Stockholm School of Economics
Department of Economics
5350 Master Thesis in Economics
Academic Year 2023-2024

Are consumers inattentive to fuel saving for Electric Vehicles? A stated choice experiment

Lanxi Ji (42125)

Abstract. The transition to electric vehicles (EVs) is a crucial component of the global green transition within the transport sector, where EVs are often characterized by higher initial costs. This study investigates whether enhancing the salience of fuel savings information influences consumer decisions towards EVs, amidst criticisms of manufacturers like Tesla for leveraging such information in marketing strategies. I collected data from university students and conducted a stated choice experiment with randomized information treatment. The findings indicate that making fuel savings information more salient does not statistically increase the likelihood of consumers choosing an electric vehicle.

JEL: D91, Q50
Key Words: Climate Change, Electric Vehicle, Stated Choice Experiment

Supervisor: Julius Andersson
Date submitted: December 4, 2023
Discussant: Klara Strömberg

Acknowledgement

I would like to express my sincere gratitude to my supervisor, Assistant Professor Julius Andersson, for his guidance and to Professor Anna Dreber for her suggestions on survey design. I would also like to thank my family and friends for their support along the way.

Table of contents

1 Introduction

Climate change has evident impacts across regions and sectors, such as human health, agriculture, food security, water supply, transportation, energy, and biodiversity. To effectively work together on alleviating climate change, 175 parties signed the Paris Agreement was negotiated at COP 21, agreeing to limit the increase of global temperatures to 2°C. At COP26, governments agreed to focus on a pathway of 1.5°C instead of 2°C. However, the UN recently estimated that 43% of emissions need to be cut for the 1.5°C threshold and 29% of the emissions need to be cut for the 2°C threshold to be realistic by 2030 (UNFCCC, 2023). As none of the G20 countries are reducing the emissions at the pace of the net-zero target, the possibility of limiting global warming at 1.5°C is estimated to be only at 14% (UNEP, 2023). Subsequently, the goal of UN leadership for the upcoming COP28 in December this year is to look for concrete commitments in tripling renewable energy capacity, doubling energy efficiency, and funding for "loss and damage" to help vulnerable countries in dealing with climate change.[1]

Emissions from energy use account for three-quarters of total emissions. The transport sector is one of the primary sources of energy use and it accounts for 16.2% of total emissions, of which 11.9% stems from road transport and the rest from shipping, aviation, and railways (Ritchie, 2020). Thus, ramping up EVs is one of the most important steps in reducing emissions in the transport sector. Even though emissions from transportation rose by 2.1% in 2022, low-emission cars have played an important role in decarbonization. If all the electric cars were petrol cars, emissions would increase by 13 Mt (IEA, 2023). Sales of EVs rose from 4% in 2020 to 14% in 2022 and is expected to grow because of increasing oil price, policy encouragement, and financial incentives (IEA, 2023). Sweden is one of the leading countries in EV adoption, where EV sales make up 32% of total car sales in 2022, following Norway (80%) and Iceland (41%) (Jaeger, 2023).

Though the potential sales growth is expected to be high, there are many barriers for consumers to adopt EVs. One of the barriers is the high upfront costs. For example, for the Volvo XC 40 model, the electric version is around 27% more expensive than the traditional one with an internal combustion engine. However, the total cost of ownership (TCO) for EV and petrol cars merges after a few years, depending on fuel

[1] https://www.ft.com/content/9bbd39e8-eccc-4827-989d-0a2c3bfd934d

prices and driving distances. According to the International Energy Agency (IEA), TCO includes a range of costs including the upfront vehicle cost, home charger cost, purchase taxes, electricity purchase, electricity tax, financing, annual registration fee, insurance, maintenance, resale value, and net cost.[2] Figure 1 illustrates an example of the cumulative costs of owning an EV and a gasoline car respectively and estimates that the accumulated cost of a gasoline car will exceed an EV in about six to seven years. The average passenger vehicle age in EU is 11.8 years and in Sweden is 10.2 years (Autoalan Tiedotuskekus, 2022). The cumulative cost of EVs will likely be lower than gasoline cars during their lifetime. The calculation is generated by IEA's Electric Vehicle Total Cost of Ownership tool, using the annual average electricity and fuel price (0.24 USD/kWh, 2.28 USD/L) and annual average driving distance (approx. 11000 km/year) in Sweden for medium cars.[3]

Figure 1. Cumulative annual owning and operating costs

While some researchers studied the effect of providing TCO to consumers (Dumortier et al., 2015), this paper will mainly focus on the upfront cost and electricity and fuel costs. Holding prices and driving mileage constant, Figure 2 shows that petrol cars will still potentially cost more for an average car user in Sweden in a 10-year lifespan, excluding other costs.

[2] https://www.iea.org/data-and-statistics/data-tools/electric-vehicles-total-cost-of-ownership-tool
[3] https://www.iea.org/data-and-statistics/data-tools/electric-vehicles-total-cost-of-ownership-tool

