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What is the effective level of the Dutch aviation tax?

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Abstract

The aviation industry has grown significantly over the past decades, but this industry is a major contributor to the level of carbon dioxide worldwide. This development has led to the introduction of the aviation tax to discourage the use of flight services. The Netherlands maintains a tax of €8 per flight and is planning to raise this to €24 per flight in the next year. The question arises if this is enough to influence air passengers' travel behavior and stimulate them to take other transport modes. Therefore, the main question is what the Dutch aviation tax should be to make the plane equally popular as the train for short-haul travels within Europe. To obtain results a survey has been conducted among Dutch respondents. Respondents were provided different European destinations with their corresponding commuting times and ticket prices. The preference in the initial situation had to be given, whereafter plane users had to answer at which price increase they would switch from the plane to the train. The data retrieved from the survey allowed finding the effective level of the tax where the demand for both transport options was the same. The average extra price along all the destinations where the plane and train preference was the same was €45,75. Then, the characteristics of the respondents were used for an OLS regression to determine whether there was a relationship between income and the willingness to pay more for the plane. The regression showed no significant relationship between these variables and hence should air passengers with higher incomes not be levied more tax. Concluding, is difficult to determine one definite effective level of the Dutch aviation tax because it depends on several circumstances. However it should be higher than the new proposed tax of €24 to affect the air passengers' choices, but no distinction should be made based on income and there should be one equal tax for everyone.

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1. Introduction

The concept of taxing environment unfriendly goods and services gains more and more popularity. The Dutch Parliament debated in March this year about the introduction of the so-called meat tax. The tax was intended to reduce meat consumption and to greener the eating pattern in the Netherlands. In the end, the majority of the Parliament did not agree on the implementation of this tax due to the existing inflation and the resulting raised grocery prices. Another argument against the tax was the idea of stimulating plant-based and healthy food instead of restricting meat consumption. Thus to realize a successful tax it should be feasible for the consumption, production, and government side and that is why the debate continues on these matters (NOS, 2022).

The discussion of adding the Dutch aviation tax is more or less similar and is based on the compensation of the caused environmental and societal costs and discouraging the use of flight services. However, the debate has begun years earlier than the previously mentioned meat tax. When did the concept of the Dutch aviation tax got introduced and how did that develop?

On the 1st of July 2008, the Dutch government which was climate-orientated decided to implement a flight tax. The motivation behind this tax was to set boundaries for the expansion of the aviation sector. The imposed tax was based on the distance traveled; €11,25 was charged for distances within 2500 km and €45 was the tax fee for travels longer than 2500 km. Right after the introduction of the tax, there was a reduction in the number of people traveling from a Dutch origin to a certain foreign destination. People were noted by advertising to use airports from neighboring countries like Germany to avoid the flight tax. The Dutch airlines and airports were frustrated by this trend of Dutch citizens leaving the country for foreign airports. This reduction in travelers making use of the Dutch flight services was also caused by the financial crisis present in 2008. The financial crisis strengthens the effect of the flight tax and the unwillingness of travelers to pay this extra fee. Throughout the year the critics became bigger and bigger and this led to the cancellation of the Dutch flight tax on the 1st of July 2009 (Gordijn, 2010).

Years passed by till the Paris Climate Agreement took place in 2015. This convention between roughly 200 countries over the whole world aimed to mitigate greenhouse gas emissions globally. The purpose of these actions was to limit the rise in temperature caused by these emissions. In 2016 the agreement was made officially and countries were requested to set up a list of measures to reach their climate goals. The measures had to be presented by 2020, thus from this moment sustainability became a crucial topic again and actions had to be taken (United Nations Climate Change, 2016).

The Dutch government decided to shed a light again on the aviation sector. It is no secret that this sector is a big contributor to the national level of carbon dioxide which is one of the most important emissions to diminish. This has led to the announcement of the return of the Dutch aviation tax.

The aviation tax was introduced again on the first of January 2021. It applies to both passengers and freight travels while transfer passengers are excluded from the tax (NOS, 2020). The tax fee which is included in the ticket price has a value of precisely €7,845 which should compensate for the negative externalities caused by the flight travel. In 2022 they raised the amount to €7,947 which is far from a substantial increase but reflects the environmental mindset of the government to discourage plane traveling (Tax and Customs Administration, 2020).

The previous rise in the aviation tax will not affect plane travelers in their behavior. What if a real shock is implemented in the amount of aviation tax that should be paid? Nowadays that is an essential question to be asked because on the 28th of March 2022 the Dutch Minister of Finance announced a planned rise in the aviation tax. From the 1st of January 2023 till the end of the year, the aviation tax will have an estimated value of €24 per flight. It is expected that in the short term people will not be heavily impacted by the rise but there will be some changes in traveler's behavior (Dutch Ministry of Finance, 2022).

The actuality and the uncertainty of the consequences of these increased taxes are the motivation behind this paper. There could be different reactions; travelers will not care, travelers will take an alternative transport option or travelers will not make the trip. The best options are the two latter ones because if no costs are made then the compensation is unnecessary too. But travelers should be provided with a substitute for the plane because they still should have the possibility to make the trip. Therefore, choosing an alternative transport option is the most desirable outcome. The train is the most suitable alternative and is much greener than taking the plane.

There have been studies that examined the effects of a given aviation tax on the demand for flight tickets. However, there has been no research on what the amount of tax should be to cause a ‘modal shift’. The modal shift is the significant change in the shares of the most favorable transport options. In this case, the modal shift represents the share of people taking the train which grows compared to the share of plane users for travels to a foreign country. The underlying theory is the cross-price elasticity of demand which describes the change in demand for train tickets resulting from the change in flight ticket prices. This theory will be precisely explained later in the literature review section of this paper.

The Netherlands-Destination routes that will be investigated should be accessible for both the plane and train. This will allow people to make the switch from the plane to the more sustainable train. Therefore, the routes will be intra-continental and will not reach outside Europe. These short travels are also interesting from an environmental point of view. Short flights within 750 kilometers are relatively more harmful to the climate than long flights because most of the emissions are caused by take-off and landing. (TU Delft, 2022).

This stresses the urgency of encouraging the transport switch for these short travels and has led to the following main research question:

What should be the price of the Dutch aviation tax to make the train as attractive as the plane for short-haul travels within Europe?

The outcome of this study could implicate advice for the Dutch government because the decision about the future aviation tax is still to be made. Therefore, this research is socially relevant because it contributes to an important discussion that is going on in the Netherlands. The switch from plane to train is one of the hot topics in the sustainability sector and that is why special attention is paid to this element and makes it socially relevant too.

2. Literature review

2.1 Cross-price elasticity of demand

The ‘law of demand’ forms the core of the economical science and tells you that when the price of a good or service increases the volume of sales will decrease. This theory could be specified into a more mathematical formula that calculates the sensitivity of the consumers towards the change in prices, named the price elasticity of demand. When the price changes by one percent and the demand changes by one percent in the other direction, the price elasticity is defined as a negative 1. Elasticities closer to zero than negative 1 are considered ‘inelastic’ and elasticities that are valued higher (more negative) than a negative one are considered ‘elastic’. Inelastic consumers will not react heavily to price changes and will stick to the good or service, whereas elastic consumers will show a significant change in demand and this reaction becomes stronger with higher elasticity. (Anderson et al., 1997). This theory could be helpful when analyzing the demand for flight tickets after the implementation of the aviation tax. However, in this paper, the change in demand for train tickets due to the price change in flight tickets will be investigated. This is called the cross-price elasticity of demand and is the extensive version of the above-mentioned price elasticity of demand theory.

The main concept of the cross-price elasticity of demand is the change in the quantity demanded of a certain good when the price of another good changes. Similar to the normal price elasticity of demand this concept reflects the sensitivity towards price changes. This relationship between these different goods is shown in the following formula (Graves & Sexton, 2009):

$$E_{xy} = \frac{Percentage\ Change\ in\ Quantity\ of\ X}{Percentage\ Change\ in\ Price\ of\ Y}$$

$$= \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_y}{P_y}}$$

$$= \frac{\Delta Q_x}{Q_x} \times \frac{P_y}{\Delta P_y}$$

$$= \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_X}$$

Where:

E_{xy} = Cross-price elasticity of demand between good X and Y

Q_x = Quantity of good X

P_y = Price of good Y

Δ = Change

The two of these goods could have different relationships; substitute or complementary goods. Substitutes are goods from which a consumer could switch without losing much utility because the goods are almost similar to each other. Substitute goods have a positive value for cross elasticity. When the price of good Y in the denominator increases the consumer will seek the cheaper alternative and the demand for good X in the nominator will increase too. The stronger the substitutes are, the more consumers are willing to switch between the two given goods and the cross-price elasticity will have a higher positive value. Complementary goods are two goods that are connected in the sense of one main product and another side product that could not be used without the main product. Complementary goods have a negative value for cross-price elasticity. When the price of good Y increases the demand for good Y will decrease and this demand in Y is closely related to the demand for the complementary good in X which will decrease too because it could not be separately used. The price of Y in the denominator and the demand of good X in the nominator move in a different direction and therefore the cross-price elasticity is negative. When there is no relationship between two goods is there and they are used independently, the cross-price elasticity will have a value of zero (Graves & Sexton, 2009).

