, the Netherlands is a more desirable and popular holiday destination for international tourists (Royal Schiphol Group, 2018). The main reasons for passengers at Schiphol Airport to travel by air are leisure, business and visiting friends/relatives (See figure 1).

A huge issue within the Dutch air transportation market is the capacity constraint at Schiphol. The Alders-agreement restricts the capacity at Schiphol to 500.000 commercial flight movements per year until November 2020 (SEO Amsterdam, 2017). In the year 2017, there already were 497.000 flight movements at Schiphol, which implies that the airport has already almost reached maximum capacity (Royal Schiphol Group, 2018). Moreover, the regional Dutch airports have capacity limits (ACNL, 2018). These airports can neither grow substantially, which makes growth in the European air passenger market harder.

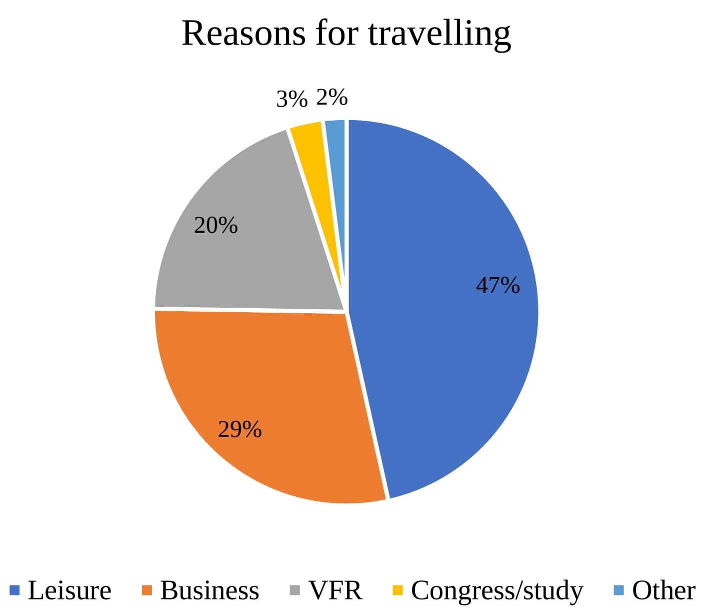

Figure 1. Reasons for travelling for passengers at Schiphol Airport. Source: Royal Schiphol Group (2018).

2.3. The air passenger tax

The taxation system of a country plays a crucial role in influencing the rate of the short- and long-term economic growth in the economy of the country. The type of tax raised, its amount, and its interaction with public spending will have an effect on the long-term growth rate of the economy. Individual tax policy measures, such as a flight ticket tax, are less likely to affect the rate of economic growth for a longer period as they are smaller in scale, but they can affect the level of GDP (PwC, 2017). A flight ticket tax is an indirect type of tax, therefore, it creates distortions in the market by increasing the price of the good or service to where the tax is charged, which is in this case flight tickets. This can lead to businesses and households to adjust their behaviour to avoid paying the tax, resulting in a lower quantity of flight tickets sold (PwC, 2017).

Transportation by air is an important form of passenger transportation for tourism and business (Lu & Shon, 2012). However, there are negative externalities generated from air transportation, of which noise nuisance, aircraft engines and ground access vehicle emissions are the biggest concerns (Lu, 2009). The air travel industry is one of the fastest growing causes of carbon dioxide emissions (Seetaram, Song, & Page, 2013). Air transport accounts for 3% of total CO_2 emissions. This proportion is expected to increase, since the aviation sector is still growing, and it still relies primarily on fossil fuels (Royal Schiphol Group, 2018). The aircraft engine emissions have a huge impact on human health, vegetation, the ecosystem, materials and the climate (Lu, 2009). Technological measures have been taken to reduce aviation emissions, such as changes to the aircraft engine design, improvements in air traffic management and operational efficiency (Lu & Shon, 2012). However, market-based measures, such as a tax burden, can also be taken. There are different types of air transportation taxation; the most common examples are a ticket tax, a noise nuisance tax, a tax on freight flights, and a fuel tax (CE Delft, 2018; Pearce & Pearce, 2000).

In the Netherlands, a flight ticket tax had been previously implemented in July 2008, and later abolished. This flight ticket tax was a measurement within the tax regime of 2008. It was one of the instruments in greening the Dutch taxation system. The goal of the Dutch Cabinet was to shift a share of the burden on profit and labour to burden on environmental pollution. Because the air travel industry clearly pollutes the environment, and the international and EU aviation agreements accept a tax on passengers, the flight ticket tax seemed to be a good instrument according to the Cabinet (KiM, 2011).

However, the flight ticket tax led to strong protests beforehand, from airlines, airports, travel agencies and other interested parties. These parties were afraid of revenue losses and they argued the motivation of the instrument, because part of the passengers would shift to airports in neighbouring countries. According to them, this would more likely cause more pollution instead of less, because passengers would have to travel a longer distance to another airport. Various parties have instituted legal proceedings against the Dutch government to try to postpone the implementation of this air passenger tax. The ticket tax was set at zero in July 2009, because of its negative effects on the air transportation sector (KiM, 2011).

According to the State Secretary of the Netherlands, Mr. Menno Snel, the Dutch government plans to implement an air travel tax in 2021. On July 5th, 2018, the Dutch Ministry of Finance opened a consultation, mentioning that the Dutch Cabinet wants air travel to be taxed from 2021 onwards, with a planned revenue of €200 million a year. Moreover, the possible variations on the air transportation tax were described in the consultation (Dutch Ministry of Finance, 2018).

The following three variations of the flight tax are being mentioned in the consultation of the Ministry of Finance: a joint EER member states flight ticket tax, a taxation a taxation on aircraft based on noise certification, and a flight ticket tax implemented by the Dutch government on departing air passengers. Different subtypes for these three variations are considered, but in this research we will only focus on the variation of the flight ticket tax implemented by the Dutch government, on departing air travel passengers. Transfer passengers will not be taxed in this case, it will be a tax for OD passengers only. We will further discuss the subtypes of this taxation variation in the data section.

2.4. Demand reactions to the air passenger tax

The consumer demand is derived by maximizing the consumers utility function subject to a budget constraint (Oum, Waters & Yong, 1992). In choosing a destination to travel to, the consumer may choose to travel to a less expensive destination that yields the same utility or a destination which is as expensive as the other, but which results in a higher utility. Furthermore, if the travel costs by air get higher, the consumer may substitute traveling by air for traveling by car to their destination.

However, leisure travel is generally regarded as a discretionary expenditure, thus, it has additional substitutes outside of the transport sector, which means that the consumer can also decide to spend their money on something else than traveling (Brons et al., 2002). When the consumer has to pay an additional flight ticket tax with buying their flight ticket, their travel costs will rise, thus the way the consumer maximizes its utility function subject to its budget constraint will change. That is, their travel behaviour may be subject to change. The ticket tax is not only important for air travel demand in the Netherlands, but also demand from foreign passengers have to be taken into account. Since the Netherlands is a popular holiday destination for international tourists, with Amsterdam being the most popular city, the possible reactions of foreign air travel passengers should also be taken into account (Schiphol Group, 2018). Foreign air travel passengers can be described as tourists wanting to visit the Netherlands or business travellers visiting the Netherlands for business.

In summary, there are five ways in which travellers within the air travel market will react to the implementation of a flight ticket tax:

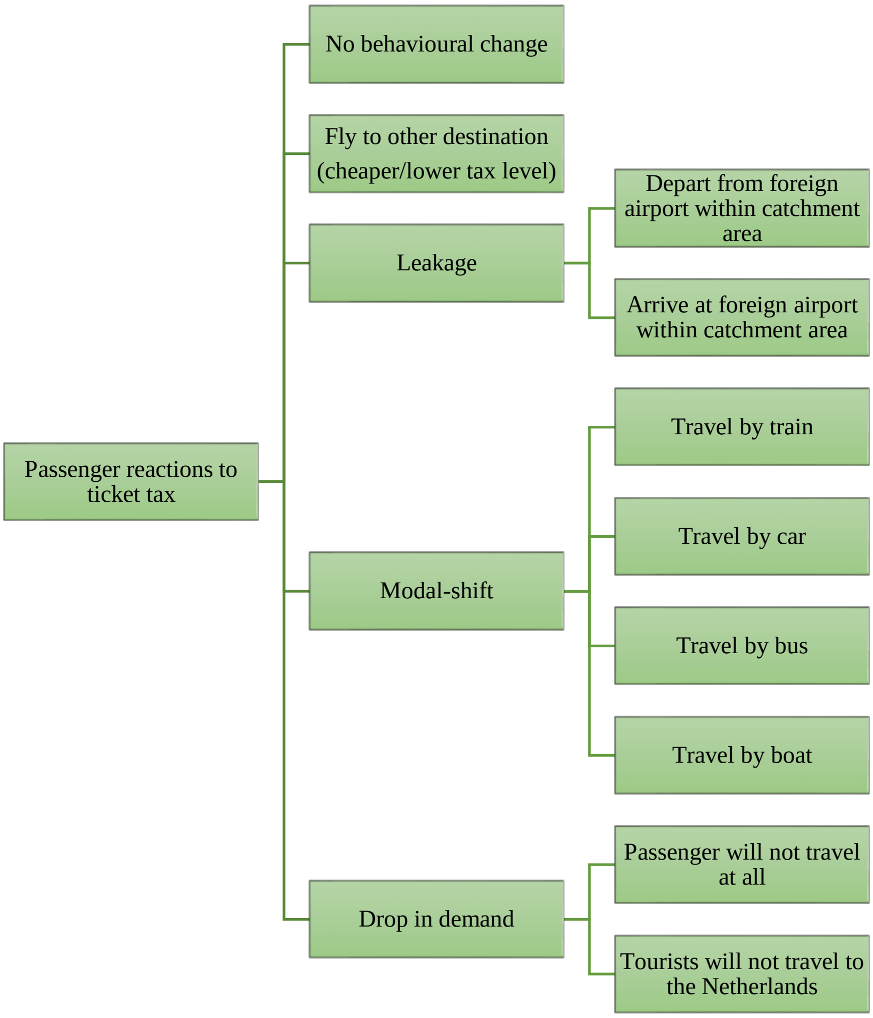

Figure 2. Passenger reactions to the ticket tax. Source: Brons et al. (2002).

To what extent the passenger demand will react on the flight ticket tax, depends partially on the price elasticity of demand. As described earlier in this section, the price elasticity of demand on flight tickets depends on different flight sectors or markets. They vary depending on trip purpose (business, visiting friends and family (VFR), or leisure), flight distance (long haul or short haul), flight class (economy, business or first class) and type of market.