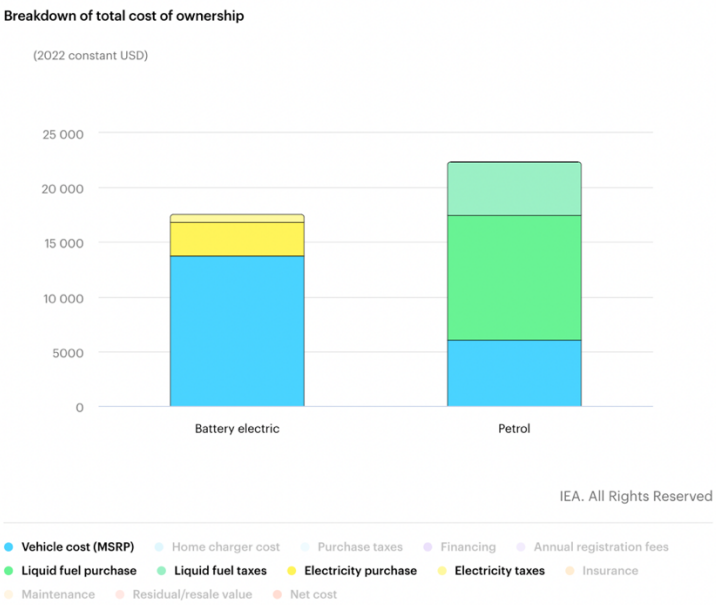


Figure 2. Breakdown of total cost of ownership

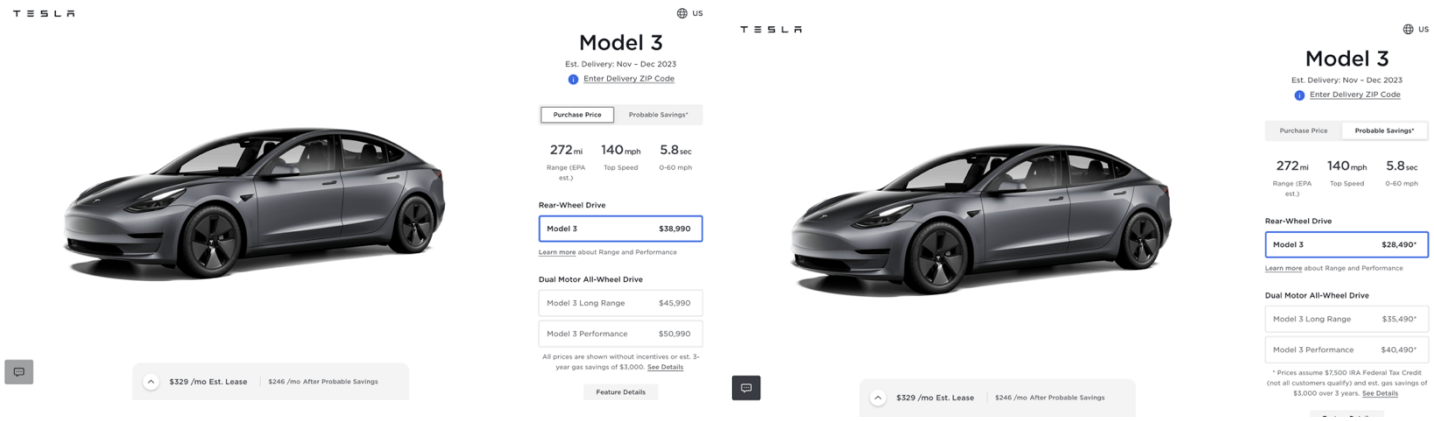
Tesla, one of the largest EV manufacturers in the world, seems to use the saving information on its website to encourage consumers to consider the fuel savings of owning an EV. When a person opens the Tesla website, it displays the probable savings on the default page instead of the actual price. Such a setting aroused the attention of an authority. In 2019, the Center for Protection against Unfair Competition (Wettbewerbszentrale) in Germany asked Tesla to not show the five-year estimated future fuel savings when displaying the price for Model 3.[4] The German competition authority claimed that the calculation of savings is arbitrary and non-transparent, and numerous reference points, such as mileage driven per year and to which car it is comparing to, is not comprehensive for consumers. They also claim that even if the savings are achieved, showing a potential deduction of price is not in accord with fair trade law. Later, Tesla adjusted and only showed the base prices for EVs on its German website, but still displayed the fuel savings on its U.S. website. However, despite the issue of non-transparency of displaying potential savings, is showing fuel savings reasonable?

Turrentine and Kurani (2007) interviewed American households and found that when consumers buy vehicles, they do not have basic knowledge and make errors in estimating fuel costs. Alcott (2011) suggest that American consumers devote little attention to fuel costs when purchasing vehicles. Supplementing to the theory of inattention, making shrouded costs, such as sales tax, salient alters consumers' purchase

[4] Wettbewerbszentrale. https://www.wettbewerbszentrale.de/de/_pressemitteilungen/?id=349

behaviours (Chetty et al., 2008a). Hence, does making the information about future fuel savings more salient address the inattention of consumers?

Figure 3. Tesla website price display



To start with, there is a recognized energy efficiency gap, meaning the underinvestment in energy efficiency tools, because of market failures and behavioural anomalies. Behavioural anomalies such as limited attention, loss aversion, heuristics, and time-inconsistent preferences may contribute to the energy efficiency gap. In this context, I am going to shed light on inattention. In order the answer the question of whether more salient fuel-saving information affects the likelihood of consumers preferring EV over gasoline cars, I used stated choice experiments with randomized information treatment. There is one control and one treatment group. In the treatment, participants will be shown the potential fuel savings per year. In this experiment, I can exploit the exogenous variation of information provided to respondents and find out whether making fuel savings more salient increases the likelihood for consumers to choose EVs over gasoline cars in a hypothetical market. I sent out online surveys to students and faculties in the Stockholm School of Economics and collected 283 complete answers, of which 202 were used in the main analysis. Participants in the experiment were randomly assigned to one of the groups. The random assignment of respondents to the treatment and control group makes sure the difference in the choices between groups is likely to emanate from the effects of information treatments. Nevertheless, there are limitations of the stated choice method compared with the revealed preference method, reflected in result interpretations. Also, students are not the main group of car buyers so they may not represent the car buyer group very well, decreasing the external validity.

The paper's contribution is to provide the first experimental evidence on the effects

of fuel-saving information on consumer's preference between EVs and gasoline cars. There is a growing literature on information provision experiments in recent years, while not many in vehicle choice and fuel efficiency. Firstly, this paper draws on and adds to research in randomized evaluation of information provision, such as Allcott and Knittel (2017) on the effect of fuel economy information on vehicle purchase and Filippini et al. (2020) on the effect of operating cost information on likelihood of choosing electric bikes in Nepal. Secondly, there is inattention to the shrouded attributes of products. Therefore, this research is also linked to shrouded attributes in other contexts, including sales tax (Chetty et al., 2008a) and shipping costs (Hossain & Morgan, 2006).