2.2 What is the aviation tax?

The taxation in the aviation industry is special, has its laws, and is relatively mild compared to other economic activities. The flight tickets are mostly taxed by the means of a departure or solidarity fee. However, the fuel used by the plane is usually excluded from any form of tax and the Value Added Tax (VAT) is not charged or takes a value of 0% for flight tickets in many countries (CE Delft, 2019). Thus the only effective aviation tax is the ticket tax, which could vary in amount based on the distance traveled. The length of the flights could be distinguished into short- and long-haul flights or short-, medium- and long-haul flights. The longer the duration of the flight the higher the tax rate which is applied to the ticket. Furthermore, there could also be a flat rate-based ticket tax which is a fixed amount of money levied (Krenek & Schratzenstaller, 2017). Nowadays more and more countries do decide to implement or increase their flight ticket taxes to take environmental measures. These actions are not favorable for the airlines because they are afraid of losing passengers and making less profit. This has led to many cases in court where airlines try to question whether the ticket tax is based on lawful grounds. In response to the opposition, the legal system states that the ticket tax is justified as long as the fuel consumption is unrelated and the tax does not influence any other rates within the EU. The possible exclusion of transfer passengers in consequence of the imposed tax is legally allowed and could not be used as an argument against the introduction of these taxes. Thus the ticket tax legally exists in the EU but what is it exactly? The ticket tax is a tax that is levied on air passengers who depart from a certain origin and the amount of the tax is determined by this country of departure. Airlines are responsible for collecting these taxes because departing from a commercial airline is a taxable activity. The airlines should pay these revenues to the government but can decide themselves to what extent they pass on the amount of the tax to the air passenger (CE Delft, 2019). The cost pass-through rate is the percentage of the extra cost that is passed on to the air passenger. Competitive markets will make the airlines pass almost 100% of the costs through to the passengers. If the market is not competitive it will depend on the price elasticity of demand from the passenger. The high price elasticity of demand will cause a low-cost pass-through rate and vice versa (Bernardo et al., 2022).

2.3 The flight ticket taxes in Europe

The Dutch flight ticket tax has been reintroduced one year ago, but they are not the only country maintaining such a ticket tax. Ticket taxes are operative in several countries inside and outside of Europe and in different forms. In this section, only the European countries will be highlighted since intra-continental short-haul trips are subject to the main question. Earlier research showed that the demand for Dutch airports declined when the introduction of the ticket tax took place. Many travelers decided to move to German and Belgium for their departure which deteriorated the competitiveness of Dutch airports. After the abolishment of the Dutch ticket tax, many people remained using foreign airports (Gordijn & Kolkman, 2011). Thus countries are not eager to implement such taxes but at a certain point, there is no choice left.

In November 2019, Frans Timmermans the European Commissioner for Climate Action proposed an equal flight ticket tax in the EU to compensate for the negative externalities caused by the industry. The statement was signed by the ministers of Finance from nine European Union states consisting of Belgium, Bulgaria, Denmark, France, Germany, Italy, Luxembourg, the Netherlands, and Sweden. A strong agreement that implies the willingness of the EU states to solve the environmental problems that could not be seen separately from the Paris Climate Conference and the extraordinary growth of the aviation sector over the previous decade (European Commission, 2019). In the long term, there is the intention to unify the taxes in the EU, however, nowadays there is a significant variety in the rates and the definition of the taxes (see Appendix 7.1).

The ticket tax rates shown in the table are originating from December 2020 which was the most up-to-date list of the rates shown on the internet. However, the rates and tax schemes have barely changed since that day and therefore the overview could be used as proper reference material.

In Appendix 7.1 it could be seen that the names of the taxes across the European countries do differ, but the underlying principle of the taxes are the same. They do all represent the ticket/departure tax from the airport of origin.

Other similarities are the fact that the domestic ticket taxes are equal to the international ticket taxes. The domestic rates could resemble the international flat rate or the international short-haul rate. However, there is some distinction between domestic and international flights and that is the appliance of the VAT for air travel within one country.

The Netherlands is comparable to Portugal and Italy considering that they all do use a flat tax rate. Portugal has the lowest tax levied of merely €2, whereas the Netherlands and Italy handle the tax levy of respectively €7 and roughly €8. The Netherlands and Portugal have implemented the tax intending to make the aviation industry greener and discourage plane use. Contrary, Italy introduced the so-called 'Italian City Council Tax', which is logically focused on collecting revenues for the cities and thus the government. Besides that, does Italy also maintain an 'Italian Luxury Tax' for private flights which is not flat-rated but varies with distance. This luxury tax only applies to the extremely rich minority of Italy and is thus not relevant.

Norway and Sweden divide their ticket taxes into two categories; short-haul and long-haul travel. Norway and Sweden define short commuting as any trip within the continent of Europe. The tax levied for these intra-continental trips is €8 for Norway and €6 for Sweden which is like the flat rates of the Netherlands and Italy. Long-haul travels are any flights to destinations beyond Europe and have a corresponding tax rate of €20 for Norway and €31 for Sweden.

Germany and the United Kingdom have a more extensive tax scheme than Norway and Sweden and handle multiple tax rate categories. Germany divides the destinations into short-haul, medium-haul, and long-haul trips with respective taxes of around €13, €33, and €59. The UK maintains two distinctions; namely the length of the flight and the class of seats. Short-haul economy flights are levied with a €15 tax while short-haul premium flights have an air passenger tax of €30. Long-haul economy flights have a tax levy of €94 while long-haul premium flights have a corresponding tax of €206. Long-haul trips for Germany do exceed 6000 kilometers. whereas the UK has a lower limit for long-haul trips already at 3,219 kilometers. Combined with the higher tax rates from the UK they do have a less favorable ticket tax climate than Germany. However, Germany is still less optimal for air passengers than the other countries mentioned before in this section

Austria has an opposite tax scheme compared to the other European countries because normally the amount of the tax rate increases with distance. Austria introduced an air transport levy of €30 for any flights within 350 km, whereas flights beyond that distance are levied with only €12. Flights beneath 350 km will occur significantly less than longer flights, but this tax scheme is still remarkable because it is the only country actively discouraging short-haul flights.

France does have the most elaborated tax scheme containing four different ticket taxes for domestic flights. The 'Corsica Tax' and the 'Airport Tax' however do not apply to international flights and will be thus not further explained. The 'Civil Aviation Tax' is in force for air passengers and is divided into trips to European Economic Areas (EEA) and other destinations. The travels within the EEA have a tax of roughly €5 and destinations outside this area are levied with an €8 tax. The other additional 'Air Passenger Solidarity Tax' is more related to the environmental problems and includes therefore the class of seats too. For flights to EEA destinations, the tax levy is around €3 for economy class and €20 for premium class. Flights beyond the EEA have a solidarity tax of €8 for economy class and €63 for premium class. The French ticket tax system is more complicated than all the other countries but not less optimal for air passengers than some other countries.

Switzerland and Spain are the only countries on this list that do not have an active ticket tax implemented. Although, Switzerland is planning to introduce a distance-based tax for commercial flights which varies between a range of €29 and €115. Spain states that they are willing to levy a 'green tax' too, but no further decisions on the rates and start date are communicated to this day.

2.4 Passenger reactions toward price changes

The aviation industry is constantly growing and to maintain this growth new investments should be made by the airports and airlines. The aviation market is improving and inventive, however, there has not been found a solution to the noise and pollution problems. The authorities have an important role in protecting the residents against these negative externalities. One of these tools is to implement an additional price into the flight tickets to discourage plane use. The effectiveness of this policy depends on the sensitivity of the air passengers towards price changes. What are possible reactions, in different situations, for air passengers when prices increase?

The price elasticity of demand for services in the aviation sector cannot be seen separately from the supply of substitutions. The price elasticity is primarily based on the amount of alternatives present and they will increase simultaneously. The more substitutes an air passenger may choose, the higher the elasticity. The choice model of substitution in the aviation sector is illustrated by Brons et al. (2002) in their paper:

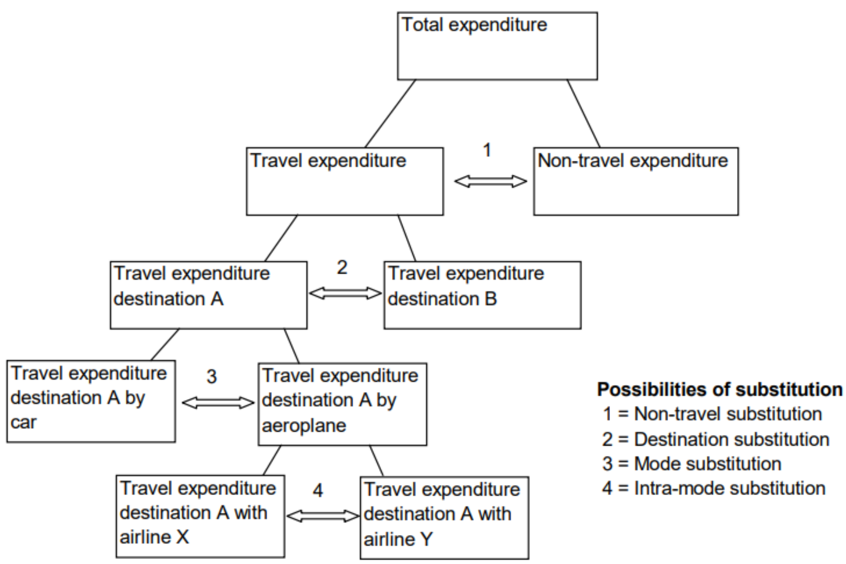


Figure 2.1: The choice model of substitution in the aviation industry

Adapted source: Brons et al., 2002

The possibility to switch between travel companies (4) within the same transport option is called ‘intra mode substitution’. This market is divided into different airlines that are very similar in the services they offer and this will cause perfect competition resulting in a high elasticity.