The price elasticity of demand for a good is directly related to the possibility of substitutions for that good. A large number of substitutes for the good implies a high price elasticity, while a lack of substitutes will likely make demand more fixed, which implies a price inelasticity (Brons et al., 2002). The availability of a substitute to flying depends on the particular market and varies according to the costs and benefits of the alternatives. In the Netherlands, Schiphol Airport is the airport which provides the most intercontinental flights (SEO Amsterdam, 2009). Hence, for a number of international destinations, there are no alternative airports in the proximity to depart from to go to these particular destinations. For European destinations, there are more substitutes to choose at nearby competing airports.

Therefore, over intercontinental, long-haul, flights, there are almost no travel alternatives to air travel. However, on short-haul distances, air travel can easily be substituted. If passengers would choose to travel with another mode of transport, there are two most common possible alternatives: by car and by train (Kouwenhoven et al., 2008). Furthermore, consumers try to maximize their overall utility, in a way that they will choose a destination that yields their highest level of utility. When the fare level of this destination increases, the consumer may reconsider his choices and thus may choose for a less expensive destination with the same utility results. For business travellers, there may be no other destination available as substitute, because of the individual characteristics regarding this destination (Brons et al., 2002).

Whether passengers would instead choose to depart from a foreign airport, would depend on the specific airport; if the distance to the other airport is not too big, and if the airport mainly serves low-cost flights or not (Berster, Gelhausen, Grimme, Keimel, Maertens, Pabst, & Wilken, 2010). For passengers flying from and to the Netherlands, airports to which passengers would possible be leaking to are Brussels, Charleroi, Liege, Antwerp, Oostende, Düsseldorf, Köln/Bonn, Dortmund, Münster, Weeze and Bremen (Royal Schiphol Group, 2018).

Non-transport goods may also be regarded as substitutes for transport goods, since a person's budget constraint forces them into competition with each other. An example of a non-transport substitute is to spend budget on a theatre show instead of traveling by air for a city trip. A non-transport good may be regarded as a substitute for a transport good, as long as the utility level derived from an alternative good is equal to that of the transportation good (Brons et al., 2002). If this is the case, the passenger will choose not to fly anymore, resulting in a drop in demand.

2.5. Earlier research on the flight ticket tax

In the Netherlands, the ticket tax had been implemented on July 1st, 2008, but after passenger numbers had declined tremendously, it had been set to zero on July 1st, 2009. This ticket tax was one of the instruments of the government to make the Dutch taxation system ‘more green’. The tax rate was €11,25 for destinations within an EU Member States or other destinations with a flight distance of maximum 2500 kilometres. For all other destinations, the tax rate was €45. The flight ticket tax was levied on OD passengers departing from the Netherlands, it was not levied on transfer passengers and there was no taxation on freight (KiM, 2011).

Beforehand, Kouwenhoven et al. (2008) had conducted a research where they forecasted the effects of the implementation of the ticket tax. The researchers forecasted that as a result of the flight ticket tax, the average ticket price for departing from a Dutch airport would have increased by about 5%, and the reduction in the number of passengers departing and arriving at Dutch airports would be about 8% to 10%. Shortly after the implementation of the ticket tax, the credit crisis occurred, which resulted in a big fall in air transportation worldwide. Exchange rates and oil prices also did play a role in this fall. At Schiphol Airport, the fall in passenger numbers was even bigger than in other countries (KiM, 2011).

The total number of OD passengers fell by 3.6% over the year 2008, while the number of transfer passengers could still grow with 3% (SEO Amsterdam, 2009). This implies that because of the implementation of the flight ticket tax, passenger numbers at Dutch airports have decreased. Furthermore, Dutch travel agencies saw the number of air passengers significantly shift to foreign airports. Because of other factors that had a significant role in the declining passenger numbers at airports worldwide and in the Netherlands, it is difficult to compute the exact effects that the flight ticket tax had on passenger numbers in 2008. KiM (2011) estimated that the leakage from Dutch airports to foreign airports was approximately 1.2 million passengers. The big attention to the flight ticket tax in the publicity prior to the implementation of the air passenger tax has played a big role in the scope of this effect. The effects of the flight ticket tax were small at the Airports Groningen and Rotterdam-The Hague, but they have been clearly felt by the Eindhoven and Maastricht Airports.

The Dutch government reacted on this fall in passenger volumes by putting the air passenger tax at zero on July 1st, 2009, and on January 1st, 2010, the air passenger tax was abolished under conditions (KiM, 2011). After setting the air passenger tax at zero, the number of air passengers at Schiphol did not rise immediately to the level before the implementation of the air passenger tax. This was also an effect of the economic credit crisis.

One of the conditions for the abolishment of the ticket tax, was that Schiphol airport itself should implement enough measures to reduce costs and improve their competitiveness (Ministry of Finance, 2009). After the abolishment of the air passenger tax, one of the conditions was that Schiphol airport should implement enough measures to reduce costs and improve their competitiveness. The airport developed a new strategy: It lowered its airport tariffs with 10% on April 1st, 2009, thus it would be cheaper for airlines to operate at the airport. Furthermore, Schiphol Airport implemented expenditure cuts throughout the whole company. Accordingly, their marketing goal was to win back their passengers (KiM, 2011).

Before and around 2008, there were two trends within the air transportation market in the Netherlands, and especially at Schiphol Airport. First, travellers from eastern and southern parts of the Netherlands made more frequently use of airports in Germany and Belgium, such as Düsseldorf, Brussels and Weeze Airports. Second, around that time, there was the evolution of LCCs, such as Ryanair, which are operating more from regional airports. The number of passengers of low cost airlines Ryanair and easyJet together had grown from 10 million passengers in 2000 to 110 million passengers in 2009, while the growth of passengers from traditional airlines stagnated. These low cost airlines are mainly based in nearby foreign airports. Furthermore, the Dutch air transportation market already had declining numbers before July 2008, oil prices were rising, and there were also effects of exchange rates on passenger numbers. Because of these trends and developments in the airline industry, it is hard to determine the effects of the Dutch air passenger tax that was implemented in 2008 (KiM, 2011).

Nowadays, the economic situation and air transportation market is different from the situation in 2008. LCCs have a share of over 30% in the European aviation sector in 2017 (Royal Schiphol Group, 2018). However, present day, the dividing line between LCCs and legacy carriers continues to blur, as they implement strategies from each other's business models (Belobaba et al., 2015). Dutch airports do not have much room for growth at the current moment, since they have capacity restrictions. The effects of the implementation of a ticket tax at present day will certainly be different from the effects that the flight ticket tax had when implemented in 2008.

2.6. The effects of the flight ticket tax

The implementation of a Dutch flight ticket tax in the Netherlands will possibly have some implications. First, there will be an additional tax revenue for the government from the flight ticket tax, which is estimated to be €200 million (Ministry of Finance, 2018). Second, there will likely be a change in the number of passengers at Dutch airports, which will result in losses of revenue for Dutch airports. Of these losses, there are two categories; loss in aeronautical revenue (passenger- and landing charges) and non-aeronautical revenue (expenditures of passengers at the airport). Additionally, airlines flying from the Dutch airports will possibly have losses in revenues, the Netherlands itself will have losses in revenue from foreign tourists and business travellers, and there possibly will be losses in revenue due to a drop in activities in the aviation industry and even wider industries (SEO Amsterdam, 2009).

Nowadays, a big issue for the growth of airports is that they have capacity constraints. Major European airports have capacity limits, such as London Heathrow Airport. Likewise, Dutch airports have capacity constraints, as earlier described in Section 2.2..

When an airport has reached its capacity limit, not all demand can be accommodated (CE Delft, 2018). Consequently, the producers will increase their prices until there is an equilibrium between the demand and supply. Considering that most airports are price-regulated, it is unlikely that they will increase their charges. Hence instead, the airlines will increase their prices (Evans & Schäfer, 2014). The extra costs that travellers have to pay in this case, is called the *scarcity/economic rent*, which is captured mostly by the airlines (CE Delft, 2018) (See figure 2)

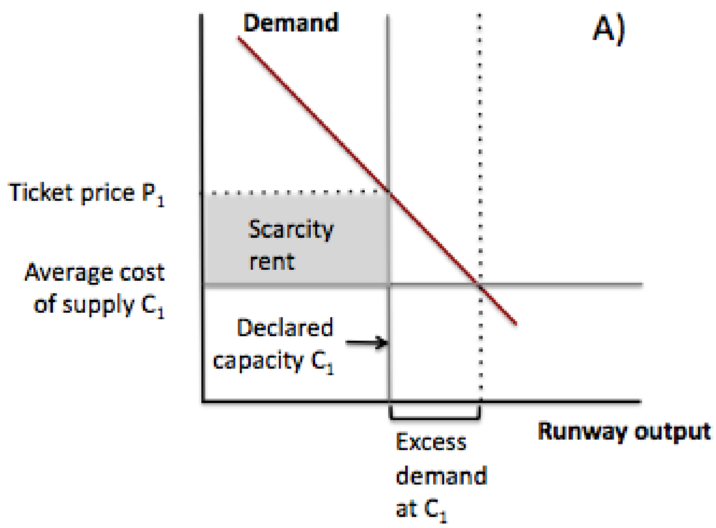

Figure 3. Scarcity rent. Source: Starkie (1998).

When fares are increased, consumers with the lowest willingness to pay are ‘pushed out’. Generally, these consumers are the leisure and transfer passengers, because transfer passengers have a lot of alternatives to choose from, and therefore transfer passengers have a lower willingness to pay, and leisure passengers have a lower willingness to pay than passengers with other motives, such as business passengers (SEO Amsterdam, 2009). This phenomenon of ‘pushed out’ passengers is called the ‘*crowding-out effect*’. Their travel costs and travel time will be higher, because they have to travel via an airport further away, which can result in a part of the passengers deciding not to travel at all anymore. This phenomenon is called ‘*market degradation*’ (Evans & Schäfer, 2014).

In theory, with the capacity constraint, the ticket tax will be at expense of the scarcity rents of the airlines. The airlines will earn less profit, and the costs for passengers will not be (a lot) higher (SEO Amsterdam, 2018). However, the flight ticket tax will likely partly be paid by travellers and partly by the airlines. Travellers will pay in the form of higher priced tickets, and airlines will have to sacrifice a part of their scarcity profits (CE Delft, 2018). Here, passengers that are not willing to pay for the higher costs, will be ‘crowded-out’. In this case, transfer passengers will not be crowded-out because they do not have to pay for the ticket tax, instead there will be more room for transfer passengers when OD passengers are crowded-out because of the ticket tax.

The network quality of an airport is important for the competitive position of the airport. The network quality of airports can be described in terms of connectivity, of which there are three types (ACI Europe, 2018):

- Direct connectivity – the connections from airport 1 to other airports in the world.
- Indirect connectivity – the connections with a layover at a layover airport from airport 1 to other airports.
- Hub connectivity – the connections via airport 1 from one airport to other airports.

