Abolishing Stockholm’s public transport fares

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Abstract
The decrease of car emission levels has stagnated in the latter years in Stockholm, Sweden. Since the city’s public transit system is highly developed via its large access to areas located in the city’s outskirts, it could serve as a tool to partially replace the city’s car traffic and reduce emissions. This study therefore aims to examine expected travel behavior changes from a fare-free public transport system and investigate potential limitations when increasing the public transport travel degree in Stockholm. The theoretical background consists of the mode choice theory that dissects the reasons behind travel habits, and the zero-price effect which explains the effects from abolishing prices when purchasing a service product. The methodological approach was conducted through a random probability survey conducted in a face-to-face mix mode survey interviews in outdoor environments and via computer-assisted telephone interviewing. The data was then analyzed through MS Excel and SPSS to extract patterns and correlations. The results thereafter implicated preferences from the survey participants implying their desire to primarily reduce or abolish the public transport fares, which would lead to significant travel habits changes among the majority of respondents. This would result in a high number of both frequent car drivers and frequent public transit commuters that would commute more by public transit and drive less.

Keywords: Sustainable Development, Free Public Transport, Mode Choice Modelling, Zero-price effect, Car emissions.

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Summary

Car emissions are one of the main causes behind air pollution that provokes global warming. In Sweden, these issues have often been overshadowed by the country’s smaller population size emitting less total emissions in relation to larger populated countries. But when considering emissions per inhabitant, the reduction rate has decreased and stagnated at high levels in the latter years. In regards to these tendencies, studies have been conducted in smaller-scale municipalities where the public transit fares have been abolished in order to find correlations with decreasing car driving. The effects from these studies proved to be positive, which turned out to be one of the main incentives of this study to investigate if the effects would yield similar results in a large-scale city such as the Swedish capital. The aim of the study is therefore to examine the expected travel behavior changes from a public transport system free from fares, and investigate potential limitations when increasing the public transport degree in Stockholm. This will be accomplished through measures that will replace luxury commuting with more environmental consideration.

The theoretical background consists of a mode choice and zero-price effect theory that identifies reasons behind travel habits and how to create interventions toward them by abolishing prices. The methods approach was conducted via a randomly distributed survey that was handed out in a pilot version and afterwards, through a final version. The data collection took place in outdoor environments and via computer-assisted telephone interviewing to extract replies from Stockholm inhabitants and people having access to the city’s public transportation system. The sampling identified several target groups whereas car drivers, people above 40 years old and public transport combination card commuters were less represented due to difficulties in approaching them in environments of high likeliness of allocating them. These difficulties consisted of lacking response interest and ungiven permissions to distribute in car environments such as dealerships and petrol stations. The survey responses were then coded through MS Excel and SPSS to identify possible travel behavior changes and correlations to free fares.

The results indicated that a majority of the respondents were willing to reduce their car trips and increase their public transport frequency. The expected travel behavior changes among all the respondents resulted in a 67-percentage increase in additional public transit one-way trips and a 72-percentage increase among additional public transport commuters. The results also imply that 3 out of 4 car drivers would replace their primary mode choice with commuting to a degree of approximately 87 percent, and 2 out of 5 commuters would increase their public transit frequency by 57 percent. Recipients that often, partially or never used public transport, were asked to identify incentives that could encourage them to increase their public transit frequency. This revealed a consensus requesting lower prices, followed by more departures and faster traveling time.

In order to apply these measures into the city’s public transport system, the suggested measures of this study are to replace car lanes with pedestrian spaces, bicycle and bus lanes, and increasing public transport capacity. Additional fees would then be added on parking and car-registrations instances as well as adjustments to the current Swedish company-car taxation policy that would reduce luxury commuting. Furthermore, the SL funding and ownership structure would be adjusted to increased state funds. These measures would ultimately result in more positive health and environmental outcomes.

The study however misses practical evidence to draw conclusions on the extent of the respondent’s future travel behavior and in a fare-free public transit reality rather than just hypothetically. Further research has therefore been requested to conduct similar studies in other large-scale cities to implement pilot projects consisting of randomized control trials.

Keywords: Sustainable Development, Free Public Transport, Mode Choice Modelling, Car emissions, Zero-price effect

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1. Introduction
This chapter narrates the environmental conditions affected by road traffic both globally and in Stockholm, Sweden. The narrative also depicts Stockholm’s current public transport system and the possible effects from a fare-free public transit system.

Car traffic globally and in Stockholm
The day-to-day travelling to and from work/school is nowadays a strong habit of many people’s everyday element. The construction and expansion rate of highways and speed rails operating with more travelers has increased significantly, and Cools et al. (2016, p. 2) imply that the expansion of roadways encourages people to drive more, leading to higher traffic volumes, and thus stressing the need to investigate its sustainability outcomes. Car use derives from the individual need to minimize physical, financial and psychological efforts such as personal space, control and journey-time, whereas these intentional and unintentional mode choices then create sustaining travel habits (Gardner & Abraham 2008, p. 308; Gardner & Abraham 2007). Within the increase of transport demand tendency, car travelers are together with other roadway related-movements running on petrol, among the main causes of all emissions if measured through the emitted carbon dioxide (CO₂) amount per traveler in comparison to the public transit commuter (Cools et al. 2016). Many European cities are also suffering from exceeding amounts of nitrogen dioxide (NO₂) emissions caused by diesel-operating cars with similar detrimental effects as CO₂. This leads to degradation effects on the tropospheric ozone (O₃) also known as the “ozone layer” that otherwise reduces harming ultraviolet radiations (Degraewue 2015, p. 218). The exhaust particles from diesel cars also cause increasing risks of asthma, lung cancer and other cardiovascular diseases when inhaled (Leem & Jang 2014; Stockfelt et al. 2017; Qian 2017).

Cools et al. (2016, p. 3) suggest that there exists a way in which car drivers can be encouraged to switch their means of conveyance if the public transit service frequency increases and extends its accessibility between households and jobs/schools. If successful, this would produce social cost savings on a state and individual level, and reduce the detrimental health and environmental effects from roadway traffic (Gössling & Choi 2015). Buehler (2011) also suggests that if emission levels would diminish, the ozone layer could regain more of its former thickness. Hence, increasing information distributed towards car drivers can help raising awareness about the detrimental effects on the natural environment and human health caused by the emissions (Hagen-Zenker & Jin 2013, p. 708).

Stockholm has by European standards, a high CO₂ emission rate per inhabitant from roadway emissions but yet relatively low if perceiving the emissions on a collective basis in comparison to other large-scale European cities (Börjesson et al. 2015). Today, 4 out of 10 Stockholm residents drive their car on a weekly basis whereas 3 out of 10 commute using public transport, and the closer the city centre the inhabitant lives and if the person is an adolescent or woman, the less likely the person is to use her or his car (SLL 2016, p. 5-6; Stockholms stad 2016). By 2016, 93 percent of all private cars were either fully gasoline or diesel driven whereas the remaining percentages were driven on alternative fuel (Myhr 2016), and the city’s private car emissions have gradually been abbreviated from the years 2000 to 2012, but has according to Miljöförvaltningen (2016), lingered on similar levels since. This issue urges the need to identify solutions for car drivers without public transport commuting options or more delicate economic conditions. However, since the decreasing rate of car emission has been halting, it yet remains uncertain what the most effective measures are in order to combat car emission levels.

1.1. Aim & research questions
This study aims to examine expected travel behavior changes from a fare-free public transport system and investigate potential limitations with this approach to increase public transport travel in Stockholm, Sweden. To achieve the aim, the formulated research questions are the following:

1. To what extent would a fare-free public transport system infuse public transport demand changes?
2. To what extent would the expected public transport demand changes following free fares correlate with less car driving and increasing public transport commuting?
3. Which measures can be suggested for the Stockholm municipality in order to encourage less car driving and increasing public transport commuting?
2. Background

The background section comprises further background on the consequences of car traffic, and the issues
taking place in Stockholm’s public transit system that shapes the transport behaviors of the city’s
inhabitants. The presented statistics derive from secondary sources with an equal number of study
participants for each conducted year.

2.1. Consequences of car traffic

In Paris, the measured pollution levels were high for the past ten years, which led to the communal
decision to abolish the city’s public transport fares for a few days to lower the emission levels by
attracting car drivers to commute more by public transport (Sharman 2016). In 2016, a decision was taken
between the cities, Paris, Athens, Mexico City and Madrid to ban diesel cars from the beginning of 2025
(Karlsson 2016). The emissions from roadway movements do not only derive from increasing traffic, but
also from traffic congestion caused by it (Negoeescu & Tokar, 2011, p. 38 & 45). Traffic congestion
provokes multiple effects on the environment from cars operating on low or idle gear engines, leading to
the emission of more CO₂ and NO₂ (Ibid.). It also correlates with higher road accident rates (Buehler
2011), and leads to high social costs from every traveled kilometer for the municipality. In terms of car
drivers, Johansson-Stenman (2002, p. 959 & 967) describes the typical driver to be a 50-year old male
living outside the bigger cities and most likely possessing a company-car, the higher the personal income,
the more likely the owner is to possess and drive his car to and from work. The car traffic issues have
raised awareness of how to reduce its carbon footprint without impairing traveler’s possibilities to
mobilize in the most economical and fastest way possible. There are legitimate doubts to the economic
feasibility of implementing reduced prices or a fare-free system, but decreased car travel will according to
Grabow et al. (2011) yield major air quality improvements and less roadway congestion, leading to less
social costs.

Social costs

Gardner & Abraham (2007, p. 197) explain the enticements behind car use as the driver’s priority to
minimize the physical, financial and psychological efforts such as personal space, control and journey-
time, which were regarded as bigger issues when commuting via public transport. Regardless of the
consciousness behind the decisions, Gardner & Abraham (2008, p. 308) indicate that it creates a mix of
intentional and unintentional habits that gradually influences personal travel preferences. Leem & Jang
(2014) and Koplna (2017) implies that diesel cars are emitting diesel exhaust particles (DEP) and NO₂
that wears the tropospheric ozone and increases the risk of asthma and lung cancer when inhaled.

In addition to air pollution, Mizutani et al. (2011) executed a study in Tokyo, Japan to estimate the social costs from car traffic in terms of air pollution, congestion, traffic accidents, noise, global warming and traffic congestion. The study estimated social costs from cars to 2.8 euro/liter and 0.3 euro/vehicle-km in comparison to the cost of buses, 8.6 euro/liter and 2.8 euro-km/vehicle-km, meaning that buses will lead to less social cost when transporting more than 3 passengers than in a car (Mizutani et al. 2011 p. 3556). The results show that traffic congestion covered almost half of all costs followed by air pollution’s 20 percentages, and that construction and amplification of roads alleviated congestion but increased social costs (Ibid.). The numbers from Mizutani et al. (2011) are regarded as approximate since Gössling & Choi (2015) calculated the euro-km/passenger car driving cost to 0.5 when considering each car to drive at 50 km/h and transport 1.5 passengers including the driver. In addition to that, Gössling & Choi (2015, p.109) assessed and compared the social cost of car-driving and bicycle-driving in Copenhagen where the considered cost-factors were the operating of vehicles, travel-time, accidents, pollution and related externalities, recreational value, health benefits, safety, discomfort and tourism branding. Henceforth, the observations implied a significantly higher social cost and accident risk from car driving than biking, which is also emphasized by Celis-Morales et al. (2017).

Fare-free projects

The documented travel behavior effects from free public transport systems is the increased frequency of
public transport use among intermittent public transport commuters rather than habitual car drivers, and
the incremental risk of human congestion from more public transit commuters (Börjesson et al. 2015).
Hence, De Witte (2008, p. 216) intended to examine if the price factor was important when attracting
more public transit commuters in Brussels, whereas the results unveiled that there was no correlation
between decreasing car-driving frequencies and the 9 percent of the population that were willing to extend their public transport commuting if prices were lowered enough to their content. Instead, factors such as mobility, speed and commodity as well as leased company-cars had higher influence on the travel behavior. Cools et al. (2016, p. 7) also reports that public transportation subsequently increased by 50 percent at the University of California from free bus tickets and road capacity reductions.