The paper is structured as follows: Section 2 provides a literature review on the energy efficiency gap, as well as the behavioural anomaly in scope, limited attention; Section 3 explains how the experiment was designed and conducted, as well as how data are handled; Section 4 discusses the method used in this study, namely stated choice experiment and information treatment; Section 5 presents the results; Section 6 discusses the results and limitations of the research, as well as pointing out future research directions.

2. Previous Literature and Hypotheses

2.1 Energy Efficiency Gap

Energy efficiency has been seen as a win-win solution to save money and reduce negative externalities associated with energy use. However, consumers fail to make energy-saving investments that have positive net present value. Dating back to Hausman (1979) and Train (1985), they suggested that consumers discount future energy savings heavily when deciding to select energy-efficient durable goods. Recently, some studies have found that consumers seem to undervalue future fuel savings. If consumers do not undervalue future fuel savings, future discounted gas costs should move one-for-one with the vehicle purchase price. However, for example, Alcott and Wozny (2009) found that consumers are indifferent between $1 in discounted gas cost and $0.76 in vehicle purchase price. More evidence has been found in the automobile market. By studying the price responses from consumers of an unexpected restatement from Kia and Hyundai who overstated the fuel economy, Gillingham et. al (2019) found that consumers undervalue fuel economy in vehicle choices: consumers are indifferent between 1 dollar in future gasoline cost and 15-38 cents in vehicle purchase prices. These studies more or less show that consumers' decisions lead to slower diffusion of energy-efficiency products than what would be expected if they make investments that result in positive net present value. The phenomenon is known as the energy efficiency gap.

There is a broad literature addressing the current issue of the energy efficiency gap from the perspectives of market failures and behavioural anomalies. Market failures include imperfect information (Anderson & Newell, 2004), principal-agent issues (Wood et al., 2012), liquidity constraints (Golove et al., 1996), learning-by-using (Mulder et al., 2003), and regulatory failure (Brennan, 2011). On the other hand, behavioural anomalies that may contribute to the energy efficiency gap have also been widely discussed. The neoclassic economic assumption suggests that consumers behave as if they maximize their utility function, are fully informed, use all available information, and process information appropriately. However, behavioural anomalies tend to tell that consumers deviate from the standard neoclassic assumptions, encouraging consumers to choose less energy-efficient products. Gillingham and Palmer (2013) addressed behavioural anomalies in three categories: nonstandard

preferences, nonstandard beliefs, and nonstandard decision-making.

Self-control problems and reference dependence are relevant to explain the energy efficiency gap in the category of nonstandard preferences. Consumers seem to have time-inconsistent preferences (Tsvetanov & Segerson, 2011). Consumers face uncertainty when making decisions, so the outcomes depend on the outcome's relationship to a certain reference point. For example, consumers could be uncertain about future fuel prices and how much they actually will drive when they decide which vehicle to buy. Greene et al. (2008) argue that uncertainty combined with loss aversion could explain the underinvestment in energy efficiency.

Nonstandard beliefs suggest that consumers hold systematically incorrect beliefs about the future through being overconfident, expecting small samples to exhibit large-sample statistical properties, and projection bias (DellaVigna, 2009).

Nonstandard decision-making, a decision-making process which does not follow neoclassical assumptions, has been emphasized a lot in previous literature. Consumers may have limited attention. Chetty et al. (2008b) provided evidence that even though consumers are well-informed about sales tax, making sales taxes more salient in supermarkets by posting it under prices changes consumer buying patterns. Consumers may be affected by the framing of information. Blasch et al. (2017) show that displaying the future energy consumption of electrical appliances to Swiss consumers in monetary terms rather than physical units increases the possibility that an individual identifies the lowest lifetime costs correctly. Similarly, Newell and Siikamäki (2013) found that providing consumers with energy labels having information about the monetary value of energy saving is the most important factor guiding energy efficiency investments. Consumers may also use heuristics to simplify the decision-making process. Turrentine and Kurani (2007) used semi-structured interview data from the US and found that consumers did not analyze their fuel costs in a systematic way when purchasing automobiles.

2.2 Limited attention and salience of information

Among all behavioural anomalies, I will focus on limited attention. Simon (1955) raised the concept of bounded rationality where individuals make choices within a limited rather than the whole range of choices. The underlying concept is that agents face costs when processing information, so they rationally use simplifying heuristics to solve complex problems.

Salience has been studied in various contexts. Hossian and Morgan (2006) found

that shipping costs are more salient if they are included in the initial price than if they are added at the end of the transaction. Chetty et al. (2008b) is one of the first studied effects of tax salience in public finance. By experimenting with posting sales tax under the price tags in a grocery store, they found that sales fell when the salience of sales tax increased for consumers. Salience has also been studied in consumers' food choices. Bollinger et al. (2011) found that posting calories mandatorily on consumers' purchasing decisions in Starbucks decreases the average calorie per purchase by 6%. Salience has also been studied in energy efficiency. Carroll et al. (2014) provide evidence that improved consumption feedback, in particular, the installation of smart metering, reduced electricity demand. Similarly, Gilbert and Zivin (2013) found that making electricity expenditure more salient reduces peak demand in households in the US. Following these ideas, salience could also be used to address inattention to consumer vehicle choices. Even though it is expected that consumers put more effort into estimating future fuel costs when they make large purchases like cars, they still may have limited attention to the discounted value of future fuel costs (Turrentine & Kurani, 2007). Other previous studies have also tested if consumers are inattentive to future fuel costs, thereby undervaluing fuel costs (Austin, 2008; Busse et al., 2013; Allcott & Wozny, 2009; Sallee et al., 2016). Greene (2010) reviewed 28 quantitative analyses, in which 12 suggested consumers tend to undervalue gas costs, 5 suggested consumers overvalue gas costs, and 8 indicated that consumers make correct tradeoffs.

Making information more salient has been used to study consumer behaviours in energy efficiency decisions. Newell and Siikanmäki (2013) explored the effectiveness of providing information through energy efficiency. labelling on energy efficiency decisions by households, using a choice experiment. Moreover, Filippini et al. (2020) studied the effects of providing running costs to motorcycle buyers in Nepal

Following this strand of literature, this paper focuses on studying the effectiveness of making fuel savings more salient in consumers' decisions in vehicle choices, bridging information salience and energy efficiency in the automobile industry.