Direct connectivity and hub connectivity are the most important types of connectivity for Schiphol Airport. For the Dutch regional airports, only their direct connectivity is important. Because ticket prices will rise, passenger demand will reduce. A great reduction in the demand for air transportation, will lead to a decrease in the number of flights at an airport. As a result, the connectivity of the airport will be reduced, because there are less travel options available at the airport (SEO Amsterdam, 2018).

When a ticket price is raised because a ticket tax is implemented, it is likely that passenger demand will fall. This can possibly result in a decrease in load factors. Furthermore, when load factors are low, airlines can choose to discontinue flights or even a whole route. If this happens, it is not good for the competitive position of an airport. Connectivity is one of Schiphol's key strategic principles, so the implementation of a ticket tax may have consequences for the competitive position of Schiphol and the Dutch economy (Royal Schiphol Group, 2018).

However, according to SEO Amsterdam (2018), a ticket tax will have little effect on the total number of aircraft movements at Schiphol, which is partly a result of the capacity scarcity at the airport. According to this research, the flight ticket tax will result in a shift from passenger flights to cargo flights. Additionally, because the ticket tax will only be levied on OD passengers, it will result in a shift from the number of OD passengers to the number of transfer passengers.

Furthermore, it will be less attractive for LCCs to serve from airports in the Netherlands, when a ticket tax would be implemented. The LCCs that are based near the border, can choose to re-base at a foreign airport close to the border, in order to minimize costs and to increase their attractiveness (Berster et al., 2010). This would give passengers even more incentives to choose a foreign airport near the border, and there thus will be even more ‘leakage’, as described in Section 2.4..

Because the implementation of the flight ticket tax will result in a decline in demand, it will subsequently result in decreased load factors of airlines and the network quality of the airport (SEO Amsterdam, 2018). Moreover, these consequences can have the de-hubbing process of the hub airport as a result. During this process, airports are (gradually) losing their hub function. It is shown that airports who lost their hub function, have barely been able to win their position back (SEO Amsterdam, 2015). It would have huge implications, for the airport, jobs and economic, when the de-hubbing process would set in at Schiphol Airport.

Recently, CE Delft (2018), has researched the possible effects of an air passenger tax in the Netherlands. Their researchers have forecasted that still, there will be a capacity scarcity in the years ahead, even in a low-growth scenario. When the government would be implementing a ticket tax for OD passengers only, we will see a shift in the number of OD passengers to the number of transfer passengers. When more transfer passengers will be travelling via Schiphol, KLM and their partner airlines are still able to expand their network. When there will be a higher tax tariff for long-haul passengers than for short-haul passengers, we will see a shift in passengers from long-haul to short-haul flights. However, because of the capacity constraint, an implementation of the ticket tax will barely have an effect on the hub connectivity of Schiphol Airport. Surprisingly, according to CE Delft (2018), overall, the implementation of an air passenger tax will have a positive effect on the Dutch welfare.

3. Empirical analysis

3.1. Data and methodology

The following section describes the data used for the study, the methodology conducted in the study and the results obtained from the study.

3.1.1. Data description

The main data source of this study is obtained from the FMg database of DiiO Mi. The DiiO Mi FMg database consists of ticket sales data from ARC and IATA. The dataset consists of monthly fares, seat classes, distances in miles and passenger numbers for 154 destinations, including zero or one stop(s), from three Dutch airports[2], of the period January 2010 till July 2018. We did not include the smaller airports Groningen Airport Eelde and Maastricht Aachen airport, since the data availability on flights from these airports was not sufficient. We do not take transfers via Dutch airports into account, since the tax will almost certainly be levied on OD passengers, and not on transfer passengers. We will call the non-Dutch airports 'destination airport' and the Dutch airports 'origin airport' in the analyses. However, non-destinational data is used, which means that the fares for both directions are taken into account. We use fare data for passengers that are categorized into different service classes on a flight, such as Discount Economy, Premium Economy, Business class and other classes. Additionally, we obtained monthly average Jet Fuel prices from the US Energy Information Administration. We use yearly country GDP data, which is obtained from IHS and the World Bank.

Our dataset consists of monthly Origin-Destination (OD) data between the three Dutch airports and 154 destinations in 56 countries.[3] These destinations are chosen based on sufficient number of pax per month, a sufficient number of observations, throughout the months and the years 2010 to 2018. Our dataset consists of 61.872 unique observations and 1.771 clusters, clustered on service class per airline and per route. We use passenger motive data (business, congress/school, leisure, VFR) from the database of ContinuOnderzoek.

After testing our hypotheses regarding the price elasticity of demand for air travel in the Netherlands, we will examine the effects of a rise in ticket prices as a result of the

[2] Schiphol Airport, Eindhoven Airport and Rotterdam-The Hague Airport
[3] A list of included destinations can be found in Appendix 1

implementation of the flight ticket tax. In order to do that, we first have to determine the type of ticket tax that will be implemented in the Netherlands. In an online consultation by the Dutch Ministry of Finance, the tax tariffs and variants that are considered to be implemented in the Netherlands are listed. The main types that are mentioned by the Dutch Ministry are a collective EER Member States ticket tax, a tax on the noise level of airplanes and a Dutch ticket tax. For this study, the latter is the most relevant, of which the variants we use in our analysis are described in table 3.

Tax Variant	*Description*	*Tariffs (in €)*
3b	The Dutch government will implement a flight tax with three tariff zones according to the German system. Freight and transfer passengers are excluded from this tax. The tax tariffs will be €3,81 for passengers traveling to a destination in Zone I (a distance of less than 2000 km), €11,95 for passengers traveling to a destination in Zone II (distance between 2000 and 6000 km) and €21,73 for passengers traveling to a destination in Zone III (distance of more than 6000 km)	Per passenger: Zone I: 3,81 Zone II: 11,95 Zone III: 21,73
3c	The Dutch government will implement a flight tax with two tariff zones, like the flight tax in the Netherlands in 2008. Freight and transfer passengers are excluded from this tax. The tax tariffs will be €4,34 for passengers traveling to a destination in Zone A (distance of less than 2500 km) and €17,37 for passengers traveling to a destination in Zone B (distance of more than 2500 km)	Per passenger: Zone A: 4,34 Zone B: 17,37
3e	The Dutch government will implement a flight tax with two tariff zones, where short-haul flights are taxed heavier than long-haul flights. Freight and transfer passengers are excluded from this tax. The tax tariffs will be €9,17 for passengers traveling to a destination in Zone A (distance of less than 2500 km) and €2,29 for passengers traveling to a destination in Zone B (distance of more than 2500 km)	Per passenger: Zone A: 9,17 Zone B: 2,29

Table 3. Variants of the flight ticket tax. Source: Ministry of Finance (2018)

We assume that the flight ticket tax will be levied on passengers on flights departing from a Dutch airport. Passengers from flights landing in the Netherlands will not have to pay the tax, which means that it is a one-way tax only. Furthermore, transfer passengers, with a transfer at a Dutch airport, do not have to pay the flight ticket tax. All the tax tariffs, mentioned above, are based on a yearly State revenue from the taxes of €200 million. We will examine the three types of tax described in table 4 in our scenarios. Tax variant *3b* is based on the German flight ticket tax, where there are different tariffs for three different zones, based on the distances between the particular airports. Zone I is for flights till 2000 kilometres, flights between 2000 and 6000 kilometres are taxed based on Zone II, and the tariff for Zone III is for flights longer than 6000 kilometres. The second tax variant, *3c*, has Zones based on the former Dutch flight ticket tax, and consist of two Zones, for flights shorter than 2500 kilometres and flights longer than 2500 kilometres.

The last tax variant, *3e*, seems to be an interesting variant. This variant is again split up between two zones, but has a higher tariff for shorter flights than for longer flights. Nowadays, for leisure travellers, transport to and from a holiday destination is not a big part of holiday expenses, especially on short-haul destinations, because the air fares are low on short-haul flights (Njegovan, 2006). Furthermore, there are other important demand drivers in this market such as the costs of travel substitutes. If, for leisure travellers, the price of short-haul flights rises, the relative price of other travel modes will be lower, causing leisure travellers to shift to another mode of transport. Therefore, the objective of the government with tax variant *3e* is to lead to a modal shift on shorter flights.

Our dataset shows that a high share of passengers at the regional airports Eindhoven Airport and Rotterdam The Hague Airport, fall in Zone 1 and A. This would imply that in the case of tax variant 3b and 3c, these airports are less affected by the flight ticket tax than international Airport Schiphol, which has a lower share of passengers that fall into Zones 1 and A. On the other hand, if tax variant 3e would be implemented in the Netherlands, and the passenger demand for these destinations would react heavily to the implementation of the flight ticket tax, it would impose a real threat to the regional airports that mostly fly to shorter destinations.

	Number of destinations in the dataset	% of passengers in 2017 per zone, all destinations taken into account (including transfer)
Schiphol Airport	**149**	
Zone A	103	73%
Zone B	46	27%
Eindhoven Airport	**47**	
Zone A	44	96%
Zone B	3	4%
Rotterdam The Hague Airport	**26**	
Zone A	25	96%
Zone B	1	4%

Table 4. Number of destinations per zone, according to the 'old' Dutch taxation system.

	Number of destinations used in dataset	% of passengers in 2017 per zone, all destinations taken into account (including transfer)
Schiphol Airport	**149**	
Zone I	92	67,9%
Zone II	25	13,8%
Zone III	32	18,3%
Eindhoven Airport	**47**	
Zone I	42	92,0%
Zone II	5	7,9%
Zone III	0	0,04%
Rotterdam The Hague Airport	**26**	
Zone I	23	95,6%
Zone II	3	4,3%
Zone III	0	0,1%

Table 5. Number of destinations per zone, according to the German taxation system.

3.1.2. Methodology

In this study, to answer our hypotheses, we will determine the price elasticity of air travel at the Dutch airports Schiphol, Rotterdam-the Hague, and Eindhoven. To determine the price elasticity of air travel, we will consider a price elasticity model. Since the problem of reverse causality may arise when investigating the relationship between price and demand, we will consider a two-stage least squares model (2SLS), to solve the problem of price endogeneity. Since the pricing management of airlines sets the fares based on existing bookings and historical sales, fares are influenced by demand, therefore, they are endogenous. On the other hand, demand is also affected by price. Therefore, an ordinary least squares (OLS) model would be biased. 2SLS is often used to improve the consistency of elasticity estimates when explanatory variables are believed to be correlated with the regression model's error term. With this method, an instrumental variable (IV) for fare will be used, which is correlated with the fare (endogenous variable) but is not included in the demand equation. Furthermore, the IV must be independent of the error term in the model.