Since June 2012, the municipality of Avesta, Sweden with approximately 23,000 inhabitants, has had a fare-free public transport system (Avesta kommun 2017). The purpose behind is to increase public transportation and reduce private car emissions, and it has been considered as a successful system when it became evident that the inhabitants’ traveling frequency increased by 80 percent and the Carbon dioxide emissions abated to an extent of 40 tons less per year (Ramböll 2013, p. 16). Similar projects have been applied in other municipalities of different sizes such as Tallinn, Hawaii, Chateauroux and Chapel Hill. There, the travel frequency increased between 80 and 1200 percent in higher urban density areas where the fares had been considered high prior to the price change. Communities of less urban density and relatively low fares before the price change had only smaller increases in public transport commuting as well as marginally lower emissions. It was also reported that target groups with the most upturn in public transportation frequency were the ones that already were frequent users of its service or frequent pedestrians or bikers (Ramböll 2015). However, despite the project’s success, several municipalities decided to reset the fares due to insufficient financial funds (Ramböll 2015, p. 16-17).

Potential counter measures
Car driving can be enticed to change travel mode to public transit service by certain interventions such as increasing the accessibility between the public transport system and households and jobs/schools (Cools et al. 2016, p. 3). Thøgersen & Møller (2008) conducted an intervention study that provided access for frequent car drivers to a one-month public transport card, which lead to decline in car trips and increased the public transport commuting. But the habit never sustained after the free fare period ended. If an intervention however could create a long-term habit of lesser car driving, it would culminate into air quality improvements and more roadway availability since buses, trains and trams carry significantly more people than cars by using notably less space (Grabow et al. 2011). If free fares were to be implemented, Redman et al. (2013) denotes that car users would become more prone to commute more by public transportation, causing an increasing public transport demand. It would moreover save social costs and improve the general health and environmental conditions and regain the former thickness of the tropospheric ozone (Gössling & Choi 2015; Mizutani et al. 2011; Buehler 2011). The durability and habit achievement of these measures will however depend on how well the provided public transit infrastructure will apply to the traveler’s accessibility and mobility demands. Feasibility wise, a fare-free public transit system usually requires subsidies. On those grounds, Webster & Pounds (1980, p. 316) implicates that subsidies on public transport can be funded through car-taxation policies on fuel and vehicle licenses. Practical examples can be found in Israel, where 44 of frequent company-car drivers decreased their frequency and commuted more by public transport when having to pay for their car ownership due to inflated taxation policies (Shiftan et al. 2012, p.145). In Germany, Buehler & Pucher (2011) reports that a few German municipalities managed to lower the public transit prices by cutting down costs through purchasing new transports with lower maintenance costs and greater passenger capacity, implementing a comprehensive timetable coordination as well as increasing costs on multiple dense-traffic sectors that inhibited car driving to a larger degree. However, these cost reductions also came from restructuring employee benefits, freezing salaries and increasing work hours and job tasks (Ibid.).

2.2. Stockholm’s conditions
Stockholm’s public transport authority (Storstockholms lokaltrafik) was founded in 1964 by different state and private owned companies (Jansson & Wallin 1991, p. 103). Today the network consists of commuter and underground trains, trams, buses and smaller ferries (Jansson & Wallin 1991, p. 103; SL 2017). The system is publicly referred to as SL and it is driven through a corporate form with multiple stakeholders such as the bus operators Nobina and Keolis Sverige, the bus and tram operator, Arrriva Sverige and the commuter and underground operator, MTR (SL 2017). SL carries approximately 750,000 travelers each day and its budget is financed by 50 percent from the city’s council tax along with the remaining 50 percent from the stakeholder’s ticket sales and commercial revenues (Ibid.). SL’s railway traffic is fully driven by renewable sources consisting of water and wind power, and the bus traffic is renewable by up to
99 percent. A monthly period card to commute within the public transit system, costs 830 SEK for adults, which is an increase from the 565 SEK in 2003 (SL 2017), and in 2013

According to Stockholms stad (2016), 4 out of 5 inhabitants were satisfied with their access to the city’s public transport in the year 2013, which was an increase of 2 percent from 2004. According to ABSL (2011), 67 percent of the public transport travelers were satisfied with SL’s general departure frequency, half of the population were content with the delay frequency, and 51 percent were concerned with the public transit passenger congestion degree. Between 2005 and 2015, the general satisfaction towards the city’s public transit system albeit increased from 63 to 78 percent with exceptions towards the bus and commuter train system that diminished by 9 respectively 16 percentages of lower satisfaction. Hence, 53 percent were content with passenger congestion in buses, trams and trains during the journeys (ABSL 2011).

Road tolls
Stockholm currently has road tolls installed around the city centre. Before the implementation, a trial was introduced in 2005, which abbreviated carbon dioxide emissions marginally (Stockholm stad 2006). What initially seemed to be a strong population opposition towards the trial, became consequently a strong support in favor of the implementation. Eliasson & Jonsson (2011) says that the reasons behind it was the information from authorities suggesting that the income would be primarily invested into the expansion of SL. When the tolls were installed, the number of car trips passing the cordon were comprised by 15 percentages into public transport trips in comparison to trips conducted outside the cordons (Karlström & Franklin 2009). Stockholm stad (2006) state that the travel behavior was partially reset in 2011, but yet marginally lower than prior to the implementation, and today, CTS (2014) argues that the current car traffic volumes have equalized the levels prior to the trials (ST 2016), which ABSL (2016) believes it to depend on the opening of the tunnel, Norra länken that increased the car accessibility by maneuvering north-east trips outside the city without driving inwards through the centre. Today, car drivers passing through the tolls must pay between 35 and 11 SEK depending on the daily hour (Transportstyrelsen 2017). More newly proposed measures to combat the emissions of the city’s traffic volumes is the current ban proposal of diesel driven cars which due to its popularity, has inhibited the city’s in reaching its former environmental goals by the end of 2020. Thus, if the ban is passed, the proposal would come into force in 2040 (Karlsson 2016).

Local travel behavior
As a result of the implementation of the tolls in 2013, more than half of all inhabitants decided to leave the car at home and travel with other means of conveyance. Average wise, the average Stockholm resident made 0.63 public transport trips and 1.06 car-trips each day during the years 2011-2014 (ABSL 2015, p. 28 & 42), which was a decrease from 2005-2006 where 0.67 public transport trips and 1.19 car-trips were conducted each day (ABSL 2008, p. 7). It is however not stated whether the trips are round or single trips. During the fall of 2015, SL distributed a survey where it became evident that half of all motorized journeys in Stockholm’s consisted of public transportation and that car driving peaked during weekends, the study also unveiled that adolescents and women commuted more by public transit often than other target groups (ABSL 2016). According to the measures of Stockholms stad (2016), the yearly average car driving distance of the Stockholm resident decreased from approximately 6000 to 5400 kilometers between 2008 and 2014, and had a minor increase of 50 kilometers between 2014 and 2015. Public transit wise, ABSL (2016) implies that the amount of public transport trips was as high as they had ever been with approximately 562 000 journeys during 2015. Pro-environmental attitude had little or no influence in people’s transport choice according to Johansson-Stenman (2002, p. 967).

If SL’s fares would become entirely free, it would require subsidies in need of supporting finance for which it has been an ongoing debate to whether the government should raise gas prices. If applied, it would negatively affect car commuters with substandard financial conditions that may not have equally good public transit access as inhabitants living in the city centre (Johansson-Stenman 2002, p. 966). The Swedish governmental administration highlighted the issue in the beginning of 2017, by proposing car traffic reductions through a company-car taxation with respect to their numerical increase from 151 000 to 250 000 users during the latter 20 years. The current system only charges companies and not the drivers when bypassing the tolls whereas the new proposal would lead to personal charges towards the driver instead (Matson 2017). In addition to that, free fares could not only change the travel behaviors
among the locals but also reduce the large amount of physical injuries among travelers passing through the SL ticket barriers, leading up to approximately 100 reported injuries per year (Drevinger 2016).

2.3. Research limitations
Surveys have been used in this study as a source of empirical data. The secondary sources from the surveys of Stockholm stad, Storstockholms län and SL miss demographical correlations to whether travel behaviors are correlated with income, educational level, age and occupation. Other than the presented statistics, the literature review does not problematize secondary source interpretations on Stockholm’s traffic conditions such as measures on Stockholm’s current CO₂ emissions and social costs related to the roadway traffic. The secondary data is thereupon extracted from car traffic and public transit volumes from both peer-reviewed articles and official reports. Albeit, peer-reviewed articles only contain the quality approval of the reviewer, which to a certain extent is better than a non-reviewed journal, but yet requires further scrutiny to reassure a higher reliability and quality. Lastly, this study will not center its attention to calculate whether a free public transport system is economically feasible or not for the Stockholm municipality, but rather suggesting evidential measures to facilitate the transition from today’s partially subsidized public transit system to a future fully subsidized public transit system.

2.4. Report structure
The report does apart from the background have a methodological section describing the study’s survey approach, followed by the data collection description of the distributed questionnaire pilot and final version. Thence, the study’s sampling of the Stockholm target group is outlined together with the limitations of the research approach. The theoretical section depicts mode choice modeling and the zero-price effect, their relation to each other and the study’s topic. The theory will additionally contribute in shedding light on why certain tendencies are shaped the way they are. The results thenceforth present the collected data related to the research questions, if the fares were to be abolished. The discussion primarily focuses on the research questions, bridging it together with the background and theory before proceeding to the discussion and the validity and reliability of the extracted results, and lastly concluding with the study’s importance and requested further research.
3. Theoretical background

The study exercises two different theories, Mode Choice Modelling and the Zero-price effect and theoretical implications that reduce car usage and increase public commuting. In regards to the study’s research question, the study’s findings will not focus on being interpreted primarily through the theory. The theory of this section will thus contribute to explaining certain tendencies among the findings.

3.1. Mode Choice

The mode choice theory is included in this section by the agency of Schneider (2013, p.129) in how people choose their primary means of conveyance in their daily routine travelling such as trips to and from work or school. Mode choice is highly influenced by social influences, habits and facilitating conditions that enhances enjoyment after the taken decision. Within the decision, there are five different steps permeated by socioeconomic conditions that determine the reason behind it, and they are the following:

1. Awareness and availability; determines what available transportation modes the user is aware that he or she can presume from (Schneider 2013, p. 131).
2. Basic safety and security that surrounds the person of interest during the journey. An example is the experienced concern of having your bicycle stolen if biking, which can leverage the decision in favor of choosing another transport mode (Schneider 2013, p. 131).
3. Convenience and cost factors that requires the least amount of accessibility, time, effort, control and money contributes to the mode choice (Schneider 2013, p. 132).
4. Enjoyment that provides physical, emotional and social pleasure and makes the traveler feel good about their decision (Schneider 2013, p. 132)
5. Habit, which is defined and reinforced by the previous choices during phase 1 and 4 as long as the conditions remain the same with the exception of the possible purchase of a new car (Schneider 2013, p.132). Bamberg et al. (2003, p. 185) also denotes the mode choice theory to be similar to the theory of planned behavior that recognizes the element of automatic patterns when the travelers no longer analyze their decisions but performs them based on memorial intentions.

In addition to influencing mode choice factors, About-Zeid & Scott (2011, p. 583) mention similar factors that the individual consciously or unconsciously looks for when traveling. These are the higher reliability and faster journey times when commuting by public transit, the need of integrity and comfort, the tolerance of walking and waiting when traveling by public transportation, and work schedules that correlates with certain congestion degrees during certain travelling hours of the day and the safety perception during the trip.

Reducing car driving habits

Improved general economy of a country normally correlates with an increasing individual income which itself leads to a probable car ownership. This tendency however lessens when the economic growth of the country is more gradual and less dynamic (Souche 2010). Bamber et al. (2003) state that mode choices can be largely affected by creating interventions in people’s everyday travel habits, which produces normative and behavioral changes. About-Zeid & Scott (2011 p. 584) imply that traveler’s tendencies in switching from car-driving to public transit is strongest in areas where the public transit system holds an equal or shorter amount of travel time as a car trip. There are however difficulties in predicting future mode choice behaviors before possible changes to external circumstances such as the lowering or abolishing the public transit prices (About-Zeid & Scott 2011, p. 584).