The air passengers could also decide to take another transport mode (3) to reach their desired destination and this is defined as ‘mode substitution’. The availability of substitutes within this segment depends on the geographical aspects of the involved route. The length, surface, and roughness of the crossed land could reduce the supply of alternative transport options.

Air travelers could also spend their money on a trip to another destination (2) which gives them roughly the same utility as the original destination chosen. This change is called the ‘destination substitution’ in the model.

Lastly, the money spent on flight services could also be used to buy other than transport-related services (4). The air passenger decides not to make the trip and to use his income to purchase non-travel goods, which is logically defined as the ‘non-travel substitution’

The price elasticity of demand in the aviation industry is thus primarily based on the opportunity to choose homogeneous substitute goods or services which provide the same utility. When the alternatives are highly similar in their characteristics this will indicate a high elasticity. Whereas alternatives that do differ significantly, from the original good or service, will give a lower elasticity (Brons et al., 2002).

Besides this key factor is also important when examining the price elasticity to have determined the context in which the price is changing. The price elasticity could occur on different aggregation levels and is classified by I.A.T.A. (2007) into the following five categories:

Fare class level - Smallest scope where the elasticity of demand is studied and makes a distinction between price changes in the business and economy classes. Air passengers could optionally switch to another class, airline, or transportation mode.

Carrier level – The demand is analyzed when an airline increases its ticket prices in all the different classes. The air traveler could book a flight ticket with another airline or take another transportation mode.

Route level - The price changes for all carriers in the same manner on a given route due to taxes or other fees related to the involved airports. An alternative route or transport option could be taken but the price elasticity is generally lower than at the previously mentioned levels.

National level- If the government of a country implements a flight ticket tax, all the inhabitants are obliged to pay these taxes when taking a plane. The only substitute for them is to take another transportation mode or to depart from another country if they are not willing to accept these price changes.

Pan-National level- When multiple neighboring countries decide to impose an equal flight ticket tax there are almost no possibilities for the air passenger to avoid the tax. The possibility to depart from a foreign airport, if the ticket tax is lower, disappears because the taxes are unified. Thus at this level, the amount of different substitutes is the lowest and therefore the price elasticity is likely to be the lowest too.

At the lowest aggregate level, there is the possibility to apply many different substitutions as explained in the choice model earlier. On the highest aggregate level, there is only the substitution into non-travel expenditures possible that causes the low price elasticity. Thus when determining the price elasticity the quality (homogeneity) of the substitute goods should be analyzed. But the context should be considered too because it indicates what the different substitution possibilities and the related price elasticities are.

There are also some other factors directly related to the flight itself which could influence the price elasticity. Low-cost carriers (LCC) have drastically grown in the last decade in the aviation industry (Franke, 2004). The LCC gained a bigger market share and was able to offer its services at an affordable price. The flight industry was accessible to more income groups from this moment and this boosted the leisure segment of the air traffic (Mason, 2000, 2001). This trend has highlighted the distinction between leisure and business travelers but is there any difference?

Oum et al. (1986) researched the price elasticities of demand for holiday routes and non-holiday routes in the US. The price elasticities for the leisure route turned out to be 1.52 while the price elasticity for the business route was significantly smaller with a value of 1.12. The air passengers departing for holidays are thus more price-sensitive and have higher price elasticities. This discovery triggered the airlines to provide cheap flight tickets on these routes and has led to the introduction of the earlier mentioned LCC.

Gillen et al. (2002) studied the price elasticities for business and leisure flights too. However, a new dimension was added to this paper and that involved the short-haul and long-haul flights. The price elasticities ranked from low to high were as follows: Long-haul business, short-haul business, long-haul leisure, and short-haul leisure. These results confirm the theory from Oum et al. (1986) and indicate that the price elasticity is higher for air passengers on short-haul flights. This is in line with the 'mode substitution' from the choice model of Brons et al. (2002) because passengers could switch to a different transport mode on the short-haul, contrary to long-haul routes.

The reaction of the air passengers towards these price changes depends on the context in which this increase occurs, the quantity and quality of substitute goods, and the characteristics of the flight itself.

2.5 Existing research on flight ticket taxes

Since the introduction of flight ticket taxes, there has been much research to discover its impact. Simulations were executed by the mean of a model and predictions could be made. Tol (2007) started one of the first to investigate these taxes that had to compensate for the environmental damage caused. The tax is based on the amount of carbon that is offset during the flight and is implemented in the model at $10, $100 and $1000 per ton of carbon dioxide emitted. The first one is a negligible amount of tax, while the latter one represents around $73 for a 1,000 km round trip. However, this significant sum of money did not have the desired impact with a reduction in tourist travel of 0,8% and a fall in emissions by 0,9%. The reason behind this little effect is the fact that in the case of this high tax it will not even double the price of the flight ticket. If the tax is compared to the total cost of the trip then this will represent a small share. Hence traveler's behavior will not change quickly when taxes are imposed and if some impact is desired then the tax should be extremely high. Tol (2007) is convinced that in other domains of society, more environmental impact could be made for less money.

Falk & Hagsten (2018) looked at the effect of the flight ticket tax in the short term. The introduction of the departure tax in 2011 in Germany and Austria is subject to research in this paper. The percental change in air passengers for low-cost airports and regular airports was estimated. The main findings were an average reduction of 9% in the air passengers using the airports in the first year of tax and a 5% decrease in the year after the introduction. The low-cost airport had a major contribution to the estimates since people with a smaller disposable income are more sensitive to price changes. In the long-term, there is still a significant negative change for the low-cost airports in the regression, but this is mainly due to the introduction of long-distance busses like Flixbus that compete with the aviation industry. The biggest shock could be noticed in the first years, whereafter the air passengers will adjust to a new equilibrium and the numbers of air travelers will stabilize.

Another remarkable finding was that the airports from the neighboring countries around Germany and Austria did not attract significantly more travelers. In contrast to the paper from Gordijn (2010) who noticed that Dutch travelers departed from German airports, before the German departure tax, to avoid their national departure tax. Since the introduction of the German departure tax one year later, this effect does not apply to the current Dutch ticket tax anymore. Besides, that travelers can make use of better alternative ground transportation than a decade ago. Thus air travelers departing from foreign airports due to departure taxes are not a common consequence anymore (Falk & Hagsten, 2018).

More recently research is done by Bernardo et al. (2022) who did complement the previous outcomes of other studies. In contrast to other papers, the investigation was done over a longer period, from 2007-2019, and data was collected for several countries within the European Economic Area (EEA) instead of only one. This specific period allowed the application of the Difference-in-Difference method because countries implementing the tax in this period (treatment group) could be compared to countries already maintaining the tax long before 2007 (control group). The paper aims to identify the causal impact of the ticket tax on the supply of flights and the related emissions and to clarify the distributional effects of the ticket tax. Airlines on many routes bear high fixed costs while providing flight services against low prices resulting in small profit margins. When extra costs in the form of the tax are added up this will heavily influence their supply which was confirmed by the results of the research, having an average significant 12% decrease in the number of flights over the period. The number of emissions did decrease significantly too by 14%. Estimates for the price elasticity of the demand were made too and that turned out to be relatively inelastic towards the price changes. Considering this fact and combining it with the high cost of the airlines, most of the tax levied will be passed on to the air passenger. Low-cost travelers and low-cost airlines are affected the most by this tax scheme and this leads to some outrage. Resulting in discussions about what the rate of the tax should be, while the most important underlying factor is the environment. Thus, in this paper the authors plead for a unified tax in the EEA, in line with the European Commission (2019), to create more comprehension of its existence (Bernardo et al., 2022).

The written literature about this topic has developed over the years and more clarity is gained. However, in all the papers there is a main consensus regarding the tax; the demand does move in the negative direction when the tax is levied, but the demand is relatively inelastic and hence the impact made by the ticket tax is not too big. Though the price elasticity of demand may be higher if a high-speed train network could compete with the airlines on the same route.

This results in the first hypothesis:

H1: The Dutch aviation tax should be higher than the new-proposed €24 tax to make the train as attractive as the plane.

The indication of what the amount of the flight ticket tax should be is determined but should there be a distinction between the air passengers based on their disposable income? Economic goods could be divided into three different categories; luxury goods, inferior goods, and needs. The classification of the good is related to the corresponding income elasticity that the consumer holds. The income elasticity describes the change in demand for the good compared to the change in income. Luxury goods are purchased more when the income rises and the demand increases relatively more than the income. Needs will be bought in bigger amounts too when consumers own more money, however, the extra demand is relatively smaller than the positive change in income. Inferior goods will become less popular when a consumer's income increases and consumption will decrease despite the higher income. The income elasticity value for luxury goods exceeds 1, while needs have a value between 0 and 1, and for inferior goods, their value is lower than 1 (Kasztalska, 2017).