Earlier studies that have used 2SLS to determine price elasticity, have used different instruments. Jet fuel costs are often used as an instrument for fare (Hsiao & Hansen, 2011). In the research of Hsiao (2008), the jet fuel costs multiplied with the distance between the two airports is used as an instrument for fare. If the jet fuel price is multiplied by the distance between the two airports, it can represent the costs of offering the air transportation service, since jet fuel costs represent 20 to 50% of the airline costs (Koopmans & Lieshout, 2016). Costs affect the price of the service, but they do not directly have an effect on the demand. Therefore, a cost-side IV would be a good fit. Secondly, a lot of studies use a competition variable as an instrument for fares (Berry & Jia, 2010; Giaume & Guillou, 2004; Malighetti et al., 2010; Stavins, 2001).

As a competition-indicator IV, Berry & Jia (2010) use the number of carriers on a specific route as an instrument for fare. This variable indicates the level of competition on a route. If there is a higher level of competition on the route, the fares are suppressed. Furthermore, the level of competition does not have an influence on the demand, which makes this variable a good instrument. For our 2SLS model, we use the jet fuel costs multiplied by distance between the airports as a cost-side IV, and the number of carriers on the route as a competition-indicator IV. There is a chance that airlines cross-subsidize their costs between profitable routes and less profitable routes. Therefore, we add the number of carriers on the route, which describes competition, to our cost-side IV, the jet fuel price multiplied by distance. More competition mostly indicates a lower profit margin, therefore, the competition indicator is a good instrument in determining fare.

Another characteristic of our dataset is that it consists of panel data, which is clustered by airline and service class per route in the model. Therefore, we will estimate a panel 2SLS model with fixed effects estimation. In the fixed effects estimation, a, as shown in equation (4) and (5), takes the route-level unobserved time-constant factors into account in its estimations, which is also called 'fixed effect'. Therefore, characteristics that do not change over time cannot be included in the model (Wooldridge, 2014).

Here, the first stage of our model is:

$$\log(Fare)_{jt} = \pi_1 \log(Distance * JetFuel\ Price)_{jt} + \pi_2 Carriers_{jt} + \pi_3 i.Month_{jt} + a_j + v_{jt} \qquad t = 1, \dots, T, \qquad (4)$$

Where *Fare* is the average *fare* per month on the route, *Distance * JetFuel Price* is the monthly average Jet Fuel price times the distance flown in kilometres, *Carriers* is the number of carriers serving on the route in the same month, and *Month* represents the month of the observation. In our models, the month January is not shown, because it is used as the reference month.

The second stage of our model is:

$$\log(TotalPax)_{it} = \beta_1 \log(Fare)_{it} + \beta_2 i.Month_{it} + \beta_3 log(DestGDP)_{it} + a_i + u_{it} \qquad t = 1, \dots, \mathrm{T}, \qquad (5)$$

Here, *TotalPax* represents the number of passengers on the route for the particular service class, *Fare* represents the first stage model, equation (4), and *DestGDP* represents the GDP of the country of destination in the year of observation. Other variables we used, but did not put into our final model are *Airports*, which gives the number of airports in the catchment area offering the same destination and *Seats*, which gives the number of seats on direct flights on the route in the particular month. Further description of these variables and why they were not put into the model will be described in Section 4.1.1..

The STATA package we used in computing the model, ‘xtivreg2’, automatically controls for heteroskedasticity, with robust standard errors when using fixed effects (Baum, Schaffer & Stillman, 2003). The level of air travel demand is season-dependent. Figure 2 shows that air travel demand has a peak in summer months. To control for this effect, we include month-specific variables in our model. In our model, we use the log of Total Pax (Passengers) and the log of Fare, which directly shows the percentage change of both variables, which is also called the price elasticity[4].

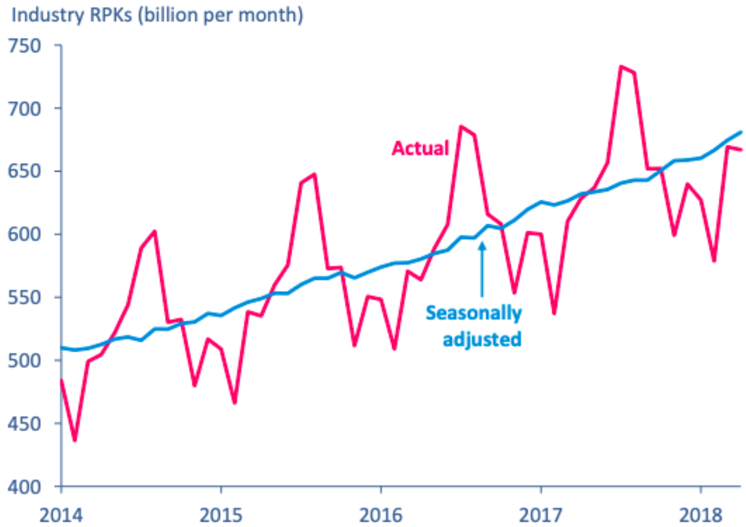

Figure 4. World airline demand from 2014 till 2018 in RPKs (Revenue Passenger Kilometers). Source: IATA Economics (2018).

For the variable Airports, we defined the catchment area as the catchment area of Schiphol Airport, which is shown in the figure below (Royal Schiphol Group, 2018). It will be assumed that the catchment area for Eindhoven Airport and Rotterdam-The Hague airport consist of the same catchment area. The catchment area, which includes Brussels, Charleroi, Liege, Antwerp, Oostende, Düsseldorf, Köln/Bonn, Dortmund, Münster, Weeze and Bremen, and all Dutch airports (Schiphol, Rotterdam-the Hague, Eindhoven, Groningen Eelde, and Maastricht Aachen), is defined as the area surrounding the airport from which it attracts its passengers (Lieshout, 2012). The catchment area for transfer passengers are not taken into account in this

[4] Equations on elasticities can be found in Section 2.1

case. Thus, if another airport is with its catchment area within the catchment area of the Dutch airport, the airports both attract passengers from the same area, and thus they are in each other's catchment area.

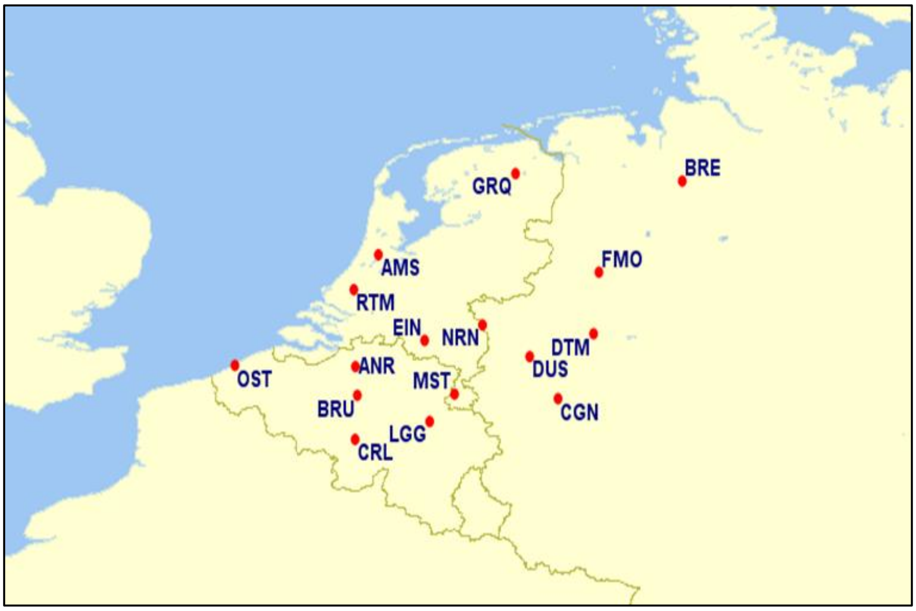

Figure 5. Catchment area. Source: Great Circle Mapper (2018)

"Hypothesis 1: Air travel demand is price elastic"

Before testing our first hypothesis, we test whether our 2SLS model is valid. By running a normal panel data fixed effects regression, which would be the 'second stage' only, and comparing the coefficients of this model to the coefficients of our 2SLS panel data fixed effects regression model, we can conclude whether the 2SLS model estimates the coefficients better than the normal model. If so, we can test our first hypothesis by examining if the coefficient of *log(Fare)* estimates a negative demand elasticity.

"Hypothesis 2: Air travel demand is more price elastic in the leisure segment than in the business segment"

To test our second hypothesis, we examine whether there are differences in price elasticity of demand between the leisure segment and the business segment. With the help of data from ContinuOnderzoek (2017), we cluster our destinations into three groups, which will represent different markets. ContinuOnderzoek examines the motives of traveling of passengers departing for different destinations at Amsterdam Airport Schiphol. Then, the 2SLS regressions will be run on the 'leisure' and 'business' clusters, to determine the differences in the coefficient of *log(Fare)* between the clusters. We identify our clusters as follows[5]:

- Leisure destination = more than 50% of passengers departing to the destination are leisure passengers
- Business destinations = more than 30% of passengers departing to the destination are business passengers, less than 50% of passengers are leisure passengers and less than 20% of passengers are VFR passengers.
- Other destinations = all destinations that do not fall in one of the above categories, or if there is no (sufficient) data on passenger motives for these destinations

"Hypothesis 3: Air travel demand is more price elastic on short-haul flights than on long-haul flights"

To test the third hypothesis, we will examine whether there are differences in price elasticity of demand between short-haul flights and long-haul flights. For this hypothesis, European flights are defined as short-haul flights and Intercontinental flights are defined as long-haul flights. We will run the price-elasticity model on both European flights and Intercontinental flights, and determine whether the coefficients of Fare for both models are significantly different from each other. Furthermore, we run regression models on the Business destination and Leisure destination clusters, for both the short-haul and long-haul segments, and determine whether there are differences in price elasticity between short-haul and long-haul destinations for the groups.

[5] The exact destinations per group can be found in Appendix 1

3.1.3. Scenario analysis

Based on the tax variants, shown in table 3, we have created three different scenarios, which are shown in table 6. For each of these scenarios, we will determine what the effects would be on the number of passengers flying to and from the Netherlands if the flight ticket tax would have been implemented. We will examine these scenarios for one particular year, which is the year 2017. This year is the most recent full year, therefore we can easily compare our base year to our scenarios. In determining the effects of the flight ticket tax on passenger numbers, we use the total number of air passengers in the Netherlands, and the percentage of passengers from our dataset flying in the different taxation zones. Then, with these numbers, we calculate the approximate number of passengers flying in each taxation zone.