Different approaches can be utilized to stress mode choice changes. To attract car drivers to choose other travel modes, Schneider (2013, p. 134) suggests an increasing investment in developing infrastructure within and around the transportation system. These are the implementations of safer sidewalks, car lane reduction and the allowed speed within them, converting pedestrian-dense streets into public spaces with more outdoor vending and planting trees, raising societal awareness in other means of conveyance besides the car, raising the parking prices and providing monetary benefits for bicycle users and public transit commuters. The negative aspect is the risk of retailers and business diminishing logistical possibilities (Schneider 2913, p. 134). Buehler (2011) recommends a higher taxation of car registrations and ownership which has created significant differences between Germany with a lower car usage. In USA, the tendency is different since the car-taxation policy is lower, followed by a higher car
usage despite having more densely populated cities that otherwise coincides with increasing public transport commuting. Souche (2010, p. 3) also argues that increasing fuel prices and decreasing public transport fares increase the public transit travel demand, but risks affecting car-dependent people with fewer public transport options. Conclusively, Souche (2010, p. 4) implies that increasing the capacity rate of the public transport system has smaller augmenting effects on the travel demand.

3.2. The Zero-price effect

Cools et al. (2016) explain that abolished prices have a zero-price effect, which increases the product demand significantly when there is no monetary transaction cost in comparison to when there is. That is because of the mental transaction cost that appears within customer’s rationalization, which leads to the customer’s self-asking question to whether the product is worth its value or not. Without the transaction cost, the customer would avoid the same amount of consideration and more instantly perceive the product with more desire, attaching more value to the product. Cools et al. (2016) imply the zero-price effect only to take effect when the product’s price is abolished and not just reduced. However, the zero-price effect is not a pure psychological effect, because individuals performing the same or similar choice patterns would develop a more habitual behavior rather than taking decisions based on cognitive behaviors, which may lead to the perception that the product without prizing may lack quality in comparison to full pricing. Cools et al. 2016, p. 19). Henceforth, Cools et al. (2016, p. 21) implies that public transport commuting increases when fares are free and the zero-price takes effect, whereas subsidies are the costliest but yet most efficient use of achieving those circumstances.
4. Methods
The methods section contains the survey research strategy and questionnaire data collection approach that are used in the study. It also depicts the structure of the pilot and final version of the distributed questionnaire as well as the considered research ethics during the empirical extraction and limitations. Noteworthy is that the terms respondents, recipients and participants are used as synonyms referring to the same person in question, meaning the person that was interviewed for the questionnaire.

4.1. Survey strategy chosen
The chosen research strategy of this report is to conduct a survey within the social research methods of Bryman (2016). The strategy was chosen to enhance the possibilities of acquiring a large amount of quantifiable opinions from the Stockholm residents via a faster and wider scope than a qualitative research strategy would offer. A survey does not represent a research method but a research strategy since several methods can be applied into a survey, and it proposes to scrutinize the selected object on a detailed and comprehensive level at a specific point in time, which extracts a larger degree of empirical realism with a more profound understanding drawn the observations (Denscombe 2003, p. 6-7). The survey strategy entails a field approach that focuses on face-to-face interviews, and computer-assisted telephone interviewing. These two approaches allow the interviewer to enhance the geographical sampling flexibility and establish a more personal and trustworthy contact with the interview recipient (Denscombe 2003, p. 8).

Exclusion of case study strategy
In regards to Stockholm’s particular climate, infrastructural and economic conditions, a case study could be argued as an appropriate approach, shedding light on different behavior prospects more profoundly (Denscombe 2003, p. 30). A case study also focuses on the relationships between the involved actors that shape the unique case (Denscombe 2003, p. 30). With respect to the study scope, case studies are more comprehensive since they allow the application of both interviews and surveys whilst the latter often imply smaller sampling sizes (Denscombe 2003, p. 31-32). In terms of interviews, the strategy could extract information on what the sample size perceives as potential improvement areas or measures in the public transit system and what measures the municipality and SL need to take in respect to decrease car-driving incentives. Albeit, the case study approach was excluded by dint of the low probability of producing comparable data that would represent all the Stockholm population for a longer time period, and the researcher would also risk influencing the process with its presence and bias to a larger participation degree that could affect the empirical data (Denscombe 2003, p. 39).

4.2. Data collection method
This section narrates the arguments of selecting a questionnaire format as the main data collection method in addition to excluding alternative methods.

4.2.1. Using the questionnaire method
The questionnaire framework was chosen because Denscombe (2003, p. 145) considers it suitable when wanting to quantify large response numbers and standpoints. This can be more effectively executed because it allows the recipient to participate anonymously and increases the possibility to ask close-ended (quantitative) and open-ended (qualitative) questions to the person being interviewed without getting too extensive answers (Bryman 2016).

The questionnaire was designed as mixed mode survey consisting of self-administered and structured interview questions, which took place via paper form, mobile phones, and computer-assisted telephone interviewing. See 4.5.3 further on in the text for details on the specific mix used here. The combination would entail the interviewer’s presentation of the questionnaire purpose and format and afterwards allowing the respondent to go through the questionnaire with possibilities of asking for prompting, and increasing the response rate that otherwise would decrease by solely distributing the survey via a self-administered method. The interviewer would in other words not read out the questions for the recipient unless requested (Bryman 2016, p. 223-224).

Self-administered questionnaires are short with few open-ended questions and designed with an easy to follow format that allows the respondent to go through the questionnaire on his or her own
without the interviewer’s necessary guidance (Bryman 2016, p. 222). However, since pure self-administered questionnaires inhibits the possibility for the interviewer to observe the respondent’s participation, and since all the participants had to be over 18 years old without physical disabilities, the mix mode survey was necessary to ensure an approved degree of the structured interview format. The structured interview format entails a tighter control during the interview where the researcher has a predetermined list of questions that are identically forwarded to all recipients (Denscombe 2003, p. 166). If the recipient would not understand the question nor the answers at disposal, the interviewer would read out the paragraph again with a slight reformulation of the question without changing the main content, which also was identical to all reformulations that were given under circumstances of raised uncertainties from participants given the specific type of survey question (Bryman 2016, p. 224). The computer-assisted telephone interviewing is faster and more geographically flexible, and it standardizes the interview to an extent that increases the quantifiable degree of the answers. The method also gives the interview recipient less possibilities to consider the interviewer’s ethnicity, age, class and physical presence (Bryman 2016, p. 203).

All interviews besides the computer-assisted telephone interviewing took place along with the interviewer’s presence to prompt if requested, and were either carried out on paper or mobile phone links depending on the respondents’ convenience. If answering on paper or mobile phone, the survey administrator would approach the respondent on sight and ask her or him to fill either in the answers on behalf of the recipient’s oral request or allow the recipients to fill it on their own. If participating through computer-assisting telephone interviewing, the process would consist of a larger degree of standardized prompting in comparison to face-to-face interviews, which helps avoiding alternative interpretations of the questions. All the telephone answers would additionally either be filled in by the interviewer or by the respondent sending him or her the direct online link to the questionnaire (Bryman 2016, p. 204). In all cases besides the telephone based interviews, the interviewer would stand next to the respondent throughout the entire questionnaire participation if prompting was requested, and no recipient participated in more than one session.

**Negative aspects**
The risks involved in using a questionnaire distribution lies in collecting careless responses, and factors triggering the risk are the reward absence, the questionnaire’s length and environmental distractions (Meade & Craig 2012, p. 438-439). This is why the length of the questionnaire was shortened with fewer open-ended questions and simpler designs to avoid misconceptions (Bryman 2016, p. 222).

Additional risks can be a different individual reply if the recipient already has participated in a similar study, which is why Keusch (2015) recommends to counteract it by making the respondent feel a stronger cultural connection with the survey by informing about the study’s purpose and topic that should revolve around the recipient’s everyday life.

An additional obstacle that the interviewer faces during telephone interviews are possible signs of puzzlements or unease in terms of the recipient’s face or body expressions, and his or hers lacking visibility of the questions that may require probing (Bryman 2016, p. 203). This may have marginal degrading consequences on the data quality in comparison to face-to-face interviews (Ibid.).

**Exclusion of data collection method**
Following the exclusion of the case study approach with its qualitative means, the gains in hypothetically using longer face-to-face interviews lies in extracting more in-depth information that reduces non-response rates, avoids unclarities and examines more thoroughly if answers are careless or in need of elaboration (Denscombe 2003, p. 8). The negative aspects are the non-response rates in some questions due to the risk of making the recipients less aware of their anonymity and more uncomfortable when replying to possible personal questions (Denscombe 2003).

With reference to the questionnaire format, an additional data collection method could have been close-ended questions that can fully quantify answers and reduce non-valid responses in comparison to open-ended questions (Bryman 2016, p. 247). It was however not relevant since it creates unclear specifics in age, travel time and net-income, forcing the recipient to give an answer that they may not entirely feel represented by (Bryman 2016, p. 249-250).
4.2.2. Principles of sampling

The sampling frame refers to what area or population that the researcher aims to focus on. When reducing sampling error and bias, Denscombe (2003, p. 19) and Bryman (2016, p. 174) recommend spreading the sampling frame to as many areas as possible in order to avoid missing target groups that have little or no chance in getting included in the sampling frame.

In order to assure a high representativeness degree, Bryman (2016, p. 176) suggests the application of a Simple Random Probability Sampling. Bryman (2016, p. 177) defines a Simple Random Probability as a method that gives equal opportunities to all units within the target group frame to answer the survey. This method reduces the risk of sampling by participant availability, because it reduces the influence of the interviewers personal judgement by choosing interview recipients regardless of the interviewers’ comfort. Conclusively, random probability sampling cannot entirely eliminate bias, but nonetheless reduces its degree significantly when conducting this method properly. The participants that form part of this process have no knowledge or awareness of their survey partaking until they are contacted on the spot by the interviewer (Ibid.).

Within the random probability sampling, a small but carefully Stratified Random sample has been drawn by available means from the city’s large population. This type of small-scale sampling intends to assure a high representativeness of an entire target group, which in this case is the Stockholm population. But stratified random sample also divides the main group into different subgroups prior to the distribution whilst continuing to opt for a smaller but similar process as the random probability sampling without an exclusion of any participant (Bryman 2016, p. 178). Since this study’s sampling frame refers to the population of Greater Stockholm, it includes subgroups using all transport modes above the age of 18 living in Stockholm county or having access to the city’s public transport, including the municipalities of Uppsala, Bälsta, Södertälje and Nynäshamn. It also to includes occupation, education and income level in as many different locations and hours during the day as possible in order to avoid any biases or target group exclusions (Denscombe 2003, p. 20). As the sampling size increases, the sampling error diminishes (Bryman 2016, p. 184), but the sampling has been assured to not include disabled individuals that in any way are incapable of utilizing either cars or public transit on their own (Denscombe 2003, p. 17).

4.2.3. Quality assurance

The study’s research strategy has applied different techniques that allow a high degree of constructed, internal and external validity as well as an increasing reliability (Bryman 2016). The construct validity degree of measuring what the report claims to, has been increased via the multiplication of data collection techniques and the creation of chain evidence through the documented survey pilot and final version distribution and the extensive literature review (Ibid.). In order to add internal validity, meaning the bias and academic gap diminishing during the data collection process, the results have been presented with tables and diagrams to reinforce the finding’s consistency and evidence (Ibid.). The external validity, meaning the study’s comparable degree, has been increased through the clarification of the study’s research scope on Stockholm’s inhabitants and comparing the findings with the literature review on previous demographical and travel behavior studies in Stockholm and elsewhere, and the reliability was increased by using the same theoretical and methodological framework during the entire data collection process (Ibid.).

4.3. Sample representativeness

Bianchi & Biffignandi (2017) refer to Sample Representativeness as how accurately the results reflect the studied object or area, and thus how generalizable they are. Thus, they additionally imply that a survey response is representative in relation to its distribution percentage among a group of people. An additional definition of a high representativeness degree is when each inhabitant of a population holds equal possibilities to contribute with a response to the survey when sampled. It is however nearly impossible to examine if the sampling results are fully representative of the population or not (Bryman 2016, p. 245). In order to validate the representativeness degree of small sampling sizes, Denscombe (2003, p. 24) states that the researcher needs to assure the following:

“Extra attention needs to be paid to the issue of how representative the sample is and special caution is needed about the extent to which generalizations can be made on the basis of the research findings.
Provided that the limitations are acknowledged and taken into account, the limited size of the sample need not invalidate the findings”.