Research had been executed on the income elasticity of the consumers towards the transport options discussed in this study. This variable could give insight into how the travelers do consider the transport modes and what the correct pricing strategy should be. Gallet & Doucouliagos (2014) studied the income elasticity of the aviation industry. The income elasticity for domestic routes was the standard of the model and had a value of 1.186. Multiple implementations in the model were done and the income elasticity for international routes increased the elasticity to 1.546. However, when the demand was determined and there was controlled for the airfare the elasticity decreased from the standard to 0.633. These shocks do implicate the uncertainty in this research field, but the standard elasticity of 1.186 is leading in this paper and labels the plane used as a 'luxury good'. Asquith (2011) investigated the existing income elasticities toward rapid transit rail networks. The paper starts with the general view among researchers that public transit is an inferior good, while the author is not sure about that statement. For multiple American transport networks in big cities, there was a model simulated. The outcome of the model was a positive relationship between demand and income even though the results did vary significantly among the cities. The positive relationship could implicate that the 'rail network' is classified as a need instead of an inferior good (Gallet & Doucouliagos, 2014; Asquith, 2011).

The plane is generally viewed as a luxury good, while the train is considered at most a need. When the disposable income of the air passenger increases this will lead to relatively more demand for the plane service than the train service. This results in the second hypothesis:

H2: The Dutch aviation tax should be higher for air passengers with a higher disposable income to influence their behaviour and stimulate train use.

3. Methodology & Data

3.1 Methodology

The main research question was answered by surveying in Qualtrics. The methodology could be defined as a survey design where qualitative and quantitative data were collected. The survey was spread out via WhatsApp, LinkedIn, the platform Survey Swap, and real-life interaction. The respondents were family members, friends, academic connections, and in-direct connections. Respondents were asked questions to discover the effective level of the flight ticket tax for short-haul travels within Europe. When the survey was opened the respondents noticed that the data gathered would be handled confidentially and anonymously whereafter they would agree on terms for the processing of the answers. After this formality, the survey started and was divided into three different parts (see Appendix 7.2).

The first part consisted of a baseline question to discover what the respondents' true preference was regarding the use of the train or the plane. The respondents were asked which transport mode they would choose in case of equal ticket prices and commuting times for a trip within Europe. In the second part, there were different routes provided with the Netherlands (Schiphol) as the origin and a popular European city as the destination. The European destinations were London, Berlin, Prague, and Vienna. In combination with each route, their corresponding ticket prices and commuting times for both transport options were given. The ticket prices were based on a one-way journey for a randomly chosen date in the summer holidays. The commuting times do represent the actual time to get from Schiphol to the city center of the European destination. The respondents should answer their preference for taking the train or plane and when the plane was chosen there would follow an additional question. They were asked at which flight ticket price they do decide to make the switch to the train use for their European city trip. When this was done for all the four different routes the cross-price elasticity of demand could be derived. This does indicate what the price sensitivity is towards the increase in the flight tickets and would make them switch to the more sustainable train. The necessary flight ticket tax to make both transport options equally attractive could be calculated by noticing at which flight ticket price the demand was the same for the plane and train. This flight ticket price was compared to the original flight ticket price provided in the survey and an absolute increase was determined. For every route, the total increase in the flight ticket price reflects the needed tax. Then the average increase among all routes was calculated to formulate a more generalized answer.

The final part of the survey asked the respondents about their personal information containing the following characteristics: gender, age, and the highest level of education. *Gender* was classified into [male, female, other]. The *age* of the respondents was categorized into different groups [18-24 years, 25-34 years, 35-54 years, and 55+ years]. The *highest level of education* also had specific categories [No education, primary/secondary school, MBO, HBO, WO Bachelor, WO Master/Ph.D.]. MBO, HBO, WO Bachelor, and WO Master/ Ph.D. are degrees that could be completed after secondary education with MBO the lowest and WO Master/ Ph.D. the highest. The *age* and *highest level of education* were asked to gain insights into the disposable income of the respondents and to put the price sensitivity into context. It was on purpose chosen not to ask explicitly in which income group they belong to avoid potential aversion against the survey.

The quality of the survey was improved by forcing the respondents to answer the question before they could continue to the next question, to guarantee full completion of the survey. Furthermore, the order of the multiple-choice answers in the first and second parts was randomized to remove potential order bias.

3.2 Data collection

The survey showed the respondents the ticket prices and the total commuting times for the train and plane. The ticket price for each passenger is based on the sale of the two cheapest tickets, including the booking costs, divided by two. This is done because it is more likely that someone is making a trip with someone else than on his own. The total commuting times reflect the waiting time before the travel, travel time itself, and the transfer time from the airport to the city center. The transfer time only applies to air passengers because train passengers will arrive directly in the city center.

All these data were retrieved from official sources selling the tickets and time indications from the flight services, train services, and airports. The date of retrieving was the 21st of May and the date from the data itself was Friday the 29th of July. The trip had to be exactly within the 24 hours of this date because the specific day influences the prices.

Train ticket prices and travel times were retrieved from NS International, a Dutch rail operator that provides train travel to many European destinations. The NS International site allowed to buy tickets for European travels with their train unit named the Intercity, but other transport operators could be chosen too like Thalys, Eurostar, and ICE International. NS International recommends you to check in 30 minutes before arrival and thus is this the waiting time before departure that gets added up to the travel time (NS International, 2022).

Plane ticket prices and travel times were retrieved from CheapTickets, a Dutch booking company that allows air passengers to easily purchase flight tickets for all different airlines for many destinations worldwide (Cheaptickets, 2022). Schiphol advises the air passengers to arrive on location 2 hours before their departure for European trips (Schiphol, 2019). The time to cross through the foreign airport, without picking up luggage, to the public transport stop is assumed at 20 minutes. The transfer time from the public transport stop to the city center differs for each European destination. London provides train services that will bring you in 15 minutes to the city center (Heathrow Airport, 2022). In Berlin, it takes 30 minutes to travel from the airport to the heart of the city (Berlin Brandenburg Airport, 2022). Prague offers bus and metro services from its airport, lasting 50 minutes to get into the city center (Prague Airport,2022). Vienna airport transfers the air passengers by bus to the middle of the city in 40 minutes (Vienna Travel Guide, 2022). The ticket fare from these transfers was neglected because plane and train travelers are both likely to purchase a mid-week/week pass for public transport services in the European city. The ticket prices and commuting times for both transport modes are shown in the appendix (see Appendix 7.3).

The preceding section applied to the data used within the survey, but who were exactly the people participating in the survey and generated the data used in this research? The language in the survey was Dutch to target Dutch people who are mainly dealing with the implementation of the specific tax in their country. The survey did have 198 participants; however, 11 participants did not fully complete the survey and 11 participants had unreliable values for ticket prices. Values were all equal for every route, lower than the original ticket price, or contained textuality instead of numbers. These 22 participants were removed from the dataset to overcome biases, and this resulted in a total of 176 respondents who did complete the survey in the right way. The personal characteristics of these respondents are described in the table below:

Table 3.1: Descriptive statistics of the respondents

	Observations	**Percentages**
Gender		
Male	124	70.45%
Female	52	29.50%
Other	0	0.00%
Age		
18-24 years	95	53.98%
25-34 years	42	23.86%
35-54 years	19	10.80%
55+ years	20	11.36%
Highest level of education		
No education	0	0.00%
Primary/Secondary school	13	7.39%
MBO	10	5.68%
HBO	34	19.32%
WO Bachelor	71	40.34%
WO Master/ PhD.	48	27.27%
Total	176	100%

Notes: This table consists of information about the personal characteristics of the respondents. The first column describes the number of observations for each characteristic. The second column shows the corresponding percentage to which extent this characteristic occurs.

3.3 Data analysis

This study could be defined as descriptive research where the respondents are observed, and the desired flight ticket tax is measured. Descriptive research is contrary to an experimental design where there are controlled variables, and they are manipulated. In the survey conducted everyone goes through the same questions and the respondents are not distinct into different groups. The descriptive research, in this case, is to discover the trend from switching from plane to train and to show the needed tax. Descriptive research makes use of means, medians, frequencies, and ranges.

First, the collected data were exported to Excel to remove the unreliable and unsuitable answers. Whereafter the data is exported to Stata and the transport preferences and prices where people make the transport switch are labeled. A new variable is generated and that shows the extra sum of money travelers are willing to pay before using the train instead of the plane. When all these values are listed in Stata the median will be calculated, which represents the exact middle extra tax where the percentages of train and plane use are equal. Afterward, train demand for every extra flight ticket price is shown in Stata and exported to Excel to visualize these values in a scatter plot. The form of the graph around the median was analyzed to discover if there is a difference in the cross-price elasticity just below and above the tax, which could help in implementing policies. Afterward, the trend line was generated with the corresponding slope to quantify the change in demand for certain price increases. With this information, the cross-price elasticity of demand could be derived. Hereafter a robust OLS regression, with and without outliers, was performed to explore the relationship between personal characteristics and the willingness to pay extra money for the plane before using the train. This was done to determine whether air passengers with higher incomes are needed to be levied more flight ticket taxes to discourage their plane use.

4. Results

4.1 Transport preferences

Firstly, the respondents were asked what their initial transport preference was when the ticket prices and commuting times were equal for a short-haul trip in Europe.