Scenario	*Taxation type*
Scenario 1	Tax variant 3b: €3,81 for passengers traveling to a destination in Zone I (a distance of less than 2000 km), €11,95 for passengers traveling to a destination in Zone II (distance between 2000 and 6000 km) and €21,73 for passengers traveling to a destination in Zone III (distance of more than 6000 km)
Scenario 2	Tax variant 3c: €4,34 for passengers traveling to a destination in Zone A (distance of less than 2500 km) and €17,37 for passengers traveling to a destination in Zone B (distance of more than 2500 km)
Scenario 3	Tax variant 3e: €9,17 for passengers traveling to a destination in Zone A (distance of less than 2500 km) and €2,29 for passengers traveling to a destination in Zone B (distance of more than 2500 km)

Table 6. Scenarios used in our analysis based on the proposed tax variants. Source: Ministry of Finance (2018)

An issue with determining how air passenger demand would react on the implementation of a ticket tax, is the way in which the ticket tax costs are passed through to the passengers. According to Zimmerman & Carlson (2010), there is a pass-through of costs of 100% in perfect competitive markets, and in oligopoly markets there is a pass-through of costs larger than 20 to 50%. Since the pass-through of costs is different for each market, and it is difficult to determine the exact cost pass-through, we will assume a perfect competitive market and 100% cost pass-through. This implicates that, the prices/fares will rise with the same amount that the tax burden will be. After determining the fare changes, we will calculate the effects of the fare changes on the passenger numbers that will be travelling by air, for each of the three scenarios. We calculate this, with the help of our price elasticity model, which we have used for hypothesis 1. Since price elasticities are different on each route and for every market, we will use the 95% confidence interval of price elasticity of the *log(Fare)* coefficient to calculate the changes in passenger numbers. By using the confidence interval we make sure to take differences in price elasticities for different markets into account.

4. Empirical results

4.1. Price elasticity results

4.1.1. "Hypothesis 1: Air travel demand is price elastic"

In table 7, the price elasticity regression models with different variables included are shown. In model (1), only the months are included in the model, we see that the coefficient of *log(Fare)* (the price elasticity of demand) has a value of -0.463. The month January is not shown in the tables containing the model output, because this month is used as reference month in our model. When we include more variables, the coefficient of *log(Fare)* becomes smaller, but the coefficient also becomes insignificant and positive in models (2), (5) and (6). However, in model (3), where the log of GDP of the country of the destination is included and in model (4), where the number of airports offering the service in the catchment area is included, the coefficient of *log(Fare)* remains significant and negative. Furthermore, in model (5), when including both *log(DestGDP)* and *Airports* in the model, the coefficient of *log(Fare)* again turns out to be very small and insignificant. Model (4), that includes the variable Airports, does not reject the Hansen J statistic with different instruments used, meaning that the instruments are overidentified when this variable is included. In the panel data 2SLS model, we want the R-squared to take a value as small as possible. Because the R-squared value is 0.049 in model (3), that includes *log(DestGDP)*, and the other test values of this model are valid, we choose to use this particular model for our research.

To be sure that fares are in fact endogenous, and thus our 2SLS model is the right fit, we have to run the normal panel data regression model next to our 2SLS regression model. We run these models on both the price elasticity model with and without the log of the GDP of the destination's country. The coefficient results shown in table 7 are all of panel data models, and are all clustered on the same groups (named *ODALSC*). We see that, in the first and third model the log of Fare, also called the price elasticity, has a lower value than in the second and fourth model. When examining the confidence intervals of both coefficients of *log(Fare)* of the normal panel data and 2SLS panel data models, shown in table 8, we see that both coefficients differ significantly, and we can thus conclude that both 'normal' panel data models are significantly different from the 2SLS panel data models. We assume that the normal panel data model underestimates the results, and we assume that prices/fares are endogenous. Therefore, we will use the 2SLS panel data model in our research.

VARIABLES	(1) Log(TotalPax)	(2) Log(TotalPax)	*(3)* *Log(TotalPax)*	(4) Log(TotalPax)	(5) Log(TotalPax)	(6) Log(TotalPax)
Log(Fare)	-0.463***	0.115	*-0.279***	-0.183*	-0.033	0.104
	(0.105)	(0.103)	*(0.122)*	(0.103)	(0.122)	(0.104)
Log(Dutch GDP)		2.559***				
		(0.236)				
Log(Dest GDP)			*0.630****		0.615**	
			(0.241)		(0.245)	
Airports				0.040***	0.037***	
				(0.005)	(0.005)	
Log(Seats)						0.492***
						(0.033)
February	-0.003	0.011*	*0.002*	0.006	0.010	0.047***
	(0.007)	(0.007)	*(0.007)*	(0.007)	(0.007)	(0.007)
March	0.147***	0.145***	*0.147****	0.132***	0.133***	0.120***
	(0.008)	(0.008)	*(0.008)*	(0.008)	(0.008)	(0.008)
April	0.228***	0.213***	*0.223****	0.200***	0.198***	0.153***
	(0.014)	(0.014)	*(0.014)*	(0.014)	(0.014)	(0.012)
May	0.306***	0.284***	*0.299****	0.268***	0.264***	0.179***
	(0.015)	(0.015)	*(0.016)*	(0.014)	(0.015)	(0.013)
June	0.285***	0.244***	*0.272****	0.235***	0.227***	0.151***
	(0.017)	(0.016)	*(0.017)*	(0.016)	(0.016)	(0.014)
July	0.350***	0.292***	*0.331****	0.288***	0.276***	0.172***
	(0.020)	(0.019)	*(0.021)*	(0.018)	(0.019)	(0.018)
August	0.313***	0.278***	*0.301****	0.254***	0.248***	0.150***
	(0.020)	(0.019)	*(0.020)*	(0.018)	(0.018)	(0.017)
September	0.307***	0.274***	*0.296****	0.252***	0.247***	0.168***
	(0.018)	(0.017)	*(0.018)*	(0.017)	(0.017)	(0.016)
October	0.283***	0.264***	*0.276****	0.230***	0.229***	0.161***
	(0.016)	(0.016)	*(0.016)*	(0.015)	(0.016)	(0.015)
November	0.136***	0.130***	*0.133****	0.113***	0.113***	0.103***
	(0.012)	(0.012)	*(0.012)*	(0.012)	(0.012)	(0.011)
December	0.046***	0.054***	*0.048****	0.036***	0.039***	0.023***
	(0.008)	(0.008)	*(0.008)*	(0.008)	(0.008)	(0.007)
Observations	61,872	61,872	*61,872*	61,872	61,872	61,872
Number of ODALSC	1,771	1,771	*1,771*	1,771	1,771	1,771
R-squared	0.030	0.057	*0.049*	0.064	0.067	0.128

Robust standard errors in parentheses

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

Table 7. Price elasticity 2SLS panel data regression model results.

VARIABLES	(1) Normal regression model Log(TotalPax)	(2) 2SLS regression model Log(TotalPax)	*(3) Normal regression model Log(TotalPax)*	*(4) 2SLS regression model Log(TotalPax)*
Log(Fare)	-0.146***	-0.463***	*-0.095***	*-0.279***
	(0.043)	(0.105)	*(0.042)*	*(0.122)*
Log(Dest GDP)			*0.808****	*0.630****
			(0.212)	*(0.241)*
February	0.004	-0.003	*0.006*	*0.002*
	(0.006)	(0.007)	*(0.006)*	*(0.007)*
March	0.146***	0.147***	*0.146****	*0.147****
	(0.008)	(0.008)	*(0.008)*	*(0.008)*
April	0.218***	0.228***	*0.218****	*0.223****
	(0.013)	(0.014)	*(0.013)*	*(0.014)*
May	0.292***	0.306***	*0.291****	*0.299****
	(0.014)	(0.015)	*(0.014)*	*(0.016)*
June	0.260***	0.285***	*0.258****	*0.272****
	(0.014)	(0.017)	*(0.014)*	*(0.017)*
July	0.316***	0.350***	*0.312****	*0.331****
	(0.015)	(0.020)	*(0.015)*	*(0.021)*
August	0.280***	0.313***	*0.284****	*0.301****
	(0.016)	(0.020)	*(0.016)*	*(0.020)*
September	0.276***	0.307***	*0.280****	*0.296****
	(0.014)	(0.018)	*(0.014)*	*(0.018)*
October	0.259***	0.283***	*0.264****	*0.276****
	(0.013)	(0.016)	*(0.013)*	*(0.016)*
November	0.119***	0.136***	*0.126****	*0.133****
	(0.010)	(0.012)	*(0.011)*	*(0.012)*
December	0.037***	0.046***	*0.045****	*0.048****
	(0.007)	(0.008)	*(0.008)*	*(0.008)*
Observations	61,872	61,872	*61,872*	*61,872*
Number of ODALSC	1,771	1,771	*1,771*	*1,771*
R-squared	0.047	0.030	*0.054*	*0.049*

Robust standard errors in parentheses

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

Table 8. Results of the normal regression models (without an IV) and the 2SLS regression models, with in model (3) and (4) the variable log(DestGDP) included.

Model	95% confidence interval
(1) Normal regression model	[-0.230, -0.062]
(2) 2SLS regression model	[-0.669, -0.257]
(3) Normal regression model incl. log(Dest GDP)	[-0.177, -0.012]
(4) 2SLS regression model incl. log(Dest GDP)	[-0.517, -0.040]

Table 9. 95% confidence intervals for log(Fare)

Of the regression model we use for our analyses, regression model (4), the coefficient of the log of fare is -0,279, and is statistically significant. The confidence interval, which is shown in table 9, of the coefficient is between -0.517 and -0.040, thus we assume that the price elasticity of air travel is between -0.517 and -0.040, which is negative and has a value greater than zero. When the price elasticity of a good is closer to a negative 0 than 1, the good is said to be inelastic (Anderson et al., 1997)[6]. Therefore, when the price elasticity is between -0,5 and 0, we assume that the good is inelastic. Because the 95% confidence level of *log(Fare)* is between -0.517 and -0.040, we see that the price elasticity of the good is quite inelastic. Therefore, we will reject the null hypothesis that air travel demand is price elastic.

4.1.2. "Hypothesis 2: Air travel demand is more elastic in the leisure segment than in the business segment"

To test the second hypothesis, we examine whether there are differences in price elasticity for the leisure segment and the business segment. We have clustered the destinations of our dataset into three different groups. Because we use a fixed effects model for our analyses, it is not possible to put variables into the model that do not change over time for our clusters. Therefore, we have to run our model with a filter for each group, to examine the differences in coefficients for the groups.