A correct sampling can offset the difficulties of assuring full representativeness, and contribute to reducing the sampling error significantly, thus achieving at least rough representativeness even with small samples in relation to total population targeted. In the present study, this has been attempted by careful application of stratified random probability sampling. A consistent effort was made to give as many inhabitants as possible an equal opportunity to participate in the survey by locating them in distant and less accessible areas from the city centre, and in different hours and time windows throughout the day and week (Denscombe 2003, p. 13; Bryman 2016. P 191). These have been allocated within all of Stockholm county’s municipalities and areas with access to the public transportation system. In addition to that, the distribution process has taken part in different outdoor environments around Stockholm such as train stations, parks, bus stops, libraries, malls, street sidewalks, bars, stores, public car parks and onboard public transportsations. The recipients have within this demarcation been approached randomly from first sighted participation candidate when in these environments, whilst the phone participants were randomly picked from the online search engine, Eniro.se (The yellow pages). This complies with the recommendations of Denscombe (2003, p. 10) in regards of acquiring responses via telephone interviews from recipients living in more distant located areas from the city centre where the outdoor sampling had not been able to cover to the same extent.

4.4. Questionnaire design
This section comprises the theoretical reasoning behind the question designs and the distributed questionnaire.

4.4.1. Questions
Question 1 has the ambition to calculate the traveler’s regular one-way trips with each means of conveyance during a normal week, whereas the reply serves as basis to retrieve information regarding the recipient’s current transportation to detect a future increase or decrease in the travel frequency. Question 2 demanded the average traveling time for all one-way trips by public transport in order to extract further background information to the reply in question 1. The reply depicts how far the person lives from its regular destination and gives underlying explanations to why they choose their travel modes. Question 3 identifies which means of conveyance within Stockholm’s public transport the person exercises with purpose of creating a future forecast of how much less or more transportation capacity will change to meet a future transport demand in the case of lowered or abolished fares. The expected demand change would for instance then solely calculate the demand for underground traffic if chosen by the respondent. Question 4 requires information on what type of ticket holder the traveler is when traveling by public transport with aims of identifying the incentives behind the recipient’s decision to travel more frequently. Question 5 and 6 asks the respondent to state how many way trips he or she would perform if the public transport fares would be reduced by 50 percent, respectively 100 percent. The two questions are highly related to the research questions since they explicitly ask if the recipient’s travel behavior would change due to lowered or abolished public transport fares and to what degree. Question 7 intends to identify the travel mode to which the person would use less, equally or more during a free fare scenario. The question tries to examine if there is a correlation with an increasing public transportation travel frequency and a lower car driving frequency in regards to the recipient’s current habits. Question 8, 9, 10, 11 and 12 refers to the recipient’s background information on the chronological order sex, age, educational level, occupation and net income in order to see possible patterns to their current and future travel behavior. Question 13 intends to extract the reasons to why the respondent chooses or refuses to travel by public transport by offering a maximum amount of 3 reply alternatives. Question 13 aims to identify the main arguments behind the respondent’s decision to choose their primary mode of conveyance and if it has a relevance to if they choose their travel mode because they independently want to, or if they need to. Question 14 wants the recipient to rank the following factors that could make he or she travel more frequently with public transport by ranking their priorities from 1 to 8 with number 1 is most important. In regards to Gardner & Abraham (2007), car drivers usually exclude public transit due to time and effort. Therefore, the questionnaire’s last question is considered essential since it gives the participant a chance to consider other factors besides just lower prices in what could
makes them commute more frequently by public transportation.

4.5. Application of method
The application of methods section describes how the process unfolded during the distribution of the pilot study questionnaire and how its feedback shaped the formulation of questions in the final study questionnaire. The entire survey distribution and quantitative interview process was carried out by the author of this paper.

4.5.1. Questionnaire structure
Before the distribution, the introductive part was set to be brief, clear and transparent via the presentation of the author, the confidentiality explanation of the respondent, followed by thank you notes and the purpose of the study without leading the reader towards a certain mindset that could affect the results (Denscombe 2003, p. 151). The questionnaire’s length is recommended to be maximum 5 minutes long to reduce the risk of non-responses deriving from respondent’s short-time disposal, which is why the estimated survey time was set to 3-5 minutes. The questions appealing mostly to the research questions and the ones that can be regarded as too sensitive or private, have been moved to the latter stages so that the respondent feels more compelled to answer when almost being finished, and because it avoids guiding them into a certain agenda (Denscombe 2003, p. 155). The questions have according to Bryman (2016, p. 254) been actively designed to avoid entailing the element of leading questions. The questions consist of personal factual questions and attitudinal questions. The research questions connections are *vignette questions* that examines what and how the respondent would act in different circumstances, and how to affect that behavior (Bryman 2016, p. 259). The response alternatives show a large choice variety in accordance to Dean’s et al. (2017, p. 94) recommendations. The answers consist of both open ended and closed questions to get a more holistic reply to the recipient’s view whilst and allowing the possibility for quantification and a high validity degree. The number of open-ended questions has however been reduced and the income questions has been informed as voluntary in order to lower the response time and reduce lacking interest (Bryman 2016, p. 193). Bryman (2016, p. 194) also argues the importance of instructing the respondent to avoid misconceptions in understanding the questions and increasing the reliability degree, which is explained in the description through the definition of a one-way trip, making the results more accurate and less prone to data-collection errors.

4.5.2. Pilot questionnaire
A pilot study questionnaire was during a one-week time window, digitally distributed to 35 individuals living in Stockholm that were acquainted to the author and more prone to give elaborated feedback. Bryman (2016, p. 261) suggests this type of distribution to increase the reliability degree.

Recipient feedback
Denscombe (2003, p. 146) connotes that questionnaires are to be tested before distribution. Once distributing the survey, the response to finish the survey was 3-5 minutes, becoming the estimated time that to be displayed in the final questionnaire’s description. The last two questions of the pilot questionnaire encompassed the identification of the question to which the recipient had remarks on, followed by a question of elaboration in regards to why.

The segments with received remarks were the introduction, question 1, 2, 3, 5, 6, 7, 8, 12, 13 and 14. Question 1 was considered too verbose due to the one-way journey explanation, which led to the repositioning of the one-way journey section to the introductive part, facilitating the reader’s fully comprehension before starting the enquiry. Question 2 was often misinterpreted since it did not clarify what type of trips it referred to, henceforth the word “average” was added in order to extract the mean value from all journey types. Question 3 had remarks due to the absence of the option ‘Light rail’ which made the recipients hesitate between the ‘Commuter train’ and ‘Tram’ option, which lead to the adding of the light rail alternative. Questions 5 and 6 were equally remarked due to their answering format that initially required a percentage increase or decrease in travelling frequency. Since the questions solely allowed the recipient to answer between a traveling frequency decrease of (-100%) or (+100%), the critique turned towards changing them into number of additional trips instead because it otherwise did not allow the recipient to denote a frequency change in terms of halving or doubling their current travel frequency. In question 7, some respondents suggested an option for the travelers who could not drive a car.
by virtue of not having a driver’s license. Question 12 was noted as confusing since some were unsure it referred to gross income before taxation. Question 13 received improvement proposals to reduce the number of response choices to a maximum three since several recipients felt compelled to fill in all choices, and question 14 had minor uncertainties to one should have replied with number 1 or 8 as the most important priority number. All of the comments from the pilot questionnaire were subsequently addressed towards the design of the final questionnaire.

4.5.3. Final questionnaire
The settings for the final questionnaire were set to a maximum one reply per unit thanks to the IP-tracking, and it was distributed to 282 recipients with a response rate of 259 answers between march and April 2017. Among the answers, 211 responses were collected from face-to-face interviews and 49 participations took place through telephone-based interviews. Among the 211 face-to-face interviews, 188 were paper-written answers and 23 were sampled via the direct online link from recipient’s cellphone. All distributed questionnaires besides the computer-assisted telephone interviews, took place along with the interviewer’s presence were prompting was offered if requested, Bryman (2016, p. 245) and Denscombe (2003, p. 24) implies that a sample size of this kind is valid in regards to the study’s time frame of 1-5 months. However, within a large-scale city context, they also state that the comparability degree from similar sample sizes are nearly impossible to determine due to the fact of not having extracted responses from further percentages among the city’s population, which increases the roughness of the study’s representativeness when drawing conclusions that does represent the majority of opinions in a city with over one million inhabitants.

The distribution took place in weekdays and weekends between 08:00-18:00, and the number of responses varied between 3 and 50 per day. This has however taken place with random transcription and writing pauses in between the hours and days, meaning that the distribution process did not take part during the entire time window of 08:00-18:00 for every following day during the two full months. In addition to that, non-response rate was counted to 23, which is approximated to 8 percent of all valid responses and classified as an excellent non-response outcome since it did not undermine the total 85 percentages of all valid replies (Bryman 2016, p. 224). Among these non-responses, there were non-English and Swedish speaking people and people above the visual age of 50 when observing and analyzing their appearance and language.

The participants were approached in several train stations such as Centralen, Huddinge, Sollentuna, Gullmarsplan, Sundbyberg, Flemingsberg, Uppsala and Universitetet. Other areas that featured in the distribution were more crowded places such as plazas, malls and onboard buses and trains. Mobile phone wise, recipients were allocated in more distant areas through Eniro.se in the attempt to access people living further away from the city centre. Travelers with combination cards, pensioners and unemployed people were identified in trans-county train trips to Uppsala, approaching elderly people on the streets or conducting the interviews inside employment agency offices.

The interview sessions
All the target groups in all distribution methods were approached in Swedish with an excuse and presentation of the study’s purpose and subsequently asked if they had the time and interest to participate instantly. If the participant was English-speaking, the session continued in English with a translation of the questionnaire questions to English. If agreed to participate, they were asked if they wanted to answer on their own or on their behalf with their oral instructions. Before starting the questionnaire, they were encouraged to mention if they would encounter any uncertainties on the survey questions. The questionnaires were filled in via paper (not during telephone interviews), through online link on the mobile phone, or via the interviewer’s writing on their behalf. The raised uncertainties during the interview often seemed to surround question 1 on how to define a one-way trip, and following the recommendations of Bryman (2016, p. 212), the interviewer consistently restated the question formulation in the same instructive form to all recipients when prompting was requested. In regard to prompting, all the non-telephone questionnaire interviews were carried out along with the interviewers’ physical presence by standing next to the respondent throughout the entire questionnaire participation (Bryman 2016, p. 224).

When interviewing people on stations and waiting halls, the recipient felt remarkably stressed for which it could depend on their desire to avoid missing possible transport connections. In these environments, the recipient’s response preferences seemed to prioritize the replies, ‘More reliable
departure and arrival times’ and ‘Faster journeys’ when they were standing on a platform waiting on a delayed train. There were no observed direct nor indirect threats to the recipient during the face-to-face moment of answering the survey, and no participant was forced to participate against their will. which rhymes well with Denscombe’s (2003, p. 20) recommendations to avoid dangers nor influences that could affect the survey responses.

As mentioned by Bryman (2016), non-physical interviews such as the computer-assisted telephone interviews seemed to shed more light than other instances on the recipient’s initial lack of trust towards the interviewer by being generally less responsive in the initial conversation phase before understanding the survey’s purpose more clearly. This may depend on the lacking social contact that telephone interviews had in comparison to the face-to-face interviews. In order to reassure that no disabled person answered the survey via the telephone interviews, respondents were questioned on their physical mobility status and explained to why it was relevant to the enquiry.

4.6. Data analysis

All the statistical material inserted in the background were secondary data sources, and these have been analyzed in a critical demographical context. The collected data has been analyzed both during and after the collection process in regards to Bryman’s (2016, p. 332) encouragements. If not, the data could be distorted or deviate from the reality from badly applied techniques, samples and questionnaire designs. Additionally, the primary mode choice of every traveler was determined by identifying the travel mode in which the respondent conducts the majority of their weekly one-way trips with.

The collected data was initially inserted into the questionnaire link at the website https://sv.surveymonkey.com/r/kollektivtrafik2017. This was either submitted directly by the participant after finishing the questions or from the interviewer’s transcription from the paper replies. Thence, the data was processed through MS Excel where each answer was converted into a coded variable to draw correlations between two selected questions, which Bryman (2016, p. 293) encourages. Bryman (2016, p. 298) recommends to exclude mutual coding categories to evade the mixture of different categories, and every coder must code with inter-rater reliability (consistent coding language form) and with intra-rater reliability (consistent coding over time).

The essential focus of this study lies in drawing conclusions from reliable results with good correlation values, stating a high statistical significance, which Denscombe refers to as a regression analysis (2003, p. 263). A regression analysis is similar to an equation which calculates a statistical significance (p) through the addition or subtraction between two variables called intercept and dummy. The values from both variables are then added together to extract a dummy coefficient that reveals the correlation degree of each target group in regards to a free fare scenario.