2.3 Consumer decision process in car purchase

Car purchase decision fits in the general consumer decision making framework. The traditional consumer decision-making process involves five stages: need recognition, information search, evaluation of alternatives, purchase, and post-purchase behaviour (Stankevich, 2017). In the context of purchasing a car, consumers first develop a need for a car, then start to do internal and external information searches

about different alternatives he or she has. The internal search consists of information from memory, such as past experiences. An external search is a search of external information sources for decision-relevant information. Such sources for car buyers come from personal channels, mass media, the World Wide Web, and retailers (van Rijnsoever et al., 2009). Personal channels are usually people in one's social circle, such as friends and family. Mass media are sources that do not locally interact with an individual, such as radio, newspaper, and TV. The World Web is simply the information a person can get from internet searches and retailers are those who advise consumers in car dealerships. The majority of consumers spend more than ten hours exploring different car options both in developing and developed countries[5].

2.4 Hypotheses

The hypothesis is the information treatment of providing fuel savings on average influences consumers positively on stating that they will choose an EV over a gasoline car.

[5] https://www2.deloitte.com/content/dam/Deloitte/in/Documents/manufacturing/in-mfg-dtcm-steps-in-the-buying-process-noexp.pdf

3 Experiment

To understand the effect of an information treatment on consumers' preference for electric vehicle in Sweden. The experiment was conducted using an online tool called Qualtrics, where the participants were divided into two groups, one control group and one treatment group.

3.1 Subjects

The target group of participants in the experiment was university students in Sweden. I am aware that there are several limitations of the group. The biggest limitation is that students are not the main group that is considering buying cars so they cannot represent the wider population of car buyers in Sweden. However, homogeneity between groups is important for comparing control and treatment groups in statistical analysis. Therefore, to keep the homogeneity between the experiment groups, students are the simplest group for me to reach out to.

I created eight email lists which contain all students, faculties, and staff at the Stockholm School of Economics (SSE). Since everyone is on the email list, including students or faculty members who are not in school anymore, I ask them to identify their status of being a student or not. Besides sending emails to students at SSE, I also reached out to students at the Royal Institute of Technology (KTH). I planned to post the survey link in KTH's Facebook group chat, but because of KTH's regulation, the administrator cannot allow posts with a topic outside the field of engineering. Therefore, I only send to students with a student email at SSE in the end. In the survey, I did not collect any personal information and the data will not be stored by the completion of the project. I donate[6] for every completed answer to the survey, incentivizing people to take the survey.

3.2 Experiment Design

The experiment contains two experiment groups: one treatment group and one control group. Assigning the group is done by Qualtrics, an online survey platform.

[6] See donation in Appendix E

The objective of the survey was to collect information that may be relevant to assess the purchase decisions regarding electric vehicles. The survey collected participants' socio-economic information. I also designed some questions to ascertain participants' knowledge of fuel economy. The survey is designed to be a stated choice experiment, as opposed to a revealed preference survey. Therefore, the survey is structured in a way that the stated preference question of car choice was asked early in the survey so that the participants would not be biased.

I now describe the stated choice experiment with information treatment. In the experiment, participants are given a hypothetical situation in which they are commuting a long distance by public transportation daily and they are considering buying a car. A chart (

Figure 4) is designed, where two cars are presented in simulated diagrams with their features specified. Considering the complexity of purchasing a car in reality, I include the most common features that one will see on car dealers' websites, which include car type (5-seat SUV and automatic), acceleration, engine power, electricity/fuel consumption, and CO_2 emission. For the electric vehicle, the pure electricity driving range of one charge is also provided to participants. Moreover, the fuel type (Electricity/ Gasoline) and prices of each car are shown. I used the prices[7] and features of *Volvo XC 40 Mild Hybrid* and *Volvo XC 40 Recharge* to ensure the information was close to reality, however, the brand was not shown to participants to avoid participants opting for "None" because of the brand. The average annual prices of electricity and diesel were also presented at the bottom of the chart.

Participants in the treatment group will see the same image as the control group, however, they will also see a potential saving per year of driving an electric vehicle (Figure 5). The calculation of electricity price and diesel price are based on annual average prices. The potential savings are calculated based on the mileage of an average private car user in Sweden in 2022. After seeing these two different cars, the participant needs to make a choice between the EV, fuel car, or neither of them.

As mentioned before, some socio-economic questions are asked before the experiment starts, which are school studying, education level, age, and gender. After the experiment, the participants were asked if they computed the total cost of owning a car over its lifetime. They were also asked to rate the importance of some given factors from least important to most important. Specifically, these factors include design and appearance, purchase price, fuel economy, engine power, brand, environmentally

[7] Prices are rounded up by 100kr

friendly, resale value, engine power, brand, the popularity of the model among family and friends, safety, and expense for fuel over the lifetime.

At the end of the survey, I added a control question to assess whether the participants understood what the survey was about. If they did not understand the previous survey questions correctly, I can conclude that they did not take the survey seriously, or they did not understand the survey properly.