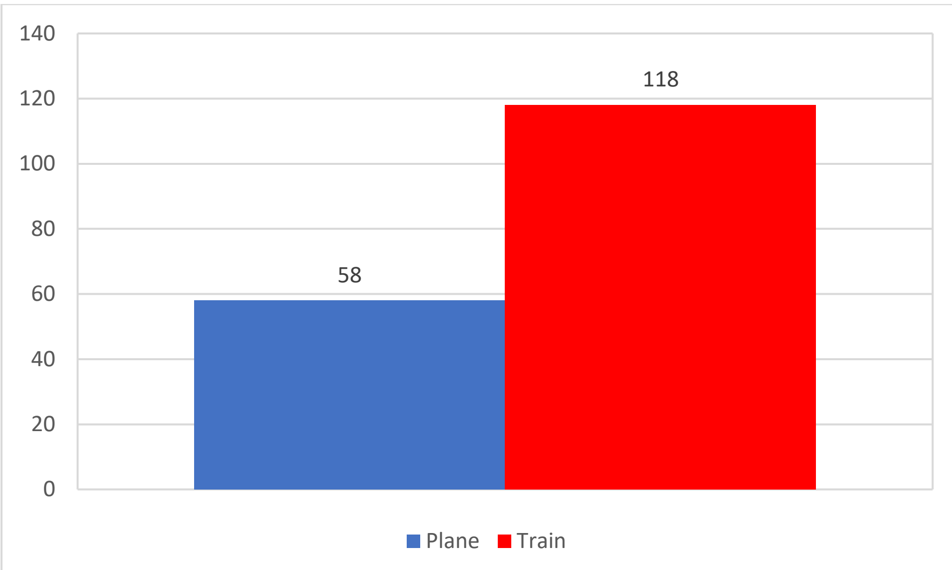


Figure 4.1: Transport preference for equal ticket prices and commuting times

The bar chart in Figure 4.1 shows that the share of travelers preferring the train is more than twice as large as the share of air passengers. This implies that travelers in the base have a strong preference for train use when two important factors are held equal. The reality is that these factors do differ strongly and this causes other proportions regarding the preferred transport mode.

Table 4.1: Transport mode demand for each European destination

	Transport demand (Frequency/percentage)	**Ticket price**	**Total commuting time**
London			
Plane	141 (80.11%)	€65	3 hours 45 minutes
Train	35 (19.89)	€108	5 hours 15 minutes
Berlin			
Plane	80 (45.45%)	€80	4 hours 30 minutes
Train	96 (54.55)	€45	7 hours 45 minutes

Prague			
Plane	145 (83.39%)	€111	4 hours 45 minutes
Train	31 (17.61%)	€70	12 hours 30 minutes
Vienna			
Plane	139 (78.98%)	€136	4 hours 45 minutes
Train	37 (21.02%)	€90	12 hours 45 minutes
Mean			
Plane	126 (71.73%)	€98	4 hours 30 minutes
Train	50 (28.67%)	€78	9 hours 30 minutes

Notes: This table presents the demand for planes and trains for the four European destinations provided in the survey. The corresponding ticket prices and total commuting times are given for each route and transport mode. The ticket prices are rounded to integers and the total commuting times are rounded to quarters.

The transport demands for each given route are shown in Table 4.1.These are in contrast with the baseline train preference, with the plane being the favored transport mode in general. This change in demand is completely due to the added ticket prices and commuting times that influence the respondent's behavior. Berlin is the only European destination that has a majority that chooses to pick the train, therefore is in this case no flight ticket tax needed to stimulate train use. The other destinations have strong preferences regarding train use and this results in the mean that is predominantly in the favor of the train. For these destinations, it will be investigated what the exact tax should be to equalize the demands for both transport options.

4.2 Flight ticket tax and cross-price elasticity

In this section, the first hypothesis is tested, and therefore it is investigated at with flight ticket price increase, the demand is equal for the plane-preferred routes. The extra price that every respondent will maximally pay for maintaining the use of the plane is listed in Stata and this variable is summarized in Table 4.2. Respondents who take the train at first instance are valued at a price change of zero.

Table 4.2: Descriptive statistics from the maximum extra flight ticket price

	Mean	50th percentile (Median)	75th percentile	Standard Deviation	Minimum	Maximum
London	48.90	50.00	65.00	38.03	0	235
Berlin	27.22	00.00	26.50	79.14	0	920
Prague	88.13	69.00	99.00	109.20	0	889
Vienna	88.44	64.00	114.00	106.53	0	864

Notes: This table shows the descriptive statistics for the maximum extra price that air travelers are willing to pay before switching to train transport. The mean is the sum of all values divided by the number of respondents. The median (50th percentile) is the value of the respondent who is exactly the middle number from the list, while the 75th percentile is the value of the respondent who is at three quarts of the list. The standard deviation indicates how far all the data is distributed around the mean. The minimum reflects the lowest value and the maximum represents the highest value. The prices are in euros.

The median reflects the price change where half of the dataset's responses are below the median and the other half of the responses are above the median. The dataset below the median are not prepared to pay this given extra price and will thus use the train. The dataset above the median is willing to pay even a higher price to use the plane and will hence still use the plane for the trip. Thus the necessary flight ticket taxes for London, Prague, and Vienna are €50, €69, and €64 respectively. The needed flight ticket tax for the Berlin route is valued at €0 because a negative tax, or subsidy, is unrealistic given the fact that plane use is discouraged in general. The average of all the routes results in the needed flight ticket tax of €45,75 Hypothesis 1 states that the Dutch aviation tax should be higher than the proposed €24 to make the train as popular as the plane. The results support hypothesis 1.

The flight ticket tax is put in perspective to observe the sensitivity of the air passengers around the implemented tax (median). The maximum extra price for using flight services per percentile is visualized in the scatter plots for every route. The share of the dataset below the percentile is not willing to pay the corresponding price for the plane, while the share of the dataset above the percentile is willing to pay even more if needed. Thus the percentile reflects what the demand for the train services is at the corresponding price increase. The results from the scatter plots are the following:

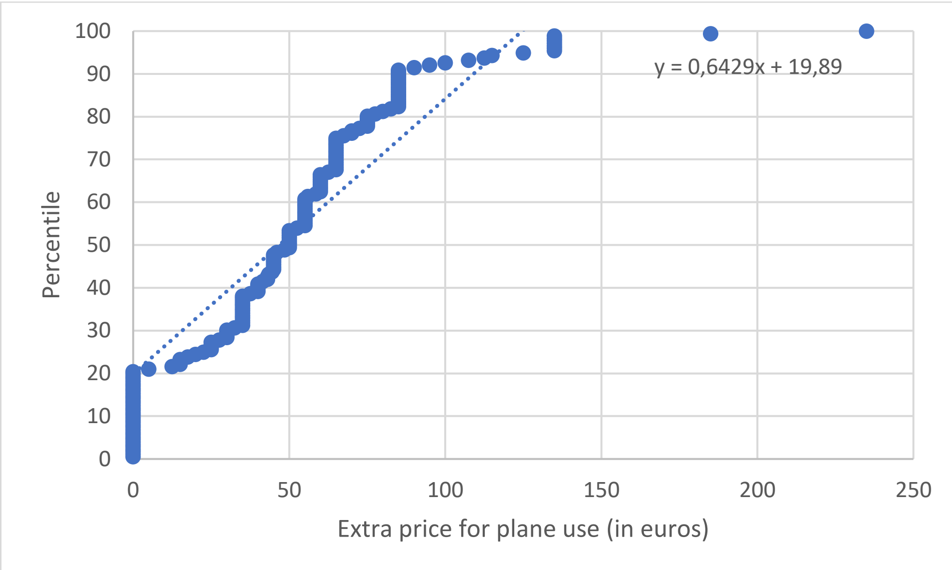


Figure 4.2: Maximum extra price for flight tickets per percentile - London

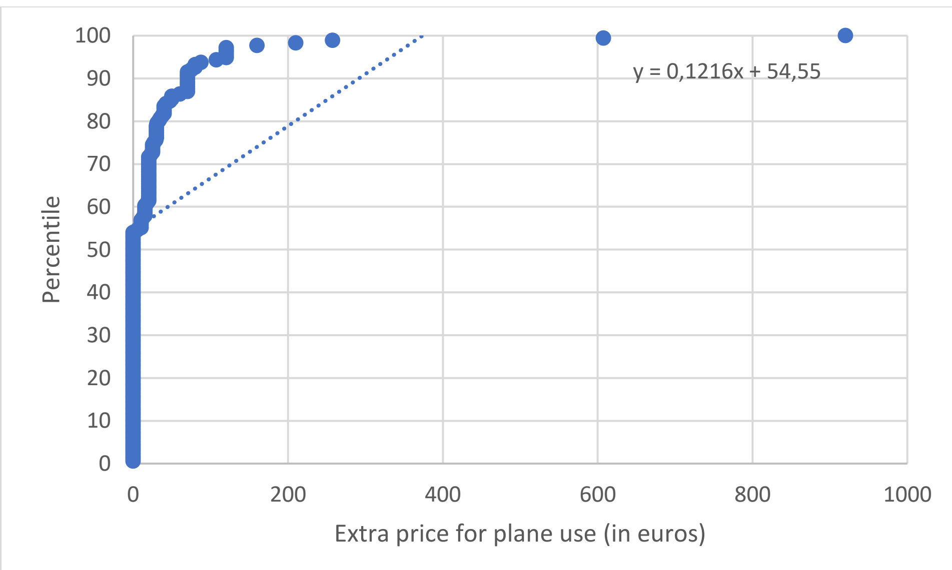


Figure 4.3: Maximum extra price for flight tickets per percentile - Berlin

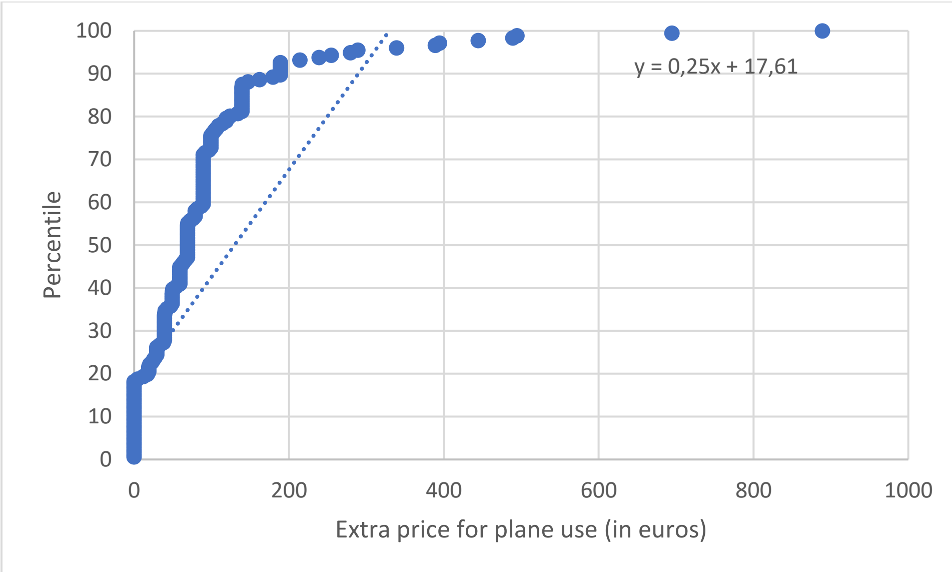


Figure 4.4: Maximum extra price for flight tickets per percentile - Prague

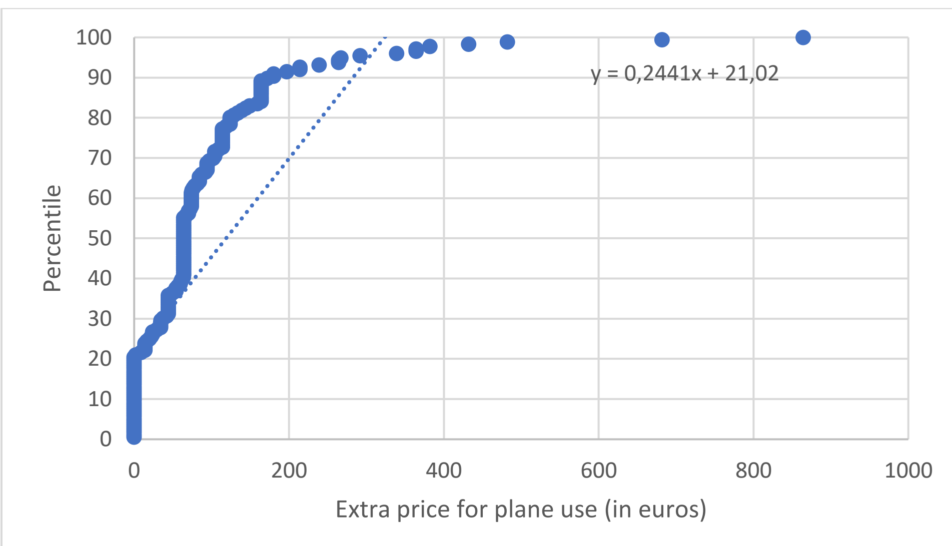


Figure 4.5: Maximum extra price for flight tickets per percentile - Vienna

Section 2.1 presented the formula for the cross-price elasticity of demand ‘Eft’. This represents the ratio of the percental change in train demand to the percental price increase in flight tickets. The form of the scatter plot represents the percental change in train demand when the flight ticket price increases by €1. For the routes with the implemented tax, it could be observed that the form of the scatter plot before and after the median (50th percentile) are nearly the same in Figures 4.2, 4.4, and 4.5. Thus the distribution around the median is equally divided. The exact cross-price elasticity is also derived by generating the dashed trend line starting from the initial train demand. The trend line is shown with the matching equation for all the routes. The constant in the equation is the initial train demand presented in Table 4.1. The other coefficient is the slope of the trend line.

The cross-price elasticity formula could use this coefficient as the percental change in train demand. However, the corresponding increase of €1 is an absolute change and should be transformed into an average percental increase. The mean of the extra price that initial air passengers are willing to pay is summarized in Stata and the extra euro is added up to this mean. The difference is the average percental increase in the price that is caused by the extra €1. These values and the resulting cross-price elasticity of demand are shown:

Table 4.3: Cross-price elasticity of demand for every route

	Mean extra price	**ΔP_f**	**ΔQ_t**	**Eft**
London	61.92	(1 / 61.92) * 100 = 1.61	0.64	0.40
Berlin	59.88	(1 / 59.88) * 100 = 1.67	0.12	0.07
Prague	107.71	(1 / 107.71) * 100 = 0.93	0.25	0.27
Vienna	111.99	(1 / 111.99) * 100 = 0.89	0.24	0.27

Notes: This table shows the determinants of the formula for the cross-price elasticity and the derived cross price-elasticity itself. The percentual price increase is denoted by 'ΔPf'. The complementary change in train demand for the air passenger is 'ΔQt' The cross-price elasticity of demand is defined by 'Eft'. The prices are in euros, and the changes in price and demand are in percentages.

The results in Table 4.3 show that when the price for flight tickets increases by 1%, the demand for train tickets will increase by: 0.41% for the London route, 0.07% for the Berlin route, and 0.27% for both the Prague and Vienna routes.

4.3 Higher income, higher tax

In this section, the second hypothesis is tested whether air passengers with a higher disposable income should pay more flight ticket tax because they are less price sensitive. To discover this possible relationship between the maximum extra flight ticket price and the income, there is an OLS multiple regression with standard robust errors executed. The regression is performed two times; first, all the data is included in the model whereafter the outliers are removed from the dataset. This removal is done to test the sensitivity of the model when few but high values are excluded from the regression. The impact of the variance in the input on the outcomes of the model is analyzed. The personal characteristics and destinations are turned in into dummy variables and are regressed against the dependent variable that represents the extra price that respondents are willing to pay for the plane.

Table 4.4: Linear regression for the relation between the maximum extra flight ticket price and the personal characteristics of the respondent.

	Extra price for plane use	**Extra price for plane use - without outliers**
	(1)	**(2)**
Gender		
Male	-6.41	-5.81
	(7.04)	(6.00)
Age		
25-34 years	8.74	8.71
	(9.67)	(7.78)
35-54 years	38.95**	29.26*
	(13.04)	(11.05)
55+ years	8.03	1.17
	(10.88)	(9.27)
Highest level of education		
Primary/Secondary school	-21.92*	-18.70
	(12.57)	(12.65)
MBO	-7.95	-0.48
	(11.04)	(10.04)
WO Bachelor	-5.40	-13.65*
	(9.07)	(6.91)
WO Master/Ph.D.	5.62	4.66
	(9.89)	(7.50)
Destination		
London	21.69**	26.80***
	(6.69)	(4.28)

Prague	60.91***	54.52***
	(9.93)	(6.13)
Vienna	61.23***	57.59***
	(9.76)	(6.46)
Transport preference - all equal		
Train	-33.00***	-20.13***
	(8.67)	(4.97)
Constant	49.37***	39.97***
	(11.47)	(8.13)
Observations	704	696
R^2	0.14	0.21

Note: This table shows a multiple regression of the personal characteristics and destination dummy variables on the maximum extra price that respondents are willing to pay for plane use. Standard errors are in parentheses; the maximum extra price is in euros; *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$

The *age* and the *highest level of education* act as proxy variables for the disposable income of the respondents. Respondents who belong to the 35-54 years and 55+ years groups are supposed to be in the best-earning period of their life. Respondents with a WO Master/ Ph.D. do have a higher possibility to have a more profitable job than respondents with other educations. The baseline characteristic in this regression is an 18-24-year-old female who has achieved HBO, takes the Berlin route, and chooses to take the plane if the ticket prices and commuting times are equal.

The multiple regression in the first column of Table 4.4 shows that respondents who belong to the 35-54 years group are estimated to pay the most for the use of flight services. This difference in price compared to the 18-24 years group, who pay the least, is €38.95 with two significant asterisks. The 55+ years group spends €8.03 more than the young reference group but includes no significant asterisk. Respondents who achieved WO Master/ Ph.D. are willing to pay the highest amount of money for the plane. This is €5.62 more than the HBO respondents but there is not any significant asterisk. The group of primary and secondary school students is expected to pay the least and is €21.92 less than the HBO students with one significant asterisk.