Correlations based on such regression analyses are presented here as mathematical summaries, in full awareness of their rough representativeness in regard to the total commuter population of the larger Stockholm area.

4.6.1. Standpoint

In quantitative studies, Bryman (2016) recommends inductive standpoints since it allows the theory to be drawn after the study’s research outcome, making it possible for more generalizable conclusions thenceforth. This study however requires a standpoint between an inductive and an abductive one. It will thus combine the inductive theory’s priority of drawing conclusions after examining the results, and the abductive theory’s pre-stated but volatile hypotheses to nuanced changes during the writing-process (Bryman 2016).

4.6.2. Coding procedure

The variables of the recipient’s free responses have been categorized as interval/ratio variables (Bryman 2016, p. 334), which for instance is the grouping of ages 1-10 or salaries 1-9999 SEK (Bryman 2016, p. 336). The replies in question 4 and 5 are ranked between -30 and +30, and are classed as ordinal variables that disports the recipient’s possible change of travel frequency in positive and negative terms. Answers consisting of arguments to decisions were categorized as nominal variables since they cannot be ranked as the previous variables (Bryman 2016). Conclusively, the Dichotomous variables have been stamped in the sex question since it excludes the ranking system as well as the equally high multi-choice degree as the nominal variables. The answers appealing to the research questions were processed through a univariate
analysis that dissects one variable at a time instead of pairing them to others (Bryman 2016, p. 336). Average one-way trips per week were calculated through the arithmetic mean, also known as the mean of values by dividing the sum of values by the number of values (Bryman 2016, p. 338). The correlation analysis is bivariate since it uncovers two variables displayed through contingency tables showing the relationship and coefficient values for the external reader in different columns (Bryman 2016, p. 339-340).

4.7. Research ethics
According to Bryman (2016, p. 125), there are four ethical principles that social research should take into account during the extraction process. These are;

- Whether there is a risk of harming the participant in a physical or psychological way through manipulating people’s authority, emotions or religion.
- Whether there can exist a lack of an informed consent where the recipient or instance may not understand the purpose of the study or that its voluntary format.
- Whether there is a privacy invasion of the participant that may risk not having enough time to decide whether want to partake in the study or not as well as not being able to have a confidential participation.
- Whether deception may be involved in the issue where the author may try to misguide the recipient of the study’s purpose and its content.

The study’s applied ethical approach follow the lines of Bryman (2016) who proposes to avoid exposing the participants to any of these four principles during the data collection by approaching the phase with a larger transparency and honesty degree. The survey was used via the website, www.surveymonkey.com, whereas the website’s privacy policy has ensured that its firewalls are restricting access to all ports except 80 (http) and 443 (https) that inhibits third party scans, reselling or different security breaches that can expose or leak the participant’s information. If there would be security breaches, the user (the author of this study) would be informed by the server. The survey’s enabled IP-tracking facilitated the participant to remain anonymous whilst constraining multiple answers from the same physical unit (cellphone, computer) (SurveyMonkey 2017).

4.8. Limitations
This section encompasses the study’s limitations in terms of access, time, conceptual, -methodological and theoretical strategies and how it may have inflicted the outcome of the results.

If additional time and resources would have been eligible to dispose, the study would have been conducted via randomized control trials to see if the answers would be applicable in the practical case (Bryman 2016). If so, the target groups would have been divided into two groups whereas one would have been given the opportunity to commute by public transit for free for a few months whilst the other group would have continued their ordinary public transportation with unchanged fares.

Issues concerning generalization and comparison
The study can only be generalized if the Stockholm population has the same financial connection between wages and public transport fares. If yes, the generalization degree shifts depending on the conditions that Stockholm shares with comparable cities of similar sizes, average financial situations and similar public transport systems (Bryman 2016, p. 164-165). In regards to infrastructural changes in the near future, the results may differ if conducted before and after (Bryman 2016, p. 194;SL 2017). The study’s demographic results did not match with the ones of Stockholm stad since the sampling took place in locations with larger possibilities of approaching public transport commuters and not car drivers. The reason for this is because locations such as car dealership stores, tire change garages and petrol stations requested permit for distributing the survey, which was denied after applying for it. In public spaces such as parking lots, all car drivers excused their refusal to partake in the interview by mentioning their lack of time. These tendencies resulted in numbers implying car drivers to be making more than 1 one-way public transport trip and approximately 0.5 car trips each day. This deviates from ABSL (2015, p. 28), that otherwise states the average Stockholm resident to be making 0.63 public transport trips and 1.06 car-trips each day during the years 2011-2014.

Besides difficulties in approaching car drivers, additional obstacles were encountered in
identifying and approaching combination card travelers and pensioners as well as unemployed people. The reason behind it were the complications in getting combination-card travelers interests to make time in answering the survey during the 20 minutes between Upplands Väsby and Uppsala or attracting the attention of unemployed in employment agency waiting-line environments. In addition to that, people above the age of 40 showed a lack of interest in participating in the questionnaire in comparison to younger ages along with the predicaments of locating sick-leave recipients via the telephone-interview approaches. This may have had consequences on the results by unfair distribution among ages and possibly also the number of car drivers, considering that the literature review identifies more car drivers among higher ages.

**Questionnaire issues**

Since the distribution took place between March and April, question 1 may have been interpreted in different ways if the recipient considered their short-term current travel frequency or their long-term frequency where biking, walking or perhaps commuting by public transit could have been influenced due to colder or warmer seasons. Also, in question 5 and 6 (see appendix 3, figure 3.4 & 3.5), recipients replying with 30+ additional trips may not necessarily identify their travel frequency with that particular number, but slightly or significantly more which lessens the opportunity for the researcher to review the truthfulness and accuracy of the recipient’s answers according to Denscombe (2003, p. 160). The way the questionnaire design was set, it was unable to be precise about the exact number of educational level since the recipients answered ‘5+ years’ but may at the response time, been studying on the first of the five or not yet finished the program. Participants interviewed in station environments were as reported in a more stressed state of mind, raising the awareness of sampling errors due to the risk of less thought through answers from filling out the survey too rapidly (Bryman 2016, p. 184). During cellphone sessions, the answers in question 13 and 14, may have been affected depending on the display sizes that can restrict the perceived choices when ranking the respondent’s preferences, leading to the possibility of electing the first answer alternatives that comes to sight when in stressful conditions (see appendix 3, figure 3.13 & 3.14). In regards to the non-responses, Denscombe (2003, p. 20) argues that the researcher does not know if the non-respondents would have answered differently to the ones that did answer, which raises the bias risk from non-response through refusal and non-response stemming from non-contact (Bryman 2016). Lastly, the events that took place in central Stockholm on April 7 could have created reasons for recipients to have prioritized the element of safety at stations and bus stops considering possible emotional postludes (Sundberg 2017), but the extent of this effect is however difficult to determine. Besides the existing questionnaire questions, they survey did unfortunately not intend to identify commuters with children and therefore more reasons to commute by car. This considered, there are uncertainties to determine the extent to which this target group would be affected by free fares, but nonetheless, this group is considered to commute by car since the travel time is expected to increase when for instance dropping and picking up their children at their schools on the way to and from work. That is why this tendency could affect the results implying that more car commuters drive because they feel obliged to.
5. Results
This section lists the collected results from the survey in relation to the aim and research questions. It provides pertinence around these insertions offers conclusive remarks on possible clarifications around the proven tendencies.

5.1. Questionnaire results
The first question of the questionnaire extracts information on how many one-way trips every respondent performed with each means of conveyance during a normal week. Respondents that used neither of the alternatives replied with the number 0 and or avoided filling in a number. The results estimated the average number of weekly public transport trips to 10.20, with an average travel time of 31.9 minutes per trip. Walking consisted of 7.91 trips followed by 3.14 car trips per week.

The travelling percentage distribution among all public transport modes, implies that subway/underground (73 %) public transportation was the most frequent mode choice, followed by bus traveling (65 %), commuter train/railroad (46 %) on third place and tram/light rail usage on fourth (13 %). 78 percent of the public transport commuters were travelling with seasonal tickets, single-ticket users counted up to 20 percent and the combination card travelers consisted of 2 percent.

Figure 5 implies that fares reduced by 50 percent would yield in a 31 percentage and 3.15 additional one-way weekly trips per person. If the fares however would be abolished, question 6 state that public transportation would increase by 67 percentages, meaning 6.8 additional weekly one-way trips per person.

Figure 7 state that just over half of the people would not exclude nor reduce their mode choice in regards to their high current public transport commuting frequency. 2 percent would proceed with their use of cars and 30 percent would consider reducing it, followed by less walking (7 %) and taxi (5 %).
The average year of birth was between 1988 and 1989, meaning the respondent was 28-29 years old during the survey's distribution time window. Categorical-wise, the age distribution (Figure 8) implies the largest participating group with 43 percentages, are the ones born between 1990-1994, meaning the respondent was between 27-23 years old during the data collection. The following and previous four years to that group were the second and third largest target groups, and people with 62-66 had no representatives whatsoever.

On a demographic level, 54 percent of the participants were women and 45 percent were men, and one person chose not to disclose their sex. All the participants had an educational basis and only one person had the elementary school as their highest educational level. Hence, the biggest group were the post-secondary education (1-3 years) with 43 percentages, followed by post-secondary education (4-5 years) on 20 percent. The post-secondary education (5+ years) landed on third place with 8 percent. Almost half (49%) of the people were full-time employed while 36 percent were students. Part-time workers consisted of 30 percent whilst the remaining of the groups (job-seeking, no occupation, parental leave, sick leave,
retired/pensioner) were approximated between 0-2 percent. 44 respondents did not reveal their income, leading to a non-response degree of 17 percentages. Albeit, the monthly average net-income among the responses was 21 290 SEK, and the average car driver was found to be a 28-year old male with an average net income of 23 326 SEK per month whilst the average public transit commuter was a 28-year old female with an average net income of 17159 SEK.

Question 13 intended to extract the respondent’s grounds to what could encourage them to commute more by public transit. 10 percent prefer not to travel by public transport while the largest group (54 %) choose public transportation due to the high car usage expenses. Environmental reasons (41 %) and faster travelling time motives (40 %) were evenly followed on second respectively third place whilst the avoidance of car queues (37 %) came on fourth. The smaller percentages such as lacking availability of parking spaces, landed on fifth place, pursued by ‘No drivers license’, while the focus on lower accident risk came last consisting of 5 percent.

The last question of the survey aimed to examine to what extent some factors were desired in order for the respondents to become more encouraged to commute more by public transit. The question's reply format had a limitation in that it could not display the largest bar as the most desired factor. Therefore, the shortest bar with least points represents the most desired factor, which in this case are the lower prices on 3.38 points as the main priority among the respondents. More departures had 3.47 points and faster travelling time had 3.71 points. The middle section consisted of ‘lesser degree of fellow passenger congestion’ (4.2 points) and more reliable departure and arrival times (4.26 points), pursued by ‘Shorter distances between households and stations’ with 5.04 points, ‘Safer environments on stations and stops’ on 5.92 points, and lastly, cleaner transports on 6.01 points.

5.2. Additional diagrams and tables
The following diagrams and tables aims to display patterns and correlations beyond the ordinary questionnaire results.

Figure 16 shows that 44 percent of all travelers owns a car that they occasionally or frequently use when commuting, whereas the remaining 56 percent do not own a car to wherefore they either utilize public transportation, bicycle, walking, taxi or other means of conveyance as their main mode choice.

![Figure 16: The distribution of car owner and non-car owner among respondents.](image)

Figure 17 implies that public transport travelers were the most represented target group with 60 percentages while respondents that walked to and from work/school consisted of 22 percent. Car drivers were counted up to 10 percent and the remaining categories were estimated below a representative level of 5 percent.
Figure 17: The distribution of the most frequent mode choices among the respondents.

Figure 18 shows how much more the public transport demand would change if the fares would be abolished, which consists of a 67 percent increase in terms of additional weekly one-way trips.

Figure 19 shows the number of people that would increase, decrease or maintain their travel frequency following the reduction of public transport fares by 50 percent. The results manifests that the number of people with an increased travel frequency would consist of 34 percent while the ones with an unchanged travel frequency that engenders in 66 percentages. Noteworthy is that both figure 15 and 16, 0.4 percent would decrease their travelling frequency since only one respondent in total answered similarly on both questions.
Figure 19: Expected transport demand changes followed by 50% cheaper fares.