[6] See section 2.1. The price elasticity of demand

Segment	Log(Fare) (Robust standard error in parentheses)	95% Confidence interval	Number of clusters	R-squared
Leisure	-0.420** (0.202)	[-0.816, -0.023]	641	0.065
Business	0.237 (0.271)	[-0.294, 0.767]	563	0.023
Total	-0.279** (0.122)	[-0.517, -0.040]	1,771	0.049

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

Table 10. Results and 95% confidence intervals of Log(Fare) (log(DestGDP) included)

Segment	Log(Fare) (Robust standard error in parentheses)	95% Confidence interval	Number of clusters	R-squared
Leisure	-0.656*** (0.162)	[-0.974, -0.338]	641	0.026
Business	-0.121 (0.233)	[-0.578, 0.337]	563	0.044
Total	-0.463*** (0.105)	[-0.669, -0.257]	1,771	0.030

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

Table 11. Results and 95% confidence intervals of Log(Fare) (log(DestGDP) excluded)

Table 10 shows the coefficient and confidence intervals of log(Fare) for the models representing the leisure and business clusters, and table 11 shows the coefficients and confidence intervals of *log(Fare)* for the clusters when the variable *log(DestGDP)* is excluded from the regression model. We will call model (2) the Leisure model, and model (3) the Business model in this section. Table 12, shown on the following page, shows the regression models and coefficient values for the clusters. To examine whether there are differences in price elasticity between the leisure and business segments, we examine the coefficients of *log(Fare)* and their significance level for the both the Leisure and Business models, along with examining the differences between the 95% confidence interval of *log(Fare)* for the clusters.

VARIABLES	(1) Total Log(TotalPax)	(2) Leisure Log(TotalPax)	(3) Business Log(TotalPax)
Log(Fare)	-0.279**	-0.420**	0.237
	(0.122)	(0.202)	(0.271)
Log(Dest GDP)	0.630***	0.881**	1.148***
	(0.241)	(0.380)	(0.347)
February	0.002	-0.016	0.042***
	(0.007)	(0.011)	(0.011)
March	0.147***	0.117***	0.187***
	(0.008)	(0.018)	(0.012)
April	0.223***	0.234***	0.249***
	(0.014)	(0.036)	(0.016)
May	0.299***	0.378***	0.291***
	(0.016)	(0.037)	(0.020)
June	0.272***	0.333***	0.265***
	(0.017)	(0.041)	(0.025)
July	0.331***	0.475***	0.204***
	(0.021)	(0.048)	(0.024)
August	0.301***	0.470***	0.161***
	(0.020)	(0.047)	(0.018)
September	0.296***	0.378***	0.268***
	(0.018)	(0.044)	(0.025)
October	0.276***	0.331***	0.266***
	(0.016)	(0.038)	(0.024)
November	0.133***	0.074***	0.184***
	(0.012)	(0.027)	(0.021)
December	0.048***	0.056***	0.057***
	(0.008)	(0.016)	(0.015)
Observations	61,872	21,341	22,168
R-squared	0.049	0.065	0.023
Number of ODALSC	1,771	641	563

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12. Regression model results for the 'Business' & 'Leisure' segments.

Table 11, which includes results of the regression model without GDP of the destination country, is added to this section, because the variable *log(DestGDP)* does have a different effect on *log(TotalPax)* in the separate regressions. Furthermore, the coefficient values of *log(Fare)* do become more positive/less negative when the GDP of the destination country is included. However, the coefficient values of fare for both models are very similar, which implicates that the variable *log(DestGDP)* does not change the model drastically.

To test the second hypothesis, we compared the coefficient values of log(Fare) for the Leisure model and the Business model of table 12. The 95% confidence interval of log(Fare) for the Leisure model is [-0.816, -0.023], while the 95% confidence interval of log(Fare) for the Business model is [-0.294, 0.767]. The upper and lower values of the intervals are overlapping, however, the intervals differ. Additionally, the value of *log(Fare)* of the Business model is not significant, which implies that a rise in the level of fares does not have a significant effect on the number of passengers for business destinations. The value of *log(Fare)* of the Leisure model is negative and significant, which implies that a rise in the level of fares does have a significant and negative effect on the number of passengers. Therefore, we will not reject our hypothesis that air travel demand is more price elastic in the leisure segment than in the business segment.

4.1.3. "Hypothesis 3: Air travel demand is more price elastic on short-haul flights than on long-haul flights"

To test the third hypothesis, we examine whether there are differences in price elasticity between short-haul and long-haul flights. Again, because of the fixed effects estimation, we cannot include a dummy variable for a factor that does not change over time, and therefore we have to run the same model with a filter for European destinations and for intercontinental destinations. These models are called 'short-haul' model and 'long-haul' model, respectively. The coefficient values and confidence intervals of fare can be found in table 13, and the regression models and its coefficient results can be found in table 14. When the variable *log(DestGDP*) is included, the coefficient value of *log(Fare)* is not what we would be expecting for both models (3) and (4). At first, we see that the coefficient value of *log(Fare)* is lower for short-haul flights than for long-haul flights, and its coefficient for the 'short-haul' model not significant. Furthermore, when looking at the 95% confidence interval, the confidence intervals of the variable do not differ a lot from each other, apart from the fact that the 95% confidence interval of *log(Fare)* for short haul flights is bigger. Furthermore, *log(DestGDP)* does not have a significant effect in the 'long-haul' model (4), however, the variable does have a significant effect in the 'short-haul' model (3).

Destination type	***Log(Fare) (Robust standard error in parentheses)***	***95% Confidence interval***	***Number of clusters***	***R-squared***
Short-haul	-0.233 (0.209)	[-0.642, 0.176]	1,070	0.052
Long-haul	-0.336*** (0.095)	[-0.523, -0.149]	701	0.055
Total	-0.279** (0.122)	[-0.517, -0.040]	1,771	0.049

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

Table 13. Coefficient values and confidence interval of Log(Fare) for short-haul and long-haul destinations, GDP of destination country included.

VARIABLES	(1) 'Short-haul' Log(TotalPax)	(2) 'Long-haul' Log(TotalPax)	(3) 'Short-haul' Log(TotalPax)	(4) 'Long-haul' Log(TotalPax)
Log(Fare)	-0.560***	-0.369***	-0.233	-0.336***
	(0.185)	(0.082)	(0.209)	(0.095)
Log(Dest GDP)			0.873**	0.184
			(0.352)	(0.217)
February	0.020***	-0.049***	0.024***	-0.047***
	(0.007)	(0.013)	(0.007)	(0.013)
March	0.173***	0.098***	0.168***	0.099***
	(0.011)	(0.015)	(0.011)	(0.016)
April	0.260***	0.169***	0.246***	0.169***
	(0.020)	(0.022)	(0.020)	(0.022)
May	0.368***	0.188***	0.349***	0.188***
	(0.022)	(0.025)	(0.023)	(0.025)
June	0.356***	0.153***	0.325***	0.152***
	(0.026)	(0.025)	(0.028)	(0.025)
July	0.381***	0.295***	0.346***	0.292***
	(0.029)	(0.029)	(0.031)	(0.029)
August	0.335***	0.269***	0.313***	0.267***
	(0.026)	(0.030)	(0.026)	(0.030)
September	0.375***	0.180***	0.347***	0.181***
	(0.028)	(0.025)	(0.029)	(0.025)
October	0.336***	0.185***	0.316***	0.186***
	(0.025)	(0.023)	(0.025)	(0.023)
November	0.175***	0.066***	0.160***	0.068***
	(0.020)	(0.016)	(0.020)	(0.016)
December	0.077***	-0.013	0.075***	-0.011
	(0.012)	(0.011)	(0.012)	(0.012)
Observations	41,504	20,368	41,504	20,368
R-squared	0.019	0.052	0.052	0.055
Number of ODALSC	1,070	701	1,070	701

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 14. Regression models for 'short-haul' and 'long-haul' segments

Table 15 shows the coefficient and 95% confidence interval values of *log(Fare)* if *log(DestGDP)* is not included in the models. When excluding the variable *log(DestGDP)*, the differences between the coefficient of *log(Fare)* for short-haul and long-haul model are bigger, the coefficients are both significant at the 1% level, and as expected, the price elasticity of air travel demand is higher on short-haul flights than on long-haul flights. However, when comparing the 95% confidence levels of *log(Fare)* of both models, we see that the confidence intervals are still overlapping, with the lower value being the same value but with the value of *log(Fare)* of the short-haul model having a higher upper range.

Destination type	***Log(Fare) (Robust standard error in parentheses)***	***95% Confidence interval***	***Number of clusters***	***R-squared***
Short-haul	-0.560*** (0.185)	[-0.922, -0.198]	1,070	0.019
Long-haul	-0.369*** (0.082)	[-0.530, -0.208]	701	0.052
Total	-0.463*** (0.105)	[-0.669, -0.257]	1,771	0.030

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

Table 15. Results and confidence interval of Log(Fare) for short-haul and long-haul destinations (log(DestGDP) excluded).

Because we have seen in the prior section that, when examining hypothesis 2, the GDP of the country of destination does have a different effect on the 'short-haul' and the 'long-haul' model, we will run the 'short-haul' and 'long-haul' models for the leisure and business clusters, and again examine whether there are difference in the value of *log(Fare)* between these models. The regression results of these models can be found in table 16 and the coefficient and 95% confidence interval values of *log(Fare)* can be found in table 17.

VARIABLES	(1) Short-haul Leisure Log(TotalPax)	(2) Long-haul Leisure Log(TotalPax)	(3) Short-haul Business lnTotalPax	(4) Long-haul Business lnTotalPax
Log(Fare)	-0.685**	-0.246	0.576*	-0.284*
	(0.342)	(0.230)	(0.343)	(0.169)
Log(DestGDP)	0.940**	0.687	2.304***	0.016
	(0.435)	(0.829)	(0.566)	(0.202)
February	0.017	-0.055**	0.048***	0.015
	(0.014)	(0.023)	(0.011)	(0.032)
March	0.175***	0.046	0.180***	0.206***
	(0.026)	(0.029)	(0.013)	(0.032)
April	0.323***	0.131***	0.241***	0.264***
	(0.057)	(0.037)	(0.018)	(0.037)
May	0.528***	0.141***	0.276***	0.309***
	(0.058)	(0.046)	(0.025)	(0.037)
June	0.515***	0.046	0.235***	0.304***
	(0.070)	(0.041)	(0.032)	(0.035)
July	0.643***	0.230***	0.176***	0.286***
	(0.080)	(0.045)	(0.027)	(0.041)
August	0.645***	0.205***	0.154***	0.236***
	(0.076)	(0.050)	(0.019)	(0.046)
September	0.578***	0.054	0.255***	0.282***
	(0.077)	(0.041)	(0.030)	(0.040)
October	0.488***	0.100**	0.249***	0.313***
	(0.064)	(0.042)	(0.029)	(0.036)
November	0.131***	0.016	0.173***	0.179***
	(0.049)	(0.035)	(0.027)	(0.032)
December	0.097***	-0.012	0.064***	-0.010
	(0.025)	(0.024)	(0.018)	(0.026)
Observations	14,517	6,824	18,918	3,250
R-squared	0.056	0.050	-0.025	0.122
Number of ODALSC	415	226	456	107

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16. Regression models for 'short-haul' and 'long-haul' segments, for 'leisure' & 'business' destination groups

Destination type	*Segment*	*Log(Fare) (Robust standard error in parentheses)*	*95% Confidence interval*	*Number of clusters*	*R-squared*
Short-haul	Leisure	-0.685** (0.342)	[-1.354, -0.015]	415	0.056
Long-haul	Leisure	-0.246 (0.230)	[-0.697, 0.205]	226	0.050
Short-haul	Business	0.576* (0.343)	[-0.096, 1.248]	456	-0.025
Long-haul	Business	-0.284* (0.169)	[-0.615, 0.048]	107	0.122
Total	All	-0.463*** (0.105)	[-0.669, -0.257]	1,771	0.030

Table 17. Coefficient and 95% confidence interval results for log(Fare) for short-haul and long-haul segments regression models on 'leisure' and 'business' clusters.