Figure 4. The options for the control group

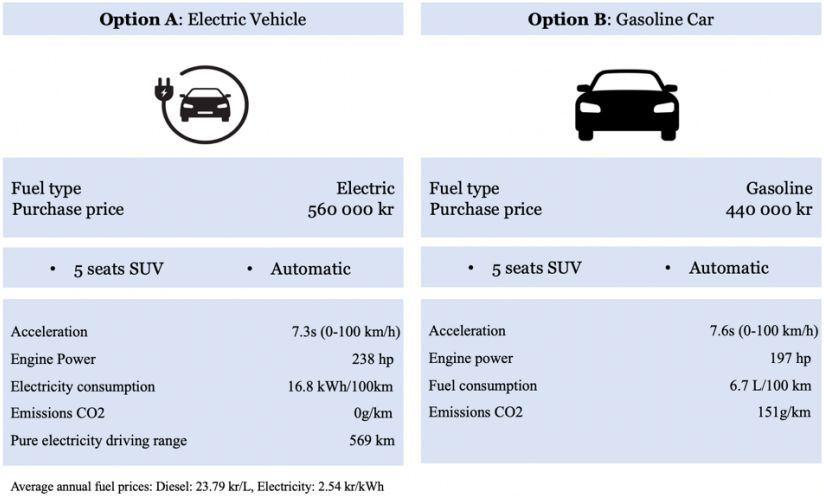
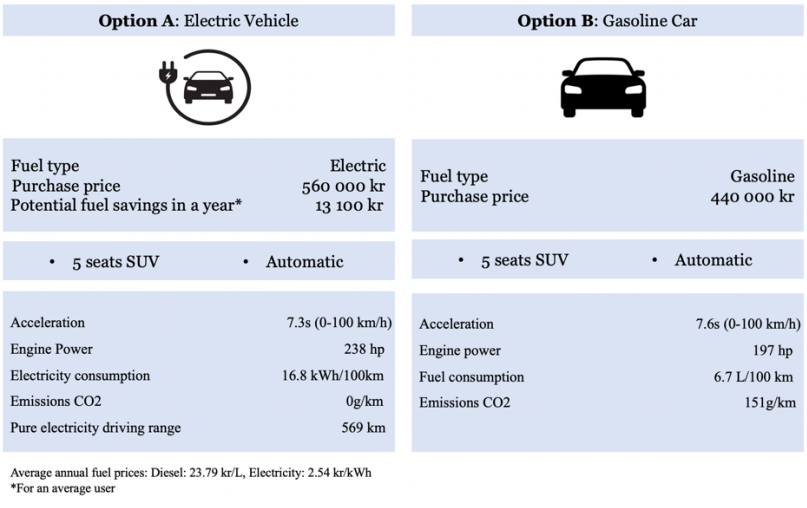


Figure 5. The options for treatment group



3.3 Experimental procedure

In Qualtrics, I turned on “Randomizer” and “Evenly Present” to ensure each group contains roughly the same number of participants. The randomization occurs in all

levels of participants. After the participant clicks the link of the survey in the email, they will be shown a message:

> *This survey is part of an experiment, conducted as part of my Master's Thesis project in Economics at the Stockholm School of Economics. I am studying people's vehicle choices. The survey is completely anonymous, in compliance with GDPR, and the information collected is handled carefully and studied in the aggregate. Completing the survey should take circa five (5) minutes, and for every adequately submitted survey, I will donate one (1) Swedish krona to Rädda Barnen.*

Then, the participant will be asked if they are currently a student/faculty in Sweden, if they answer "No", the survey will be terminated at this stage. After being asked some social demographic questions, the participant will proceed to the experiment. In the experiment, participants are in a hypothetical situation:

> *Let's assume a hypothetical situation. You are commuting a long distance by public transport on a daily basis, and you want to buy a car to commute instead. The options you are looking at are an EV and a gasoline car. Which one would you choose?*

Participants in the control group will see the message above, while the treatment group will see a slightly different message:

> *Let's assume a hypothetical situation. You are commuting a long distance by public transport on a daily basis, and you want to buy a car to commute instead. The options you are looking at are an EV and a gasoline car. Your friend who owns a car tells you that Total cost = purchase cost + running cost, where the running cost depends on km/day, price of the fuel, and lifetime of the car. Which one would you choose?*

Both messages are accompanied by an illustration graph. After this question, the participant will be asked about their cognitive skills, the importance of different factors when choosing, and fuel economy knowledge. At the end of the survey, participants are shown with an ending message:

Thank you for taking part in this survey and for helping me with my thesis project! If your answers are complete, I will now donate money to Rädda Barnen (Save the Children). All the information collected will be handled with care and will not be stored, once I am done with the project. If you have any questions about the survey, please send us an e-mail to 42125@student.hhs.se.

The complete email can be found in Appendix C and the complete survey could be found in Appendix B.

3.4 Pre-study

In the pre-study, I sent out the survey to 10 people, including students and recent graduates at the Stockholm School of Economics. The participants in the pre-study are very close to the participants in the experiment. The size of the group in the pre-study enabled me to not significantly decrease the number of responses in the study.

The survey platform records how long it took for participants to answer. The quickest one took 55 seconds, and most participants took. Most people took three to four minutes to complete the survey. Therefore, I set a lower bound for a survey response to be analyzed, which will be one minute. If a participant took less than one minute to complete the survey, it can be reasonably assumed that the participant did not read the questions clearly, did not understand the questions, or did not take the survey seriously.

Some changes were made after the pre-study in order to decrease the possibility of biased answers, make the experiment more clear and closer to reality, and make the survey shorter. The first change I made was to move the question asking about cognitive skills (proxied by math scores and total scores in high school) from before the experiment to after the experiment. The second change was to make the chart in the experiment, which presented two cars, more organized and I added some more metrics for cars. The third change I made was to exclude some questions that are not really relevant to this study, which is a question testing participants' financial literacy.

3.5 Data exclusion and missing data

First of all, answers from respondents were deleted if they stated they were not a student in Sweden anymore. Their answer automatically ended after the first question asking about their current status. However, their answers are still recorded by Qualtrics.

Therefore, I manually excluded their answers. Also, there are incomplete answers, meaning some participants dropped out during the survey or did not do the survey after opening the link. They are excluded by Qualtrics. Thirdly, if the respondent provided some answers that are not related to the survey, such as selecting "computer games" when being asked what the survey is about, they will be excluded because they did not understand what the survey was about and therefore may not provide reliable answers.[8] Excluding answers based on the rules above may give a dataset that contains complete answers for every respondent. What's more, an answer will be excluded if a respondent does not take more than one minute to complete. The dataset is further divided into one dataset that contains answers from students and the other that contains answers from both students and faculties. The overall dataset was kept checking if the results would be different.