Figure 20 reflects the questionnaire’s question 6 that aims to examine the public transport demand changes followed by free public transit fares. The results give sight that 47 percent would increase their travel frequency while 72 percent would not.

Figure 20: Expected transport demand changes followed by free fares.

Figure 21, describes how the demand changes in terms of one-way trips per week would affect every public transit type. It implies for an increasing demand across all means of conveyance whereas the use of commuter train would increase the most with by 83 percent, subsequently followed by the use of buses (60%), underground (54%) and tram/light rail (52%). Since the category “other” does not specify the type of transport and because of its relatively low reply frequency in question 1, its bar is only displayed and not analyzed.
Figure 21: Expected transport demand changes for every public transit mode traveler.

Figure 22 shows the number of car drivers that would change their travel behavior from free public transit fares. The results show that 75 percentages would decrease their car driving frequency by partially replacing it with an increasing public transport commuting whilst 26 percentages would not change their current travel behavior.

Figure 22: Expected transport demand changes regarding number of car drivers during free fares.

Figure 23 refers to car traffic in terms of replaced car trips in favor of public transit trips, which is approximated to an 87-percentage replacement. The difference between previous figures, 20, 18 and 19, is that figure 20 separates target groups via their most frequent travel mode while figure 18-19 encircles a frequent public transit commuter that occasionally drives a car two times per week.

Figure 23: Expected transport demand changes regarding number of one-way car trips during free fares.
Figure 24 state that 45 percentages of all public transit commuters would increase their travel frequency in relation to their current frequency whilst 55 percentages would maintain their public transit travel frequency.

![Bar chart showing transport behavioral changes among public transport commuters](image)

*Figure 24: Expected transport demand changes regarding number of public transport commuters during free fares.*

Figure 25 shows the number of additional trips that public transport commuters would conduct in relation to their current public transit frequency, which was estimated to a 57-percentage increase.

![Bar chart showing additional weekly one-way public transit trips among public transporters](image)

*Figure 25: Expected transport demand changes among public transport commuters regarding number of public transport commuting one-way trips during free fares.*

If respondents with an unchanged travel frequency during the case of free fares would express their desires in an encouragement to commute more by public transit, the highlights would lie in more departures (1), faster travelling time (2) and lower prices (3). The least preferred choices are shorter distances (6), safer environments at stations and stops (7) and cleaner transports (8).
Correlations
The concluding section of the result chapter explains if certain target groups reacted differently in regards to the fare-free implementation. These tendencies are observed through the previously mentioned regressions, which examine the correlation to if certain target groups would react differently to free fares and how many more or less percentages their travel frequency would change from it. Moreover, the intercept variable is paired with the dummy variable to reveal the dummy coefficient, meaning the change in travel frequency. In regressions, the intercept variable is always equal to the intercept coefficient. A regression works as mentioned in the method section, similarly as an equation since the intercept and dummy can represent variables such as sexes, different income takers and ages etc. The coefficients are only valid conclusions if the extracted p-value is estimated under 0.05 (5 %) meaning that there is at least a 95 percent probability that the coefficient represents an increase or decrease. So, if the p-value presents a value above 0.05, the coefficients are invalidated. Noteworthy is that the statistical significance is no neither more or less rough than the quality of the sample representativeness. So, if the study’s sample has given a rough representation of the entire population, the regression variable will be equally rough represented as the variable existing in the population.

Table 1 shows that both frequent public transport commuters and car drivers would travel more during free fares. Car drivers would change their travel behavior more towards an increasing public transport commuting with a 68-percentage degree in comparison to frequent public transport commuters that would increase theirs by 42-percent. Since the p-value is under 0.05, it states the correlation coefficients to have more than 95 percentage validity.

<table>
<thead>
<tr>
<th></th>
<th>Intercept (Travelers with car driving as their most frequent mode choice)</th>
<th>Intercept coefficient = 0.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy (Travelers with public transportation as their most frequent mode choice) = 0.2</td>
<td>Dummy coefficient = 0.6</td>
<td>(0.4+0.2)</td>
</tr>
<tr>
<td>P-value = 0.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Regression on frequent car and public transit travelers.

If dividing the journeys into lengths of <30 minutes and >30 minutes, the results state that there is no statistical significance (p=0.7) to whether public transport commuters with longer public transport trips are more prone in traveling more during free fares than the ones with shorter trips or vice versa. The regression also implied that all three different types of ticket holders reacts positively on fare-free tickets, but whereas 100 percentages of all the combination ticket holders would increase their public transportation degree the most. The increase on the other ticket holders would be estimated to 69 percentages among the single ticket holders and 40 percent among the seasonal tickets.

Demographic wise, both sexes would increase their travel frequency equally, the p-value is withal 0.894, invalidating the correlation coefficients that otherwise implies a specific reaction from one of the sexes in particular. Furthermore, a p-value of 0.1, implies that there is no statistical significance that certain ages would react differently to the fare-free system besides an overall travel increase among all the variables due to the positive coefficient. Every correlation coefficient also implies for a significant travel increase among all educational levels whilst the 0.7 p-value on the other hand states a zero-statistical significance in that a certain group would react uniquely to the fare-free tickets. Lastly, no statistical significance was found in that some of the occupational groups reacted differently due to the p-value, 0.4, and no income group would respond more to free fares since the p-value was estimated to 0.7.
6. Discussion
The discussion section pairs the results with the theoretical and background material as argumentative suggestions with reference to a hypothetical transition to a fare-free public transit system.

6.1. Interpretation and implication of results
The most represented questionnaire respondent among figure 1-14, is a 29-year old woman with a 1-3 year long post-secondary educational level, commuting by underground transport with approximately 10 one-way 32-minutes trips per week. This woman would not increase her public transportation frequency rate in a free fare system since she is already using a seasonal commuting card. Besides her travel behavior, she is a full-time worker with an average monthly net income of 21290 SEK. She prefers to commute by public transit due to the high car expenses while desiring lower public transit prices.

According to the study results (see appendix, figure 3.1), the average Stockholm inhabitant conducts around 3 car trips and 10 public transit trips per week. These numbers deviate from the results of ABSL (2015, p. 42) that otherwise implies the locals to be making approximately 4 weekly public transport trips. Since ABSL (2015) does not clarify if the measured trips are single or round-trips, doubling the number to a round trip would still be estimated to 8, and bellow the ABSL (2015, p. 42) results. Car-wise, the questionnaire’s results additionally show a larger discrepancy degree with 3 weekly round car trips in comparison to 7 which also is presented in ABSL (2015, p. 42). There are reasons to believe the differentiated results to depend on the significantly higher participation degree among public transport travelers in regards to car drivers.

The results imply that 3 out of 4 car drivers would change their current mode choice by commuting more with public transportation, replacing around 87 percent of all car trips with public transit trips. 2 out of 5 public transport travelers would increase their public transit commuting by 57 percent. The numbers around possible increases in public transportation show that the current number of public transit trips would increase by 67 percent, whereas underground transportation would increase by 54 percent, trams/light rail by 52 percent, buses with 60 percent and commuter trains with 83 percent. Despite the fact that 47 percent of all the questionnaire participants would hypothetically increase their public transport commuting by 47 percent from abolished fares, additional 51 percent of all the recipients would not increase their current public transport commuting frequency due to their current possession of seasonal cards that already allows them to commute to their desired extent. There is also a gap in that no commuters with children were identified, which could have increased the number of travelers that would not have increased their public transport travel frequency from free fares. Albeit, lower prices were still proven to be the most desired factor within all target groups, including seasonal car holders, which was followed by requests in adding more departures, reducing passenger congestions, more reliable and faster travel times.

Funding the hypothetical fare-free project
Despite the results creating incentives to fully or partially implement a fare-free system, the issue remains as whether it is economically feasible for stakeholders to invest in such a system. Even though this study has not researched the economic feasibility of a fare free public transit system, the statements of Gössling & Choi (2015) and Mizutani et al. (2011) are regardless of road amplification and multiplication, evidential when implying that average non-car travelling provokes less social costs than cars. The numbers presented in both studies could serve as basis to investigate the practical effects of a fare-free public transit system in Stockholm. With a higher passenger fill ratio in buses, trains, trams and subways in regards to cars, infrastructural redesigns and investments are needed to encourage public transportation and reduce congestion on roadways (Mizutani et al. 2011). In a continuing contribution to increase the public transit capacity, Schneider (2013) recommends reducing the number of car-lanes and the allowed speed within them, replacing the lanes with bus-lanes or tree-dense areas that increase street spaces. Such investments could partially if not entirely be supported via increased car-taxation rates on company-cars along with increased car-toll fares (Souche 2010). Additionally, Buehler (2011) suggests to raise fees for parking and car registrations as its effects were proven successful in Germany on the public transport commuting. But as Johansson-Stenman (2002) states, there is a risk of inhibiting the mobility of low-incomers in poorly accessible public transit locations if increasing car and fuel taxes collectively. That is why it is essential for authorities to create incentives that exponentially reduces luxury or unnecessary car travelling for owners registered and travelling within established SL operating
areas, which would reduce car driving and the risk of diminishing the car mobility possibilities of the inhabitants with most need of it.

In regards to the current stakeholder structure at SL and Stockholm’s traffic department, stated by SL (2017), new stances among the stakeholders are needed to identify and consider the local inhabitant’s opinions and interests to the current 50 percentage ownership division between private and public authorities. If the structure were to be adjusted to an extent where the corporate ownership percentage would diminish, it would facilitate the implementations of subsidies and a fare-free system, and bring more positive health and environmental conditions.

Positive and negative aspects
To the degree that my sample can be regarded as representative of the larger Stockholm area, the environmental consequences of the mentioned measures could be expected to yield an increased roadway accessibility, improved air quality, reduction of mortality and accident rates and a gradual restoration of the wearied tropospheric ozone layer (Celis-Morales et al. 2017; Shiftan et al. 2012; Leem & Lang 2014; Degrauwue 2015; Stockfelt et al. 2017; Qian Di, M.S 2017; Cools et al. 2016). In addition to that, the halts of DEP, NO₂, and NO would diminish furthermore since the Stockholm municipality proposed a regulation that if passed, would ban the use of diesel cars in 2040. An additional positive aspect would be the removal of ticket barriers, eliminating the risk of physical incidents for bypassing travelers as well as reducing congestion bottlenecks during rush hours (Drevinger 2016).

The negative aspects following a fare-free implementation is the risk of an insufficient future capacity, which according to the results, would detract travelers from commuting by public transport since it already is a semi-problem being ranked on fourth place as the most important factor among eight for them to commute more by public transit. This statement also correlates with the findings of ABSL (2011), which imply that no more than just above half of the respondents are satisfied with onboard passenger congestion during public transit journeys. In addition to that, a future capacity increase in public transport can independently from zero-price influences, attract travelers with desires in more departures, which has not been taken into account during the public transit demand assessments of this study (Souche 2010, p. 4).

Mode choice patterns
Besides privacy, car driver’s mode choice motives revolve around faster travelling time (1), which correlates with survey question 14. Other highly rated factors were more departures on second place and lower prices (3) (Gardner & Abraham 2008). This correlates with the statements of About-Zeid & Scott (2011) and Schneider (2013), implying that cost and conveyance are primary mode choice factors in font of safety and security issues. Differences among travel time, sex, age, educational level and occupation had no correlation in differing internally or externally in relation to abolished public transit fares. This contradicts with Schneider’s (2013) and Johansson-Stenman’s (2002, p. 967) statements that otherwise implies that age, sex, employment status and income, are highly influential in the individual’s decision to choose and change their mode choice.

Unless the expense difference is significant between car driving and public transportation, Thogersen & Møller (2008) implies that car drivers will not feel sufficiently encouraged to switch mode choice if having to pay for using the public transit system, validating the need and presence of zero-price effect from abolished prices furthermore. The essential measure of changing people’s traveling habits is the external intervention that inhibits or makes it more difficult for the traveler’s continuing use of mode choice (Bamber et al. 2003). These interventions take form via economic incentives of cheaper fares or increasing departure and arrival time frequency and reliability, which were highly ranked preferences in question 14, matching the patterns with About-Zeid Scott’s (2011) theory. By increasing the number of bus lanes, the traveling time would decrease and become more reliable during traffic peaking rush hours. If the change is successful, the person might start to enjoy alternative transports as stated in Schneider’s (2013) fourth step, which will lead to the fifth step where a new habit is created, making the changes more permanent and lasting. This would contrary to the resetting effects from the car tolls, have more sustaining effect rather than just temporary (Stockholm stad 2016).
6.2. Importance of study

The motivation inspiring this study is to give people the choice to commute more by public transit without being inhibited by their financial conditions. Since few similar studies have been conducted within a Scandinavian city of the proportions of Stockholm, this study intends to shine further light on the previous fare-free projects that were conducted in some of the smaller Swedish towns as well as in other minor cities around the world (Ramböll 2013). By doing so, the extracted result of this study implies that a bigger city with more than one million inhabitants, and with relatively low unemployment rate, can reduce its car driving degree correlating with an increasing public transport commuting via abolished or decreased public transport fares.