Overall, there is no significant difference in the coefficient values of *log(Fare)* between short-haul destinations and long-haul destinations. When examining the differences between the 'short-haul' and 'long-haul' models for each of the segments (Model (1) vs. model (2) and model (3) vs. model (4)), we see that the price elasticity in the leisure segment is higher for short-haul flights than for long-haul flights. However, the coefficients show different outcomes for the business segment, where the price elasticity for short-haul flights is even positive, and the price elasticity on for long-haul flights is negative, and thus more price elastic. However, the results of these models do have to be interpreted with caution, since the Hansen J Statistic is significant for the models for long-haul destinations, thus, this implies the instruments of the models for long-haul destinations are overidentified.

We cannot state with confidence that the price elasticity of demand for short-haul flights is higher than the price elasticity of demand for long-haul flights. Therefore, we reject our null hypothesis that air travel demand is more price elastic on short-haul flights than on long-haul flights.

4.2. Scenario analysis

In the previous section, we determined the price elasticity of demand for flights from and to Dutch airports. Furthermore, we see, in table 18, that in 2017, the number of passengers at these airports was a small portion (189.000 to 202.240 passengers in the year 2017) of the total number of passengers. Only for Schiphol Airport, the number of OD passengers and transfer passengers is available, but as the other Dutch airports do not function as a transfer/hub airport, we assume that the number of passengers at the other airports are OD passengers.

Airport	***Passengers in 2017***
Amsterdam Airport Schiphol	OD: 43.088.000 (Total: 68.515.000)
Eindhoven Airport	5.653.402
Rotterdam The Hague Airport	1.774.976
Groningen Airport Eelde	202.240
Maastricht Aachen Airport	189.000
Total	*OD: 50.737.518 (Total: 76.334.618)*

Table 18. Dutch airports and the number of passengers at these airports in the year 2017.
Sources: Royal Schiphol Group (2018); Rotterdam The Hague Airport (2018).

We computed the average one-way fare for the year 2017 for each zone, from the average one-way fares in 2017 in our dataset. These average one-way fares can be found in table 19. The '% Pax in 2017' in this table describes the percentage of passengers falling in each zone, computed from the passenger data in our dataset. As can be seen above, the total number of OD passengers is 50.737.518. Taking the percentages of '% Pax in 2017' in table 19, we compute the approximate number of total passengers in 2017 that would have been taxed in each zone.

Scenario	*Zone (A,B/I,II,III)*	*Average fare in 2017*	*Tax in €*	*% Pax in 2017*	*Total pax in base situation*
Scenario 1	I	€118,20	€3,81	72%	36.531.013
	II	€284,91	€11,95	13%	6.595.877
	III	€564,50	€21,73	15%	7.610.628
Scenario 2	A	€120,86	€4,34	76%	38.560.514
	B	€503,57	€17,37	24%	12.177.004
Scenario 3	A	€120,86	€9,17	76%	38.560.514
	B	€503,57	€2,29	24%	12.177.004

Table 19. Scenarios description

In our estimations, we use the price elasticity model obtained when examining hypothesis 1, as described in section 4.1.1.. The estimated price elasticity from the model is -0.279, with a 95% confidence level of -0.517 to -0.040. With the three price elasticities, we have estimated the change in the total number of passengers when the fare changes with a particular percentage. Because there are many other factors that have to be taken into account in estimating the change in the number passengers as a result of a ticket tax, we use the 95% confidence interval to estimate the approximate change in the number of passengers. The results of our scenario estimations are shown in tables 20, 21 and 22, and an overview of the scenario results in number of passengers (pax) can be found in figure 6. More detailed results of our scenario estimations can be found in Appendix 2.

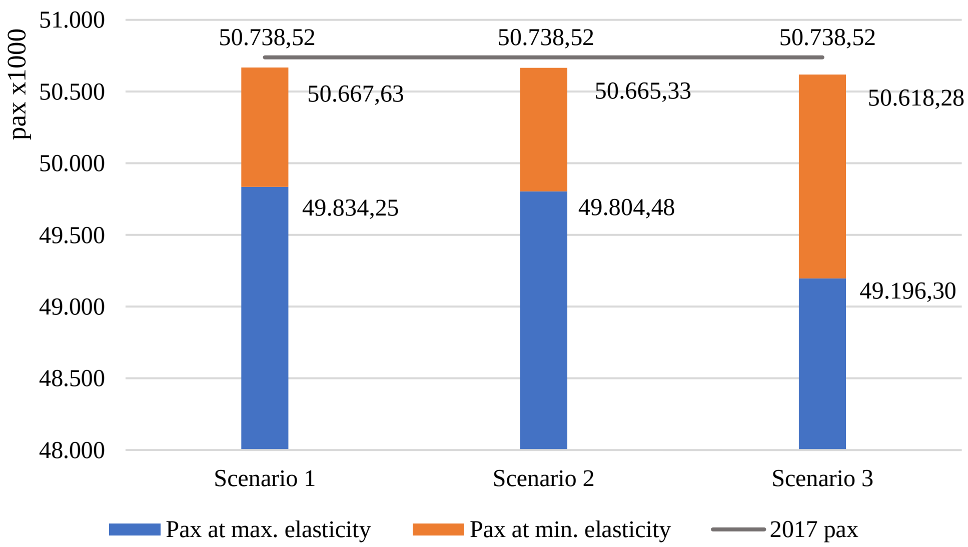

Figure 6. Scenario analyses results in number of passengers x1000

As can be found in the tables 20, 21 and 22, we expect a fall in passengers numbers of -0,14% to -1,78% in Scenario 1, -0,14% to -1,84% in Scenario 2, and -0,24% to -3,04% in Scenario 3. Scenario 1 and Scenario 2 do not show different results, with passenger numbers declining with 69.886 to 903.271 and 72.188 to 933.036 respectively. Scenario 3 however, shows much bigger changes in the number of passengers, with a decline in passenger numbers of 119.243 to 1.541.215.

	Elasticity = -0.279	*Elasticity = -0.040*	*Elasticity = -0.517*
Total pax	50.250.066	50.667.632	49.834.247
Pax change	-487.452	-69.886	-903.271
% change	-0,96%	-0,14%	-1,78%

Table 20. Results Scenario 1

	Elasticity = -0.279	*Elasticity = -0.040*	*Elasticity = -0.517*
Total pax	50.234.003	50.665.330	49.804.482
Pax change	-503.515	-72.188	-933.036
% change	-0,99%	-0,14%	-1,84%

Table 21. Results Scenario 2

	Elasticity = -0.279	*Elasticity = -0.040*	*Elasticity = -0.517*
Total pax	49.905.798	50.618.275	49.196.303
Pax change	-831.720	-119.243	-1.541.215
% change	-1,64%	-0,24%	-3,04%

Table 22. Results Scenario 3

5. Conclusion & Discussion

5.1. Conclusion

The flight ticket tax has extensively been mentioned in the national media. According to the Dutch Ministry of Finance, this air transportation tax will be, either in the form of a taxation on aircraft based on noise certification, a joint EER member states flight ticket tax or a flight ticket tax, implemented by the Dutch government. This research is focused on the flight ticket tax. A flight ticket tax is an indirect type of tax, which is less likely to have long-term effects on national economic growth (PwC, 2017). In the year 2008, the Netherlands were one of the first countries to introduce this flight ticket tax. Present day, there are numerous European countries that have implemented an air transportation tax.

According to our findings, air travel demand is price inelastic, with a price elasticity of -0.040 to -0.517 on routes to and from the Dutch airports. The findings of this study show a lower price elasticity of air travel demand than the findings of earlier studies. The main motives for passengers to travel by air, are for leisure and business reasons. Therefore, we examined whether there are differences in price elasticity on routes to leisure destinations and business destinations. Our findings show that price elasticity is higher on routes to leisure destinations, than on routes to business destinations. Furthermore, earlier research on price elasticity of air travel demand has found that price elasticity of air travel demand is higher for short-haul flights than for long-haul flights. However, according to our findings, there is no significant difference between the price elasticities of air travel demand for short-haul destinations and for long-haul destinations.

Furthermore, according to our scenario analyses, where the year 2017 is used as reference year, when the Dutch government would implement tax variant *3b*, the flight ticket tax with three tariff zones according to the German system, it would result in a passenger number reduction of 69.886 to 903.271. The passenger reduction will be biggest in Zone I. When the Dutch government would implement tax variant *3c*, the flight ticket tax with two tariff zones, according to the 'old' Dutch system, it would result in a reduction in passenger numbers of 72.188 to 933.036. Here, the effects are the biggest in Zone A, in terms of passenger numbers. With scenario 1, the effects would be biggest for the airlines, since there are destinations that are taxed with an amount of €11,95 in scenario 1, instead of €4,34 in scenario 2. Overall, there are no big differences in the changes in total passenger numbers between the tax variants. However, according to our scenario analysis, an implementation of tax variant *3e*, which has the same Zones divisions as tax variant *3c*, but here, short-haul flights are taxed heavier than long-haul flights, which results in the greatest reduction in passenger numbers. When the Dutch government would implement this tax variant, it would result in a reduction in passenger numbers of 119.243 to 1.541.215.