[8] No answer was excluded based on this criteria

4 Methods

The study is designed using randomized information treatment in a stated-choice experiment. Therefore, this section will provide the methodologies on how to properly apply stated choice experiments and information treatments to my experiment.

4.1 Stated Choice

To approach the research question, both stated preference/choice (SC) and revealed preference (RP) could be used. In this context, RP will ask respondents "How much would you pay for this car?" and SC will ask "If you are considering buying a car, which one would you choose given the two options below?". Louviere et al. (2000) have compared the two approaches in their book Stated Choice Methods: Analysis and Applications. RP data is generated by choice processes in the real world and SC data is elicited by hypothetical markets, where the choices are designed with pre-defined attributes. Despite that RP has been widely used to estimate models for discrete choice behaviours in marketing, economics, public welfare, and transport, there are situations where SC is preferred. Such situations are when 1) an agent needs to estimate demand for a product with new features or simply a new product where RP data is not available, 2) key explanatory variables of products are similar, making it hard to develop valid models using RP data, 3) explanatory variables are highly collinear, 4) RP data cannot satisfy the model assumptions, 5) collecting RP data are time-consuming and expensive, 6) products are not traded in the market, such as public goods. For this study, the reason to choose SC is to avoid measurement errors. As the respondents (students) in the survey are not the group who are planning to buy a car and therefore probably do not have a good understanding of car prices and functions, self-reported willingness to pay is uncertain. What's more, most students are financially constrained to buy a car, so it is more reasonable to choose SC because it reflects personal constraints. RP embodies the market and personal constraints, indicating that most respondents in my survey are unable to state their willingness to pay.

SC has limitations. The foremost is its reliability. Respondents answer under hypothetical situations and their answers may be inconsistent with their actual behaviors, which is known as hypothetical bias. Bennett and Blamey (2001) provided some possible explanations for such bias in environmental valuation. Respondents may have strategic bias, meaning they deliberately misrepresent their preferences to

influence a decision provision. Strategic bias is evidenced by Meginnis et al. (2018), showing that 27% of respondents in their study misrepresent preferences. Respondents may also be "yea-saying", stating that they agree to pay, not because they have preferences for positive environmental impacts but because they want to make themselves look good. Moreover, respondents' values may be not sensitive to the scope of environmental impacts involved and are not reflected in the availability of substitute goods. Nevertheless, hypothetical bias can be reduced. Hensher (2010) found that referencing an experiment relative to real experiences increases the likelihood of correct estimation. Hence, some cautions need to be exercised when designing the experiment.

In *The Construction of Optimal Stated Experiment*, Street and Burgess (2007) described such cautions for constructing stated choice experiments. First of all, "none" option is crucial for my experiment. Respondents sometimes are forced to choose one of the options even though the options provided are not exhaustive. The reason is to find out how respondents do a trade-off of different characteristics of choices. However, there are circumstances when it does not make sense to force respondents to make a choice. When people are considering which car to buy, they may not decide in a few minutes. Therefore, it makes sense to have a "none" option in the experiment when respondents found none of the provided options attractive or wanted to defer their choices. Secondly, there should not be a dominant option that will be preferred by every respondent. The EV option should not have a similar price and similar features as the petrol option in the experiment. Thus, to make it as close as possible to what consumers will see when they are browsing car manufacturers' websites, I designed two options with real prices[9] and real features that an individual would see when searching for information online. It is reasonable to assume that consumers probably want to calculate the future fuel costs when making the decision, so the average electricity price and diesel price are provided in the experiment.

4.2 Information Provision Experiment

Information provision experiments enable exogenous variations in the perceptions of real-world phenomena that cannot be changed by themselves (Haaland et al., 2020). For example, researchers could not manipulate the returns to education, but they could provide information to generate exogenous variation in perceived market returns when students make education choices (Jensen, 2010). Haaland et al. (2020) also showed that

[9] The prices are rounded up by 100kr to make calculation more convenient

there is a growing number of articles published in leading journals between 2010 to 2021, from less than five per year to more than 20. The applications of information provision experiments have been in public economics, political economy, macroeconomics, household finance, labour and education economics, and health economics.

Information provision experiment aims to measure the effect of providing information on people's beliefs, while there is a difference in measuring prior beliefs before information treatment or posterior beliefs after information treatment. Eliciting prior beliefs is used to measure heterogenous treatment effects and therefore to estimate the direction in which different groups will change their beliefs in response to the information provision. On the other hand, bringing out posterior beliefs aims to study the effect of information on people's beliefs, as well as measure attention when respondents are given a fact (Haaland et al., 2020). Hence, it is why respondents are asked to choose their preferred car option after they are given the information on fuel saving in this experiment. One could argue that my experiment could also be designed to let respondents elicit prior and posterior beliefs, but such designs are subject to experimenter demand effects as respondents may shift their responses to inferences on the survey's hypotheses.

Information provision experiments have been used under hypothetical scenarios to measure beliefs in contexts that are hard to study in a real-world setting (Attanasio et al., 2020). The advantage is that the researcher could have more control over the contexts, while the downside is that the hypothetical context may lower respondents' efforts and may lead to experimenter demand effects. Obfuscating information is one way to deal with experimenter demand effects (Haaland et al., 2020). In this experiment, respondents are provided with additional information that is not relevant to fuel savings but still relevant to car purchase decisions to respondents. Another practice is to conduct a follow-up study, which is done by Allcott and Knittel (2017). Nevertheless, a follow-up survey does not apply to this experiment due to the identity of the respondents and the time limitation. When designing the experiment, the clarity of information in the treatment was addressed as it is stated that accompanying text with a graphical illustration of the information increases the understanding of the treatment message (Haaland et al., 2020).

4.3 Average Treatment Effect

To recapitulate, I conducted a controlled experiment with two groups: a treatment

group that received information about fuel savings of electric vehicles (EVs), and a control group that did not receive this information. The aim was to determine if the information treatment influences the likelihood of participants choosing an EV over a traditional gasoline car. This methodological approach is anchored in the experimental designs discussed by Rubin (1976), which have been further developed by researchers.