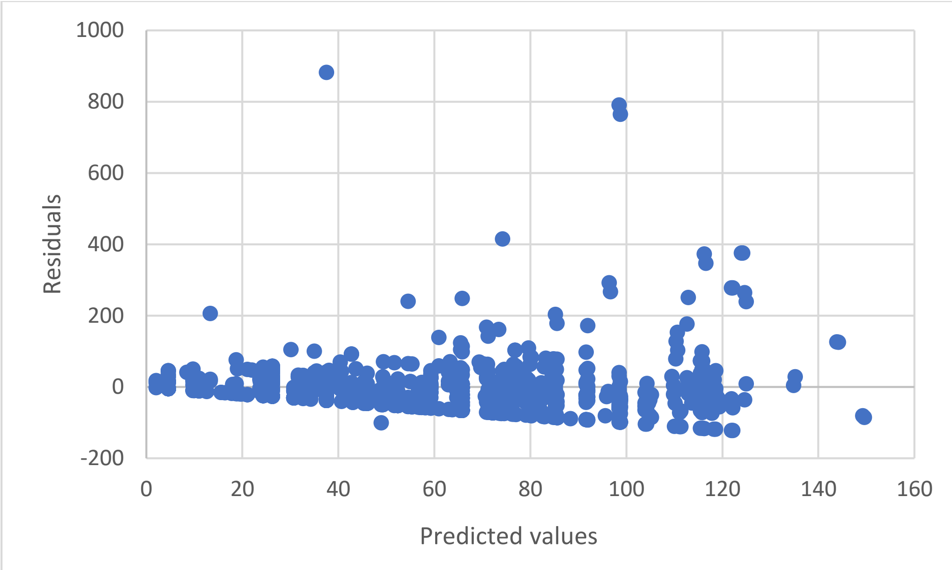
The London route causes travelers to pay €21.69 more for the plane than on the Berlin route, with two significant asterisks. For the Prague and Vienna routes, respondents are willing to pay €60.91 and €61.23 more than for the Berlin route, respectively. The Prague and Vienna coefficients do include three significance asterisks and hence could they be defined as significant. Travelers who choose to take the train instead of the plane when ticket prices and commuting times are equal are estimated to pay €33 less for the flight services when the real situation is considered. This coefficient for the initial train preference does have three significance asterisks and is thus significant.

Respondents from the 35-54 years age group have the highest extra price coefficient just like the group of WO Master/Ph.D. respondents. The age group coefficient includes two significant asterisks which imply some relationship, however, the more educated people are not estimated to pay significantly more than others because no significance is found. The combination of both groups should be significant, to prove correlation, and could not be seen separately from each other.

If the outliers in the data set are removed this will lead to a different output from the regression model. This change in the estimated coefficient show what the sensitivity in the model is by removing not much but extreme values. The results are listed in the second column of Table 4.4. The change in observations is 8 respondents and thus does not represent a big share of the total. However, the coefficient of the 35-54 years group does decrease by roughly €10 which is the same for the constant. Furthermore, the coefficients of the train-preferring people, most education groups, and destinations do change compared to the original regression. This does indicate that the model is sensitive to the removal of only a few extreme values and the real coefficients are likely to be somewhere between the two given outputs for every dummy variable. The R-squared does also increase from 0.14 to 0.21 which shows that the variance in the extra price is better explained by the dummy variables than before and that the model is improved.

Furthermore, to test whether the models fit the observed values are listed against the predicted values and the resulting residuals. Then, the residuals are visualized in a scatter plot for every predicted value.

Figure 4.6: Residual plot for the extra flight ticket price



The value for the residuals seems to get higher for every higher predicted value, thus the residuals are not symmetrically distributed. This could be defined as heteroskedasticity and this indicates that the coefficients are not precise in their estimations and the results are less likely to could be interpreted. In the multiple regression, there is controlled for this issue with the ‘robust’ command which tries to generate unbiased standard errors to overcome this problem. However, the shape of the scatter plot does still indicate no constant variance among the coefficients and hence the issue is still present (Qualtrics, 2022).

The second hypothesis that states that air passenger with a higher disposable income are less price-sensitive and are willing to pay more money for flight services are not supported by the results found in the regression and the model fit executed.

5. Conclusion & Discussion

5.1 Conclusion

This paper tried to find the answer to the main question: 'What should be the price of the Dutch aviation tax to make the train as attractive as the plane for short-haul travels within Europe?' Therefore a survey has been conducted to obtain quantitative and qualitative information.

The results have shown that in the scenario of equal ticket prices and commuting times the preferred transport mode is the train for a trip within Europe. However, the plane is the favored transport option in the real-life scenario due to the existing ticket prices and commuting times. These results confirm that the Dutch flight ticket tax is indeed necessary to discourage the plane and stimulate the train.

The first hypothesis has been tested to determine whether the necessary tax should be higher than the proposed tax of €24 by the Dutch government. The results showed that for respectively London, Berlin, Prague, and Vienna the following additional prices were needed to make equalize the transport ratios: €50, €0, €69, and €64. These values represent an average price increase of €45,75 which indeed exceeds the planned Dutch flight ticket tax of €24. Therefore, the first hypothesis is supported based on the results.

The cross-price elasticities of demand for all the routes have been derived by analyzing train demand for every price increase additional to the original ticket price. Flights to London have the highest cross-price elasticity of 0.41; Prague and Vienna do have the same value of 0.21 and Berlin have the lowest cross-price elasticity of 0.07.

The second hypothesis has been tested to discover if the air passengers with higher income should be levied a higher flight ticket tax since they are less sensitive to price changes. The multiple regression was executed for all routes, with the *age* and the *highest level of education* acting as proxy variables for the income of the individual. The results showed no significant relationship between elder highly educated respondents and the extra paid price for the flight services. Hence individuals with a higher income are not willing to pay significantly more than others for the use of flight services. Therefore, the second hypothesis is rejected based on the results.

The hypotheses have been tested to answer the main question of the research. For short-haul travels in Europe, the Dutch flight ticket tax should exist to encourage the use of train services. The Dutch flight ticket tax should be higher than the recently proposed tax and the results showed that this tax has a generalized value of €45,75 to make the demand equation for the plane and train. It is difficult to define this value as the only effective level of the aviation tax because, in reality, it depends on the context, quantity and quality of substitute goods, and the characteristics of the flight itself. The multiple regression could not find any causality between the proxy variables for income and the willingness to pay more money for the flight services. Therefore, there should be no distinction in the flight ticket tax levied between air passengers, based on their income. This research highlights the importance of the Dutch flight ticket tax and proves that it should be significantly higher than the current and planned flight ticket taxes to gain popularity for the train services on short-haul travels within Europe.

5.2 Discussion

In this research, the survey has been spread out in the first instance to closely related people, whereafter it got shared with other individuals. Table 3.1 shows that the young academic students are majorly represented, due to the background of the author himself. Young and well-educated students are assumed to have less money to spend and are more environmentally friendly-minded. This could lead to results that have a downward bias and are lower valued than they will be in real life, they have more aversion against the plane and are supporting train use. The sample of reliable respondents consisted of 176 individuals which is a solid amount, however, to generalize the personal characteristics even more this sample size could be increased.

The income of the respondents was estimated by asking about their *age* group and *the highest level of education.* This was intentionally done because asking respondents about their income is taboo and could harm the emotions of the respondent and the completion of the survey. However, to discover any causality and to execute a regression the real variable for income had to be implemented to increase the internal validity.

The results that showed the necessary Dutch flight ticket tax, were quite similar to the expectations drawn in the literature review. Tol (2007) implied that air travelers are relatively inelastic and flight ticket prices that are doubled in the research could not generate a shock effect. Gillen et al. (2002) specified several circumstances and wrote that with the supply of other substitute transport modes on the short-haul the elasticity would be higher. In this hypothetical research, there were only two transport modes and thus strong substitutes. Therefore the respondents were on average prepared to switch to the train at the additional tax of €45,75. This is significantly more than most European taxes thus a serious sum of money should be levied, but this is not extreme because of the short-haul circumstances in the research.

The calculated cross-price elasticity of demand is difficult to compare to other literature because almost no research is executed in this field. However, the highest cross-price elasticity was for the London route with a value of 0.41 and this indicates that the price increase in flight tickets is more than two times bigger than the increase in train demand. The other cross-price elasticities were even smaller, hence the overall cross-price elasticity in this research could be characterized as relatively inelastic.

The high cross-price elasticity value for the London route could be explained by the fact that the substitute train network is fast and offers proper connectivity. The Berlin route has the smallest initial plane demand and this means that this is the most persistent group in remaining plane use, thus they are difficult to influence, resulting in a low cross-price elasticity.

Outcomes of the necessary flight ticket tax could have become lower than they would be normally because the survey was spread out on the 10th of June. At that moment there was big controversy around Schiphol because of the extremely long waiting lines to get through the security checks. Respondents probably developed an aversion against Schiphol and were willing to pay less for the flight services originating from the airport. The additional price of the flight tickets was only measured in integers but to gain even more preciseness this could be done in euro cents, however, almost no respondent would be willing to think that deeply.

Other limitations were the case of the Berlin route because respondents preferred the train in the original situation. There was no question about what changes in flight ticket price the individuals using the train would switch to the plane. This was done because a subsidy for using the plane would be highly unrealistic and respondents would not take it seriously. However, to make a more accurate estimate of the generalized Dutch flight ticket tax, the tax of the Berlin route should be slightly negative instead of zero.

Further research, could include multiple transport modes instead of only the train and plane for short-haul travel to discover what the Dutch flight ticket tax should be. Respondents could also switch to the car which is less polluting than the plane but more environmentally harmful than the train. This would add a whole new dimension to the research and would make it perfectly suitable for more investigation. Lastly, the research could be executed over a longer period and for more short-haul routes in Europe.