To conclude, passenger numbers at Dutch airports will decrease, but the numbers are low. Load factors for some flights will likely decrease, especially on European routes. However, it is more likely that, as is already the case with the *scarcity rent*, that some passengers will be 'crowded out'. Most likely, these 'crowded out' passengers will be passengers flying direct from/to the Netherlands, and instead, there will be more transfer passengers flying via Schiphol Airport. When the number of transfer passengers rises, hub airline KLM and its SkyTeam partners are still able to expand their network and grow their connectivity at Schiphol Airport.

The effects at the regional airports will be different. Because there are no transfer passengers travelling via these airports, the airlines will still want to attract passengers to these airports. Therefore, a part of the ticket tax will likely be captured by the scarcity rent/excess profit. However, another possibility is that still, passengers, like leisure passengers, will be 'crowded out' by business passengers, who have a higher willingness to pay for their ticket.

The small decline in passenger numbers because of the implementation of the flight ticket tax, can, to a great extent, be explained by the fact that the transportation costs is not the only cost of travel. For example, the traveller's budget constraint consists of accommodation costs, expenditures on food, and expenditures on activities. Additionally, the transportation costs do consist of transportation to the airport and from the airport to the destination. An additional flight ticket tax will likely raise the traveller's costs with such a small percentage, that the traveller will not even notice it in the total travel cost change.

Overall, because air travel demand is price inelastic, there will be a small decline in passenger numbers at the Dutch airports, which will likely have a small negative effect on the load factors of aircraft. Despite that, the number of flight movements will most likely not decrease, which indicates that the environmental effects of implementation of the ticket tax will be minimal.

5.2. Model limitations

There are some limitations to be taken into account in this study. First, airline products are differentiated by price, number of connections, airline brand, frequency of flights, and class of service. The ticket prices for a flight are differentiated by frequency of flights, time of departure, trip duration, booking date and class of service. Not all of these characteristics are taken into account in our dataset. Furthermore, we do not make a distinction between origin and destination, so all flights and fares between the Dutch airports and the destinations are used to determine the average fare and the total number of passengers. However, this should not be a big problem, since most of the passengers will fly back to their initial origin.

An important characteristic of the airline market is the practise of revenue management, in which certain seats are reserved for different fare categories (Berry & Jia, 2010). On the other hand, airlines can choose to drop the fare on the last moment for a flight to try to increase the load factor. Since we only use the average fares between origins and destinations, we do not take differences in price because of revenue management into account. Our price elasticities are therefore based on the route-level.

Furthermore, we do not observe ticket restrictions, such as advanced-purchase and length-of-stay requirements, and flight-level details, such as time of departure, in our data. Additionally, we do not observe the fixed costs of operating a flight, so we have no insight in the cost component of the determination of ticket prices.

A limitation in our scenario analysis, is that we assume that there is a cost pass-through of the ticket tax of 100%. The air transportation market is not a perfectly competitive market, and airlines make use of cross-subsidization between routes. Therefore, it is not likely that there is a 100% pass-through of the ticket tax on all markets. Furthermore, we do not take into account other costs of travel, and how the traveller takes these costs into account. For example, someone would spend maybe the same amount that is paid on the ticket tax, less on accommodation costs or expenditures on activities or food, to make the costs still fit within their budget constraint.

5.3. Policy implications & recommendations

Because air travel demand is price inelastic, the ticket tax seems to be an ineffective policy to change travel behaviour and thereby have a positive environmental impact. However, the tax variant *3e*, where passengers on short haul flights are taxed with €9,17, and passengers on long-haul flights are taxed with €2,29, will be having the biggest impact on air travel demand. When the goal of the Dutch Government is to change travel behaviour, this tax variant will be most suitable in their policy. Furthermore, when a flight ticket tax would be implemented, airlines and airports will likely not suffer huge losses, a declining level of connectivity or the 'de-hubbing' process, contrary to what these involved parties are stating in the media. However, because the changes in passenger numbers will be small, the Ministry of Finance will likely set its goal by implementing the flight ticket tax, which is to earn €200 million for the Government's treasury.

Furthermore, our recommendation for future research on the effects of the flight ticket tax that will be implemented in the Netherlands, is to take into account the budget constraints, of travellers travelling from and to the Netherlands, in the examinations. Because this research only focuses on the flight ticket tax that will be implemented in the Netherlands only, it would be interesting for future research to examine what the effects would be on passenger numbers if the joint EER member states flight ticket tax would be implemented. Additionally, a tax based on emission or noise pollution is mentioned in the Ministry of Finance's flight tax consultation. Because these taxes are based on the noise certificate of the aircraft, this taxation type would give the airlines incentives to have a more clean fleet. Therefore, this tax variant is a very interesting subject to study the effects of, since our research has shown that passenger demand is inelastic and a general flight ticket tax would not have the desired effects in terms of environmental impact.

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Appendix

Appendix 1

Destination	*Segment*
ABZ	Business
ACE	Leisure
ADB	Leisure
AGP	Leisure
ALC	Leisure
ARN	Business
ATH	Other
AUA	Leisure
AUH	Other
AYT	Leisure
BCN	Leisure
BEG	Other
BFS	Leisure
BGO	Business
BGY	Other
BHX	Business
BIO	Other
BKK	Leisure
BLL	Business
BLQ	Business
BOD	Other
BOM	Business
BON	Leisure
BOS	Other
BRI	Leisure
BRS	Other
BSL	Other
BUD	Business

CAI	Other
CDG	Business
CGK	Leisure
CIA	Business
CMN	Other
CPH	Business
CPT	Other
CTA	Leisure
CUR	Leisure
DBV	Leisure
DEL	Other
DUB	Other
DXB	Other
EDI	Other
EWR	Leisure
EZE	Leisure
FAO	Leisure
FCO	Leisure
FLR	Business
FRA	Business
FUE	Leisure
GDN	Business
GLA	Other
GOT	Business
GRO	Leisure
GRU	Other
GVA	Other
HAM	Business
HEL	Business
HER	Leisure
HKG	Other
IAD	Other
IAH	Business

IBZ	Leisure
ICN	Business
IKA	Other
INN	Leisure
IST	Other
JFK	Leisure
JNB	Other
KBP	Other
KEF	Leisure
KGS	Leisure
KRK	Business
KTW	Other
KUL	Leisure
LAX	Other
LBA	Business
LCY	Business
LED	Business
LGW	Leisure
LHR	Business
LIN	Business
LIS	Leisure
LJU	Other
LPA	Leisure
LPL	Leisure
LTN	Other
LYS	Business
MAD	Business
MAN	Other
MCO	Other
MEX	Business
MIA	Leisure
MLA	Leisure
MNL	Business

MRS	Business
MUC	Business
MXP	Leisure
NAP	Leisure
NCE	Leisure
NCL	Business
NDR	Other
NRT	Business
NTE	Business
NUE	Business
OLB	Leisure
OPO	Leisure
ORD	Other
ORK	Other
ORY	Leisure
OSL	Other
OTP	Business
PBM	Other
PEK	Business
PMI	Leisure
PRG	Business
PSA	Leisure
PVG	Business
RAK	Leisure
REU	Leisure
RIX	Business
SAW	Leisure
SEA	Other
SEN	Leisure
SFO	Other
SID	Leisure
SIN	Other
SKG	Leisure

SOF	Other
SOU	Business
SPU	Leisure
STN	Other
STR	Business
SVG	Business
SVO	Business
SVQ	Leisure
SXF	Leisure
SZG	Leisure
TFS	Leisure
TLS	Other
TLV	Leisure
TNG	Other
TPE	Business
TXL	Business
VCE	Leisure
VIE	Business
VLC	Leisure
VNO	Business
VRN	Leisure
WAW	Business
WMI	Other
WRO	Other
YVR	Other
YYZ	Other
ZRH	Business

Appendix 2

3.1 Scenario 1

1. Price elasticity of -0.279

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
1	€ 118,20	36.531.013	€ 3,81	3,223%	-0,899%	-328.529	36.202.484
2	€ 284,91	6.595.877	€ 11,95	4,194%	-1,170%	-77.186	6.518.691
3	€ 564,50	7.610.628	€ 21,73	3,849%	-1,074%	-81.737	7.528.891
Total		50.737.518			-0,96%	-487.452	50.250.066

2. Price elasticity of -0.040

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
1	€ 118,20	36.531.013	€ 3,81	3,223%	-0,129%	-47.101	36.483.912
2	€ 284,91	6.595.877	€ 11,95	4,194%	-0,168%	-11.066	6.584.811
3	€ 564,50	7.610.628	€ 21,73	3,849%	-0,154%	-11.719	7.598.909
Total		50.737.518			-0,14%	-69.886	50.667.632

3. Price elasticity of -0.517

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
1	€ 118,20	36.531.013	€ 3,81	3,223%	-1,666%	-608.779	35.922.234
2	€ 284,91	6.595.877	€ 11,95	4,194%	-2,168%	-143.029	6.452.848
3	€ 564,50	7.610.628	€ 21,73	3,849%	-1,990%	-151.463	7.459.165
Total		50.737.518			-1,78%	-903.271	49.834.247

3.2 Scenario 2

1. Price elasticity of -0.279

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 4,34	3,59%	-1,002%	-386.326	38.174.188
B	€ 503,57	12.177.004	€ 17,37	3,45%	-0,962%	-117.188	12.059.816
Total		50.737.518			-0,99%	-503.515	50.234.003

2. Price elasticity of -0.040

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 4,34	3,59%	-0,144%	-55.387	38.505.127
B	€ 503,57	12.177.004	€ 17,37	3,45%	-0,138%	-16.801	12.160.203
Total		50.737.518			-0,14%	-72.188	50.665.330

3. Price elasticity of -0.517

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 4,34	3,59%	-1,86%	-715.880	37.844.634
B	€ 503,57	12.177.004	€ 17,37	3,45%	-1,78%	-217.156	11.959.848
Total		50.737.518			-1,84%	-933.036	49.804.482

3.3 Scenario 3

1. Price elasticity of -0.279

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 9,17	7,59%	-2,117%	-816.270	37.744.244
B	€ 503,57	12.177.004	€ 2,29	0,45%	-0,127%	-15.450	12.161.554
Total		50.737.518			-1,64%	-831.720	49.905.798

2. Price elasticity of -0.040

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 9,17	7,59%	-0,303%	-117.028	38.443.486
B	€ 503,57	12.177.004	€ 2,29	0,45%	-0,018%	-2.215	12.174.789
Total		50.737.518			-0,24%	-119.243	50.618.275

3. Price elasticity of -0.517

Zone	Fare	Reference Pax	Tax	% Fare change	% Pax change	Pax change	Total pax
A	€ 120,86	38.560.514	€ 9,17	7,59%	-3,923%	-1.512.586	37.047.928
B	€ 503,57	12.177.004	€ 2,29	0,45%	-0,235%	-28.629	12.148.375
Total		50.737.518			-3,04%	-1.541.215	49.196.303