I define Y_0 as the choice of an individual in the control group, reflective of the baseline propensity without the influence of additional information. Y_1, on the other hand, denotes the choice of an individual in the treatment group after receiving the information treatment. The treatment effect, therefore, is captured by the difference $Y_1 - Y_0$, which quantifies the change in the likelihood of selecting an EV due to being exposed to the information treatment.

In this experiment, each participant's choice—represented by either Y_1 or Y_0—is observed, but not both. To estimate the average treatment effect (ATE), I compare the choices between the treatment and control groups. The observed difference in the likelihood of choosing EVs between the groups embodies the empirical estimate of the impact of the information treatment. Observed difference is interpreted as the ATE under the premise that the differences in vehicle choice are exclusively a result of the information treatment. Such an interpretation assumes random assignment of participants to the control and treatment groups to ensure comparability across all other variables.

$$E[Y_0 \,|T = 0] = E[Y_0]$$
$$E[Y_1 \,|T = 1] = E[Y_1]$$

T tests are utilized to confirm the success of the random assignment process. These tests check for homogeneity across the groups in terms of demographic characteristics and baseline attitudes towards vehicles. If significant differences are detected, they must be accounted for to avoid omitted variable bias, which could otherwise lead to misleading conclusions about the effectiveness of the information treatment. This consideration ensures that the regression estimates are not biased by unobserved confounders.

In the analysis, should there be any significant imbalances in demographics or attitudes between the control and treatment groups, appropriate control variables will be introduced into our regression models. This adjustment is critical to isolate the pure effect of the information treatment on the likelihood of choosing an EV and to ensure

our results reliably reflect the true influence of the treatment on consumer decision-making.

The estimated effect of the treatment on the likelihood of choosing an electric vehicle by estimating a probit model of the form:

$$E_i = \alpha_i + \beta D_{i,j} + \delta X_i + \epsilon_i$$

, where E_i is dichotomous and denotes whether participant "i" chooses an electric vehicle, $D_{i,j}$ is an indicator for whether the respondent was treated by the treatment (j=1). X_i denotes the set of socio-economic controls, α_i denotes the intercept and ϵ_i denotes the residual. The model is estimated using Huber-White robust standard errors.

5 Results

5.1 Summary Statistics

I received 418 answers from students and faculties, of which 135 answers came from non-students/faculties, 214 were from students, and 69 were from faculties. The sample size is a bit smaller than I expected in the pre-analysis (Appendix A). The experiments were conducted in both faculties and students, while the results focused on students. Since there are respondents who indeed prefer other ways to commute (public transport or walking) and there are respondents who do not want to make a choice, six respondents in the student group opted for the "None" option. Ultimately, I received 96 respondents in the control group and 106 in the treatment group.

To further test for the quality of randomization, Table 1 shows the balance of the important covariates across two groups. Mean and standard deviations of variables, as well as the T-test results, are reported. The T-tests are used to compare the means and test whether the differences are significant between control and treatment groups. I find that the means of the variables between the treatment and control groups are similar for all variables.

Some characteristics could also be observed from Table 1. First of all, the proportion of female participants (around 36%) in the sample is lower than male participants. What's more, the average age is 23.6 years old. 54% of the participants are studying Bachelor's, 36.6% of the participants are studying Master's, and around 10% are pursuing a Ph.D. or other studies. Also, the participants have high cognitive skills, with around 70% of them having a score higher than the 80th percentile in high school national tests and high school math tests and none having a core lower than the 50th percentile. The result is expected because an above-average high school national test score is usually required to enter the university. The characteristics show that the majority of participants are young male university students with high cognitive skills. Given that 64% of participants are young males with high levels of education, they may have a preference for EVs without treatment and may not be very responsive to the information treatment. Some evidence is shown by Sovacool et al. (2018) that in Nordic countries, gender has a weak and significant negative correlation with interest in EVs. What's more, they also suggest that in Nordic countries, predominantly men below middle age (30-45) with higher levels of education and full-time employment, working

in civil society and academia, are most likely to buy EVs.

When considering buying a car, the least important factors for participants are brand, power and popularity among friends and family, while price is the most important factor, followed by fuel economy, safety and future fuel expenses. The factors are measured on a scale between 1 to 3, in which 1 denotes the given factor is not important at all and 3 denotes that the given factor is very important. Price, fuel economy, safety, and fuel cost are rated 2.545, 2.495, 2.49, and 2.46 on average respectively, suggesting participants value costs associated with vehicle, fuel efficiency, and safety largely among other given factors. When asked if they computed the operating cost[10] when making the choice, 12% more participants in the treatment group stated that they computed the total cost and the difference between the two groups is statistically significant at a 10% level, indicating that the information treatment raised the likelihood to calculate the fuel savings.

[10] Operating cost consists of many other costs than fuel cost, but the participants are asked to assume it is only the upfront cost and fuel cost.