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7. Appendix

7.1 Aviation taxes in Europe

Table A.1: Airport taxes, ticket taxes, and VAT applied in the EEA, Switzerland, and the United Kingdom (as of December 2020)

Country	Tax name	Domestic	International flights	VAT on domestic aviation
Austria	Austria air transport levy	€30 for very short flights (less than 350 km measures in great-circle distance (GCD) terms) €12 for all other flights VAT may be payable on domestic flights; in which case it can be subtracted from the levy (giving € 26.10 and € 10.44)	From 01 September 2020: €30 for very short flights (less than 350 km GCD) €12 for all other flights	13%
France	France civil aviation tax	€4.63 for flights to EEA airports (including France domestic)	€4.63 for flights to EEA airports €8.32 for flights to other destinations	10%
	Air passenger solidarity tax	€2.63 for economy passengers on flights to EEA airports (including France domestic) and Switzerland €20.27 for premium passengers on flights to EEA airports (including France domestic) and Switzerland	€2.63 for economy passengers on flights to EEA airports and Switzerland €20.27 for premium passengers on flights to EEA airports and Switzerland €7.51 for economy passengers on flights to other destinations €63.07 for premium passengers on flights to other destinations	
	'Fiscal tax' (Corsica)	€4.57 (single) €9.15 (return)		
	Airport tax	€10.80 for Class 1 airports (Paris Charles de Gaulle, Paris Orly, Paris Le Bourget) Between € 3.50 and €9.50 for		

		Class 2 airports (Lyon, Marseille, Nice, Toulouse, etc.) Up to €14.00 for other airports		
Germany	German air transport tax	€12.90	€12.90 for domestic and Europe and other short haul flights €32.67 up to a distance of 6,000 kilometres €58.82 for long-haul	19%
Italy	Italy city council tax	€ 7.07	€ 7.07	-
	Italy luxury tax	€10 (distance < 100 km) €100 (distance < 1,500 km) for passengers travelling on executive air charter flights	€10 (distance < 100 km) € 100 (distance < 1,500 km) for passengers travelling on executive air charter flights	
Netherlands	Dutch aviation tax	€7.85	€7.85	21%
Portugal	Carbon tax	€2 per passenger (expected to start in July 2021)	€2 per passenger (expected to start in July 2021)	6%
Spain	-	Spanish government is considering implementing a ticket tax aiming to internalise the environmental costs of air transport; no further details (rates, implementation date, etc.) are available at this point	Same as domestic flights	10%
Sweden	Air travel tax	62 SEK ≈ €6	62 SEK ≈ €6 for European destinations 260 SEK ≈ €31 for others	6%
Switzerland	-	30-120 CHF ≈ €29 - €115 for commercial flights 500 CHF ≈ €481 for private flights Levy for commercial flights will vary with distance and class of travel	Same as domestic flights	8%
United Kingdom	Air passenger duty	£13 ≈ €15 for economy class (if seat pitch is less than 1016mm)	£13 ≈ €15 for economy class (if seat pitch is less than	0%

		£26 ≈ €30 for premium class (or if seat pitch is greater than 1016mm)	1016mm) flights less than 3,219 km £26 ≈ €30 for premium class (or if seat pitch is greater than 1016mm) flights less than 3,219 km £80 ≈ €94 for economy class (if seat pitch is less than 1016mm) flights over 3,219 km £176 ≈ €206 for premium class (or if seat pitch is greater 1016mm) flights over 3,219 km	
Norway	Air passenger duty	76.50 NOK ≈ €8 for flights to European airports	76.50 NOK ≈ €8 for flights to European airports 204.00 NOK ≈ €20 for flights to destinations beyond Europe	-

Adopted source: Updates to December by (Ricardo, 2020) but based on (CE Delft, 2019)

7.2 Survey

Q1

Skip to

End of Survey if Ik ga akkoord Is Not Selected

Beste respondent,

Ik ben Tjedde Peters, student Economie en Bedrijfseconomie aan de Erasmus Universiteit Rotterdam. Hierna volgt een enquête voor mijn Bachelor scriptie die ik op dit moment aan het schrijven ben. Mijn scriptie is een onderzoek naar de huidige en toekomstige vliegbelasting in Nederland wat vandaag de dag een steeds relevanter thema wordt.

Het onderzoek zal ongeveer **2-3 minuten** van uw tijd in beslag nemen.

Door akkoord te gaan geeft u toestemming tot de verwerking van uw antwoorden. De antwoorden die in de vragenlijst verzameld worden zijn vertrouwelijk en anoniem.

Alvast hartelijk dank voor uw deelname!

Met vriendelijke groet, Tjedde Peters

Ik ga akkoord

Q2

Wat is uw favoriete vervoersmiddel voor een Europese trip in geval van gelijke ticketprijzen en reistijden?

- Vliegtuig
- Trein

Straks worden 4 verschillende Europese bestemmingen gegeven die bereikt kunnen worden met het vliegtuig of de trein vanaf Amsterdam (Schiphol). Voor elke reis zijn de ticketprijzen en tijdsduur gegeven per vervoersmiddel voor een willekeurige dag in de zomer.

De tijdsduur is inclusief de wachttijden op Schiphol en de tijd om van het buitenlandse vliegveld naar het stadscentrum te komen. De ticketprijs is voor een **enkele reis.**

Traject: Amsterdam (Schiphol) - London

	Vliegtuig	Trein
Ticketprijs	€65,00	€108,00
Tijdsduur	3 uur en 45 minuten	5 uur en 15 minuten

Q3

Welk vervoersmiddel heeft uw voorkeur?

○ Vliegtuig

○ Trein

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Traject: Amsterdam (London)- Schiphol

	Vliegtuig	Trein
Ticketprijs	€65,00	€108,00
Tijdsduur	3 uur en 45 minuten	5 uur en 15 minuten

Q4

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Bij welke prijs van een vliegticket maakt u de overstap op de trein? (Bedrag in euro's)

Traject: Amsterdam (Schiphol) - Berlijn

	Vliegtuig	Trein
Ticketprijs	€80,00	€45,00
Tijdsduur	4 uur en 30 minuten	7 uur en 45 minuten

Q5

Welk vervoersmiddel heeft uw voorkeur?

○ Vliegtuig

○ Trein

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Traject: Amsterdam (Schiphol) - Berlijn

	Vliegtuig	Trein
Ticketprijs	€80,00	€45,00
Tijdsduur	4 uur en 30 minuten	7 uur en 45 minuten

+ Add page break

Q6

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Bij welke prijs van een vliegticket maakt u de overstap op de trein? (Bedrag in euro's)

Traject: Amsterdam (Schiphol) - Praag

	Vliegtuig	**Trein**
Ticketprijs	€111,00	€70,00
Tijdsduur	4 uur en 45 minuten	12 uur en 30 minuten

Q7

Welk vervoersmiddel heeft uw voorkeur?

- ○ Vliegtuig
- ○ Trein

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Traject: Amsterdam (Schiphol) - Praag

	Vliegtuig	Trein
Ticketprijs	€111,00	€70,00
Tijdsduur	4 uur en 45 minuten	12 uur en 30 minuten

Q8

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Bij welke prijs van een vliegticket maakt u de overstap op de trein? (Bedrag in euro's)

Traject: Amsterdam (Schiphol) - Wenen

	Vliegtuig	Trein
Ticketprijs	€136,00	€90,00
Tijdsduur	4 uur en 45 minuten	12 uur en 45 minuten

Q9

Welk vervoersmiddel heeft uw voorkeur?

○ Vliegtuig

○ Trein

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Traject: Amsterdam (Schiphol) - Wenen

	Vliegtuig	Trein
Ticketprijs	€136,00	€90,00
Tijdsduur	4 uur en 45 minuten	12 uur en 45 minuten

+ Add page break

Q10

Display this question

If Welk vervoersmiddel heeft uw voorkeur? Vliegtuig Is Selected

Bij welke prijs van een vliegticket maakt u de overstap op de trein? (Bedrag in euro's)

Q11

Met welk geslacht identificeert u zich?

- Man
- Vrouw
- Anders

Q12

In welke leeftijdscategorie valt u?

- 18 t/m 24 jaar
- 25 t/m 34 jaar
- 35 t/m 44 jaar
- 45 t/m 54 jaar
- 55 t/m 64 jaar
- 65 jaar en ouder

Q13

Wat is uw hoogst behaalde opleidingsniveau?

- Geen opleiding
- Basisschool
- Middelbare school
- MBO
- HBO
- Universitair bachelors diploma
- Universitair masters diploma
- Universitair gespecialiseerd diploma (Doctoraal. Juridisch)

7.3 Flight ticket prices and commuting times

Table A.2: Ticket prices and total commuting times for the four short-haul routes

	Travel time	Waiting time	Transfer time to the center	Total commuting time	Ticket price
London					
Plane	1 hour 15 minutes	2 hours	35 minutes	3 hours 50 minutes	€64,95
Train	4 hours 47 minutes	30 minutes	-	5 hours 17 minutes	€108,00
Berlin					
Plane	1 hour 35 minutes	2 hours	50 minutes	4 hours 25 minutes	€80,44
Train	7 hours 20 minutes	30 minutes	-	7 hours 50 minutes	€44,90
Prague					
Plane	1 hour 30 minutes	2 hours	1 hour 10 minutes	4 hours 40 minutes	€111,44
Train	12 hours 3 minutes	30 minutes	-	12 hours 33 minutes	€69,90
Vienna					
Plane	1 hour 45 minutes	2 hours	1 hour	4 hours 45 minutes	€135,95
Train	12 hours 17 minutes	30 minutes	-	12 hours 47 minutes	€89,90

Retrieved from:

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