Since figure 24 implies that increasing public transportation would yield less car driving, the results clash with De Witte’s (2008) arguments claiming there is no correlation between the two elements in all circumstances. The correlation is however significant in terms of Ramböll’s (2013 - 2015) study stating that abolishing public transit fares in larger urbanized cities with high such fares would lead to larger increases in public transportation in comparison to smaller or zero traveling changes in less urbanized cities with less price differences between the current pricing and entirely free ones.

The reasons why future hypothetical changes are indicated to be as high as indicated, are expected to depend on Cools et al. (2016) so called, zero-price effect that eliminates the mental cost of the customer feeling that the liberation from a monetary transaction in order for them to utilize the desired service/product. In regards tit hos, there legitimate reasons to believe that the doubled travel frequency between halved pricing followed by abolished prices are due to the absent mental transaction that encouraged the respondent to rethink their second decision.

6.3. Reliability & Validity

Reliability rests on having stable and replicable results if repeating the study in the same approach as instructed in the methodology section. This study’s reliability degree varies along with changing conditions in terms of salary and SL ticket fares, public transit infrastructure and capacity. Besides these influential factors, the reliability of the study is considered to be relatively high in the coming 10 years considering the expected changes are gradual SL price increases and new added stations in Solna and Nacka (Stockholms läns landsting 2017).

The report aimed to improve the internal validity degree designing the questionnaire to extract empirical material to fill the academic gap identified in the literature review and consistently use the same distribution and instruction technique to avoid misunderstandings and possible bias influence on the results (Bryman 2016). The survey has been targeted and distributed to Stockholm’s residents where both sexes and all types of transport modes have featured. However, in terms of construct validity, car drivers, people above the age of 40 and combination-card (the most expensive card) holders did not participate to the desired extent in the survey. This was due to the complexities of receiving permission to distribute the survey in private spaces such as petrol stations, car retailers, dealership stores and tire change garages, and because of the lack of participative interest from respondents when being approached in outdoor environments as well as onboard commuter trains on route to trans county destinations. Despite a 44 percentage representation of car owners and a small number of frequent car drivers of up 10 percent, car drivers would yet partially contribute to what the study presupposed to measure. This have been measured through the questionnaire implying that only 0.3 percent of all recipients would travel less from reduced or abolished fares, and 47 percent would increase their public transport travel frequency. Despite having a valid sample size in regards to the study’s time frame of 1-5 months, the comparability degree of the study entail risks in not having presented the majority of the inhabitant’s opinions, which is why the representativeness of the sample is regarded as smaller and rougher (Denscombe 2003, p. 23; Bryman 2016, p. 245; Bianchi & Biffignandi 2017).

The report’s external validity is regarded relatively high since the 259 recipients are not considered to have high chances participating in similar enquiries of this character in the near future. It is therefore possible to re-apply a similar method in Stockholm or in other cities of similar financial, demographic and meteorological character, and extract similar conclusions (Ibid.). In terms of internal validity, the study has due to the regression analysis managed to separate every variable and examine if each one has a statistical significance in relation to the results, which increased the internal validity degree (Ibid.). Moreover, the results show solely correlations and no causality since causality is regarded
to be overly complex to examine; this is because decreased prices followed by increasing public transportation has not proven to have strong enough and direct effect on people’s financial situation (Ibid.).

6.4. Future research

This study has intended to shed further light on Ramböll’s (2013 & 2015) study on the fare-free projects applied in minor cities both in Sweden and globally, which could serve as a basis for claiming that inhabitants in larger cities are capable of changing their travel behavior in spite of present increasing polluting car driving tendencies. This study therefore indicates that 3 out of every 5 travelers want to make their travel behavior more environmentally friendly by commuting more by public transportation.

The limitations of the study are however the lack of practical observations from a pilot project since the time and resources limited the possibilities to measure every traveler’s actual travel behavior during a hypothetical scenario of free fares in order to compare it with the expected mode choices prior to the change. The study could have been conducted with a higher validity degree by adding a new study after the introduction of company-car taxation and diesel-free city zones. Additionally, the method would the primarily have been to reach out to a higher number of recipients and divide each target group more equally by distributing the questionnaire through an authority like SL or its equivalence in other cities.

For future research, the implications of this study can contribute to longer periods of randomized control trial studies, which in practice would take place as a fare-free trial project prior to a possible permanent implementation of the fare-free system. The following results from this project could then have brought more accurate empirical material that would shorten the discrepancy degree between the anticipated additional number of public transportation trips in relation to what would have been the practical case when the prices eventually would have been reduced or abolished. Conducting studies like this in different urban and rural environments in several parts of the world can give numerous key findings that can assist authorities with knowledge on how to address increasing car emissions which today play a major role behind the increasing pollution and global warming issues. Lastly, and essentially, this study also requests a further macro-economic perspective to examine to what extent it is economically feasible for authorities to implement fare-free systems for other global large-scale cities, and how.
7. Conclusions
The aim of the study was to examine expected travel behavior changes from a fare-free public transport system and investigate potential limitations with this approach to increase public transport travel in Stockholm. The conclusions that can be drawn from the findings is a public transportation increase in both traveler numbers and frequency among all surveyed target groups. In regards to the research questions, the conclusions have been separated into three sections that are the following.

Regarding to what extent would a fare-free public transportation system infuse public transport demand changes, the expected changes among all the respondents would result in a 67-percent increase in additional public transit one-way trips, and an increase of 47 percent of additional public transport commuters. If the fares instead would have been reduced by half the price, the number of people with an increased travel frequency would have been estimated to 34 percent. If dividing the additional one-way trips augmentation into the different travel modes, creating a point of departure platform into a future transport demand capacity, underground transports one-way trips would increase with 54 percent, trams/light rail would increase with 52 percent, buses with 60 percent and commuter trains with 83 percent.

Surrounding, to what extent would the expected public transport demand changes following free fares correlate with less car driving and increasing public transport commuting, the results imply that 3 out of 4 car drivers would replace their current mode choice with public transportation as their most frequent travel mode, replacing approximately 87 percentages of all car trips with public transit trips. 2 out of 5 public transport travelers would increase their public transit frequency by 57 percent and in terms of public transport commuters with unchanged travel frequencies due to their current commuting card, their top three ranking desires are more departures (1), faster travelling time (2) and lower prices (3).

In respect to which measures can be suggested for the Stockholm municipality in order to encourage less car driving and increasing public transport commuting, the suggested measure from the majority of the respondents to commute more by public transit and drive less is regardless of mode choice or monthly commuting card, primary through abolishing fares, having more public transit departures, less passenger congestion as well as faster and more reliable travel times. In order to accomplish these measures, this report suggests the application of additional elements that primarily aims to reduce the current car traffic levels and its accessibility in densely populated areas in Stockholm.

These measures take form through the replacements of certain car lanes with the addition of pedestrian and bicycle spaces, increased number of bus lanes, the implementation of parking and car-registrations fees as well as the possible company-car taxation policy, and the augmentation of the city’s public transport capacity. Furthermore, additional percentage adjustments in the SL funding and ownership structure with increased state funds are believed to create new travel habits among the city’s locals and make the new travel behaviors more consistent, thus preventing them from falling back into former car driving habits. This tendency would ultimately result in more positive health and environmental outcomes. Travel demand forecasts are however never precisely accurate due to every transportation system’s multifaceted aspect to consider. But it is essential to use the concluding remarks of this study in an attempt to meet the possible future transport capacity demands to avoid passenger congestions and bottlenecks that otherwise could inflict regressive effects on the new public transport travelers who just replaced their car trips. Nevertheless, despite a financially established Swedish middle class in relation to Stockholm’s current public transport fares, this study suggests that free fares could serve as an element to change travel behavior and partially reduce car traffic’s the detrimental effects towards the natural environment and human health.
8. Acknowledgement

I want to express a professional gratitude to my supervisors, Stefan Gössling for providing me with assistance and independence during the writing process, and to my evaluator, Lars Rudebeck. I also want to thank my institution for the knowledge that I have been privileged to take part of which inspired me to plan my thesis around this environmental matter. On a personal basis, I want to express my gratitude to Jacqueline Delgadillo and Linnea Arlid for the moral support that aided me to arrive to this instance through hard work and discipline. Lastly, I want to express a special thanks to Henrik Olsson for his guidance when it was needed the most.
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10. Appendices

Appendix 1. The pilot questionnaire layout

Hi!

This questionnaire is designed by me, Andrés Fuentes whom is conducting a study at Uppsala university that aims to improve Stockholm’s public transport. The questionnaire takes 3-5 minutes to answer and is targeted towards the Stockholm residents and people having access to the Stockholm public transport.

Your participating is of course anonymous since either I or anyone else neither can nor has the interest of identifying the participant’s background besides what the questions already are aim to examine. An answer to all questions are much appreciated but most importantly is that the enquiry is sent in. In case of any queries regarding the questionnaires questions or to subsequently find out about the result of this study, I can be contacted through via andres.fuentesdelgadillo.0737@student.uu.se.

Thank you for your time and participation!

1. How many one-way trips from household to work/school or vice versa do you usually perform with each means of conveyance during a normal week? (Reply in numbers).
   a. Car
   b. Bicycle
   c. Walking
   d. Public Transport
   e. Taxi
   f. Other

2. How long travelling time does every one-way trip with public transport usually last for you? (Answer in minutes)

3. Whom or which means of conveyance within Stockholm’s public transport do you usually exercise?
   a. Bus
   b. Commuter train
   c. Tram
   d. Underground train
   e. Other

4. What type of ticket fare do you most commonly travel with?
   a. One-way ticket
   b. Season ticket
   c. Combination ticket (Journeys between Stockholm’s and its nearby counties)

5. How much would your weekly one-way trip frequency change percentage wise if the public transport fares would be reduced by 50 % (Answer zero at unchanged travel frequency)
   a. Degree scale: (-100 %)—0 % —(100 %)

6. How much would your weekly one-way trip frequency change percentage wise if the public transport fares instead were to be abolished? (Answer zero at unchanged travel frequency)
   a. Degree scale: (-100 %)—0 % —(100 %)

7. If you were to travel more frequently with public transport due to reduced or abolished prices, which travel mode would you exercise less?
   a. None of the options below since I already travel with public transport
   b. Car
   c. Bicycle
   d. Walking
   e. Taxi
   f. Other

8. Sex
   a. Woman
   b. Man
   c. Other/does not want to disclose

9. What year were you born? (Reply with 4 numbers, i.e. 1980)

10. Educational level
   a. None
   b. Elementary school
   c. High school/secondary education
   d. Post-secondary education (1-3 years)
   e. Post-secondary education (4-5 years)
   f. Post-secondary education (5+ years)

11. Occupation (Multiple-choice question)
   a. Student
   b. Job-seeking
   c. Part-time working
   d. Full-time working
   e. No occupation
f. Parental leave

12. Monthly net income (Round to thousands)

13. Whom or which means make you choose travelling with public transport?
   a. Lacking availability of parking spaces
   b. Too expensive with car use (purchase, tax, petrol, paring fees, maintenance)
   c. Environmental reasons
   d. Faster traveling time than with other means of conveyance
   e. Lower accident risk than with other means of conveyance
   f. Avoidance of car queues
   g. I prefer not to travel with public transport

14. Kindly rank the following factors that could make you travel more frequently with public transport. (Mark/sort 1-8)
   a. More departures
   b. Lower prices
   c. Less fellow passenger congestion during rush hours
   d. Shorter distance between household and stops/stations
   e. More reliable departure and arrival times
   f. Cleaner transports
   g. Faster travelling time
   h. Safer environments at stations and stops

15. Please indicate which of the survey questions that you did not understand clearly, did not see as relevant or felt was too intrusive.

16. Kindly describe and explain how the remarked questions could be improved.
Appendix 2. The final questionnaire layout

Figure 2.1.
Figure 2.2.

4. Vänligen ange vad för biljettyp du oftast reser med
   - Enkobiljet (Reskassa, mobilbiljetter, engångsbiljet)
   - Periodbiljet (24-72 timmars kort, månads- eller års kort)
   - Kombinationsbiljet (Resor mellan Stockholm och andra län)

5. Hur många ytterligare eller färre kollektivtrafik enkelresor skulle du göra per vecka om det blev 50% billigare att resa med kollektivtrafik? (Siffran noll innebär en oförändrad resefrekvens)

6. Hur många ytterligare eller färre kollektivtrafik enkelresor skulle du göra per vecka om det istället blev gratis att resa med kollektivtrafik? (Siffran noll innebär oförändrad resefrekvens)

7. Om du skulle börja resa oftare med kollektivtrafik på grund av billigare eller slopade priser, vilket färmedel skulle du använda dig mindre av?
   - Inget av nedanstående val eftersom jag redan reser med kollektivtrafik
   - Bil
   - Cykel
   - Gång
   - Taxi
   - Annat
   - Inget av ovanstående val eftersom jag anbart kommer fortsätta resa med bil

8. Kön
   - Kvinnan
   - Man
   - Annat/Vill ej uppgö

Figure 2.3.

10. Utbildningsnivå
   - Ingen
   - Grundskoleutbildning
   - Gymnasieutbildning
   - Eftergymnasiala studier (1-3 år)
   - Eftergymnasiala studier (4-5 år)
   - Eftergymnasiala studier (5+ år)

11. Sysselsättning (Flervalsfråga)
   - Student
   - Arbetssökande
   - Deltidssysslangetande
   - Heltidssysslangetande
   - Ingen sysselsättning
   - Föräldraledig
   - Sjukskriven
   - Pensionerad

12. Nettoinkomst (inkomst efter skatt) per månad (Avrunda till tusental)

13. Vilket eller vilka skäl gör att du väljer att resa med kollektivtrafik? (Maxtre val)
   - Bristande tillgänglighet av parkeringsplatser
   - För dyrt med bilanvändning (bilköp, bliskatt, bensin, parkeringsavgifter, underhåll)
   - Inget körkort
   - Lågre olycksrisk än med annan transport
   - Miljöskäl
   - Snabbare restid än med annan transport
   - Undvika blickor
   - Jag föredrar att inte resa med kollektivtrafik
Appendix 3. Questionnaire replies

Figure 3.1.

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Average one-way trips / person</th>
<th>Response Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>3.14</td>
<td>812</td>
</tr>
<tr>
<td>Bicycle</td>
<td>64</td>
<td>166</td>
</tr>
<tr>
<td>Walking</td>
<td>7.91</td>
<td>2.049</td>
</tr>
<tr>
<td>Public transport</td>
<td>10.20</td>
<td>2.154</td>
</tr>
<tr>
<td>Taxi</td>
<td>.26</td>
<td>68</td>
</tr>
<tr>
<td>Other</td>
<td>.09</td>
<td>23</td>
</tr>
</tbody>
</table>

Number of respondents: 259
Total sum of responses = 5759

Average one-way trips per person = (Response total / Number of respondents)

Figure 3.2.
2. How long travelling time does every average one-way trip with public transport usually last for you? (Answer in minutes)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of choice</td>
<td>259</td>
</tr>
</tbody>
</table>

Total sum of travel time = 8260

Mean value (Total sum of travel time / Number of respondents) = 8260 / 259 = 31.9

3. Whom or which means of conveyance within Stockholm’s public transport do you usually exercise?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Transport distribution</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>64.9%</td>
<td>166</td>
</tr>
<tr>
<td>Commuter train/Railroad</td>
<td>45.9%</td>
<td>119</td>
</tr>
<tr>
<td>Tram/Light rail</td>
<td>12.7%</td>
<td>33</td>
</tr>
<tr>
<td>Subway/Underground</td>
<td>73.4%</td>
<td>190</td>
</tr>
<tr>
<td>Other</td>
<td>2.3%</td>
<td>6</td>
</tr>
</tbody>
</table>

Number of respondents: 259

Average one-way trips per person = (Response count / Number of respondents)

![Bar chart showing transport distribution](image)

4. What type of ticket fare do you most commonly travel with?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-ticket</td>
<td>19.7%</td>
<td>51</td>
</tr>
<tr>
<td>Seasonal-ticket (24-72 h card, monthly or yearly card)</td>
<td>78.4%</td>
<td>203</td>
</tr>
<tr>
<td>Combination-ticket (Journeys between Stockholm and other)</td>
<td>1.0%</td>
<td>5</td>
</tr>
</tbody>
</table>

Number of respondents: 259

Response percent = (Response count / Number of respondents)

![Pie chart showing ticket fare distribution](image)
5. How many additional or fewer weekly one-way trips would you perform if the public transport fares would be reduced by 50% (The number zero means an unchanged travel frequency)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of choice</td>
<td>259</td>
</tr>
</tbody>
</table>

Total sum of additional trips: 816
Mean value (Total sum of trips / Number of respondents): 816 / 259 = 3.15

Figure 3.6.

6. How many additional or fewer weekly one-way trips would you perform if the public transport fares instead were to be abolished? (The number zero means an unchanged travel frequency)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of choice</td>
<td>259</td>
</tr>
</tbody>
</table>

Total sum of additional trips: 1765
Mean value (Total sum of trips / Number of respondents): 1765 / 259 = 6.8

Figure 3.7.

7. If you were to travel more frequently with public transport due to reduced or abolished prices, which travel mode would you exercise less?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>None of the options below since I am already commuting</td>
<td>50.6%</td>
<td>131</td>
</tr>
<tr>
<td>Car</td>
<td>29.7%</td>
<td>77</td>
</tr>
<tr>
<td>Bycicle</td>
<td>2.3%</td>
<td>6</td>
</tr>
<tr>
<td>Walking</td>
<td>6.9%</td>
<td>18</td>
</tr>
<tr>
<td>Taxi</td>
<td>5.0%</td>
<td>13</td>
</tr>
<tr>
<td>Other</td>
<td>2.7%</td>
<td>7</td>
</tr>
<tr>
<td>None of the options above since I will only continue to travel by</td>
<td>2.7%</td>
<td>7</td>
</tr>
</tbody>
</table>

Number of respondents: 259

Response percent = (Response Count / Number of respondents)

Figure 3.8.
### Age distribution

#### 8. Sex

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman</td>
<td>54.4%</td>
<td>141</td>
</tr>
<tr>
<td>Man</td>
<td>45.2%</td>
<td>117</td>
</tr>
<tr>
<td>Other/does not want to disclose</td>
<td>0.4%</td>
<td>1</td>
</tr>
</tbody>
</table>

**Number of respondents**: 259

Response percent = \( \frac{\text{Response count}}{\text{Number of respondents}} \)

#### Figure 3.9

#### 9. In what year were born? (Reply with 4 numbers, i.e. 1980)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total sum of birth years: 515045</td>
</tr>
</tbody>
</table>

\[ \text{Mean Value} = \left( \frac{\text{Total sum of birth years}}{\text{Number of respondents}} \right) = \frac{515045}{259} = 1988.5 \]

#### Figure 3.10

#### Figure 3.11
10. Educational level

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Elementary school</td>
<td>0.4%</td>
<td>1</td>
</tr>
<tr>
<td>High school/Secondary education</td>
<td>27.0%</td>
<td>70</td>
</tr>
<tr>
<td>Post-secondary education (1-3 years)</td>
<td>43.6%</td>
<td>113</td>
</tr>
<tr>
<td>Post-secondary education (4-5 years)</td>
<td>28.8%</td>
<td>54</td>
</tr>
<tr>
<td>Post-secondary education (5+ years)</td>
<td>8.1%</td>
<td>21</td>
</tr>
</tbody>
</table>

Number of respondents: 259

Response percent = (Response Count / Number of respondents)

Figure 3.12.

11. Occupation (Multiple-choice question)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>39.9%</td>
<td>93</td>
</tr>
<tr>
<td>Job-seeking</td>
<td>2.3%</td>
<td>6</td>
</tr>
<tr>
<td>Part-time working</td>
<td>30.1%</td>
<td>78</td>
</tr>
<tr>
<td>Full-time working</td>
<td>49.0%</td>
<td>127</td>
</tr>
<tr>
<td>No occupation</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Parental Leave</td>
<td>2.3%</td>
<td>6</td>
</tr>
<tr>
<td>Sick leave</td>
<td>0.4%</td>
<td>1</td>
</tr>
<tr>
<td>Retired/Permenent</td>
<td>1.2%</td>
<td>3</td>
</tr>
</tbody>
</table>

Number of respondents: 259

Response percent = (Response Count / Number of respondents)

Figure 3.13.

12. Monthly net (after taxation) income (Round to thousands)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skipped Question</td>
<td>44</td>
</tr>
<tr>
<td>Mean value (Total sum of income / Number of respondents)</td>
<td>4577500 / 215 = 21290</td>
</tr>
</tbody>
</table>

Figure 3.14.
Figure 3.15.

13. Whom or which means make you choose travelling with public transport? (Maximum 3 choices)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacking availability of parking spaces</td>
<td>21.8%</td>
<td>56</td>
</tr>
<tr>
<td>Too expensive with car use (purchase, tax, petrol, parking fees, maintenance)</td>
<td>54.1%</td>
<td>140</td>
</tr>
<tr>
<td>No drivers license</td>
<td>10.3%</td>
<td>50</td>
</tr>
<tr>
<td>Lower accident risk than with other means of conveyance</td>
<td>5.0%</td>
<td>13</td>
</tr>
<tr>
<td>Environmental reasons</td>
<td>40.9%</td>
<td>106</td>
</tr>
<tr>
<td>Faster travelling time than with other means of conveyance</td>
<td>40.2%</td>
<td>104</td>
</tr>
<tr>
<td>Avoidance of car queues</td>
<td>37.1%</td>
<td>96</td>
</tr>
<tr>
<td>I prefer not to travel with public transport</td>
<td>10.0%</td>
<td>26</td>
</tr>
</tbody>
</table>

Number of respondents = 259
Response percent = (Response Count / Number of respondents)

14. Kindly rank the following factors that could make you travel more frequently with public transport. (Marksort 1-8 whereas the number 1 is most important)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Rating Average</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>More departures</td>
<td>51</td>
<td>51</td>
<td>55</td>
<td>28</td>
<td>24</td>
<td>17</td>
<td>16</td>
<td>17</td>
<td>3.47</td>
<td>259</td>
</tr>
<tr>
<td>Lower prices</td>
<td>78</td>
<td>43</td>
<td>26</td>
<td>32</td>
<td>26</td>
<td>19</td>
<td>18</td>
<td>17</td>
<td>3.38</td>
<td>259</td>
</tr>
<tr>
<td>Less degree of fellow passenger congestion during rush</td>
<td>25</td>
<td>46</td>
<td>37</td>
<td>41</td>
<td>36</td>
<td>25</td>
<td>24</td>
<td>24</td>
<td>4.20</td>
<td>250</td>
</tr>
<tr>
<td>Shorter distance between household and stops/stations</td>
<td>14</td>
<td>23</td>
<td>30</td>
<td>38</td>
<td>40</td>
<td>38</td>
<td>33</td>
<td>43</td>
<td>5.04</td>
<td>250</td>
</tr>
<tr>
<td>More reliable departure and arrival times</td>
<td>13</td>
<td>39</td>
<td>44</td>
<td>47</td>
<td>45</td>
<td>41</td>
<td>48</td>
<td>12</td>
<td>4.26</td>
<td>250</td>
</tr>
<tr>
<td>Cleaner transports</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>20</td>
<td>38</td>
<td>48</td>
<td>69</td>
<td>68</td>
<td>6.01</td>
<td>250</td>
</tr>
<tr>
<td>Faster travelling time</td>
<td>55</td>
<td>33</td>
<td>46</td>
<td>35</td>
<td>33</td>
<td>23</td>
<td>18</td>
<td>17</td>
<td>3.71</td>
<td>250</td>
</tr>
<tr>
<td>Safer environments at stations and stops</td>
<td>14</td>
<td>16</td>
<td>13</td>
<td>18</td>
<td>17</td>
<td>48</td>
<td>62</td>
<td>71</td>
<td>5.92</td>
<td>250</td>
</tr>
</tbody>
</table>

Number of respondents = 250
Skipped Question = 0