Table 1. Balance of attributes across control and treatment group

	Control Group N=96		Treatment Group N=106		T-test	Total N= 202	
Age	23.938	(6.679)	23.330	(4.836)	0.745	23.619	(5.779)
Female	0.365	(0.484)	0.358	(0.482)	0.090	0.361	(0.482)
Education							
Bachelor	0.510	(0.503)	0.566	(0.498)	-0.789	0.540	(0.500)
Master	0.375	(0.487)	0.358	(0.482)	0.972	0.366	(0.483)
Phd	0.104	(0.307)	0.066	(0.250)	0.847	0.084	(0.278)
Other	0.010	(0.102)	0.009	(0.097)	0.070	0.010	(0.099)
High school math test percentile							
Between 50th - 80th percentile	0.083	(0.278)	0.123	(0.330)	-0.912	0.104	(0.306)
Above 80th percentile	0.719	(0.452)	0.689	(0.465)	0.465	0.703	(0.458)
Don't remember	0.115	(0.320)	0.132	(0.340)	-0.375	0.124	(0.330)
Not Applicable	0.083	(0.278)	0.057	(0.232)	0.744	0.069	(0.255)
High school test percentile							
Between 50th - 80th percentile	0.063	(0.243)	0.094	(0.294)	-0.834	0.079	(0.271)
Above 80th percentile	0.740	(0.441)	0.698	(0.461)	0.651	0.718	(0.451)
Don't remember	0.104	(0.307)	0.142	(0.350)	-0.802	0.124	(0.330)
Not Applicable	0.094	(0.293)	0.066	(0.250)	0.726	0.079	(0.271)
Compute total cost							
Computed total cost	0.417	(0.496)	0.538	(0.501)	-1.724	0.480	(0.501)
Importance of different factors when choosing a car							
Design	2.375	(0.684)	2.255	(0.691)	1.241	2.312	(0.689)
Price	2.500	(0.616)	2.585	(0.583)	-1.006	2.545	(0.599)
Fuel Economy	2.500	(0.598)	2.491	(0.590)	0.113	2.495	(0.592)
Power	1.729	(0.747)	1.802	(0.761)	-0.684	1.767	(0.753)
Brand	1.813	(0.685)	1.943	(0.754)	-1.287	1.881	(0.723)
Envoirnmental Friendly	2.188	(0.799)	2.217	(0.743)	-0.272	2.203	(0.768)
Resale Value	1.948	(0.786)	2.104	(0.780)	-1.413	2.030	(0.785)
Popularity	1.458	(0.710)	1.387	(0.611)	0.770	1.421	(0.659)
Safety	2.552	(0.663)	2.434	(0.662)	1.266	2.490	(0.663)
Fuel Expense	2.490	(0.615)	2.434	(0.633)	0.632	2.460	(0.624)

Note: Standard deviation in paratheses. *p<0.1, **p<0.05, ***p<0.01. The importance of different factors when choosing a car is a scale between 1-3, 1=not important, 2 = somewhat important, 3 = most important. The table is based on Filippini et al. (2020). Similar to the way they present, this table reported mean and standard deviation in parathesis.

5.2 Main Results

The comparison of means of the proportion choosing EV over gasoline car is presented in Table 2.

To analyze the impact of the information treatment on the outcome variable, the probability of stating that they prefer the EV over the gasoline car, I calculated the proportion of respondents in the control and treatment group who stated that they would prefer the electric vehicle and compared the means between the groups. The comparison of group means is presented in Table 2. 80.2% of respondents in the control group and 76.4% of respondents in the treatment group will choose an EV over a gasoline car. The proportion is not significantly different from each other using a one-sided T-test, suggesting that the information treatment is not likely to affect the probability of choosing an EV. A comparison of means in the larger sample (N=259), which consists of both students and faculties, has also been done to supplement the results and the difference is also not statistically significant (Appendix D). As the respondents were randomly assigned to the treatments, the treatment allocations provided exogenous variations in the information that respondents were provided before stating their preferences.

Table 2. Treatment effects: Comparison of means

Group	Control	Treatment
Proportion of choosing Electric Vehicle	0.802	0.764
	(0.041)	(0.427)
Observations	96	106

Note: Standard deviation in paratheses. *p<0.1, **p<0.05, ***p<0.01.

A comparison of the mean values of the share of respondents who stated they would choose EV between the two groups is sufficient to evaluate the effect of information treatment, however, to make the analysis more complete, a probit model is estimated (Appendix D).

The hypotheses has been tested. No evidence has been found to support the hypothesis that information treatment on fuel saving has a positive effect on consumers stating they would prefer an EV over a gasoline car.

6 Discussion

This research question stems from a real-world debate about whether presenting the potential fuel savings to consumers could be appropriate. Despite the non-transparency in calculation and obscure reference points, the fuel-saving information could hypothetically let inattentive consumers make informed choices. Previous literature raised that consumers are inattentive about fuel costs (Allcott, 2011) and that making shrouded attributes, such as tax, salient shifts consumers' purchase decisions (Chetty et al., 2008a). I collected data on stated preferences and socio-economic factors from students studying at the Stockholm School of Economics. Using randomized information treatment in the stated choice experiment, I evaluated the role of information salience in determining the stated preference of consumers for electric vehicles.

I found no significant difference in preference for EVs between the control group and the treatment group, in which the fuel-saving information is more salient. This finding is contrary to my hypothesis that enhanced salience of potential savings would increase the likelihood of consumers choosing EVs. The study is only addressing the role of inattention in fuel savings, which is part of the potential rationale for behavioural anomalies in electric vehicle adoption. Market failures and other behavioural anomalies are also important factors. Though the effect of treatment is not significant, it draws attention to thinking and calculating the fuel savings of EVs when participants state their preferences. Furthermore, the treatment might not have been impactful enough to affect their stated preferences.

The findings of this study contribute to the growing literature about the energy efficiency gap and consumer inattention in the automobile market. It also contributes to the information provision experiment in the automobile market. The result is similar to Alcott and Knittel (2017), who found information treatment on potential fuel costs has no significant effect on the fuel efficiency of purchased vehicles.

This study has several limitations that must be acknowledged. The sample was limited to university students in the Stockholm School of Economics. Though one could argue that they will probably be car buyers in the future, they may not represent the broader population of potential car buyers now. Moreover, stated choice in a controlled setting may not necessarily translate to the actual choice when it is associated with financial decisions (Davis & Metcalf, 2014).

Future research could consider a more diverse demographic to understand better

how information intervention might affect different consumer segments. However, I doubt the effectiveness of information treatment in making fuel savings salient. Therefore, exploring the inattention to other costs or the total cost of ownership could yield different results. Of course, a follow-up survey would be ideal in such experiments. Additionally, real-world experiments, such as actual purchasing scenarios, could provide insights into how consumers behave outside of a controlled experimental environment. Exploring different methods of information delivery, such as interactive tools or personalized fuel savings in Alcott and Knittel's (2017) experiment design, might also yield different results.

Reference

Allcott, H. (2011). Consumers' Perceptions and Misperceptions of Energy Costs. *The American Economic Review*, *101*(3), 98–104. https://doi.org/10.1257/aer.101.3.98

Anderson, S. T., & Newell, R. G. (2004). Information programs for technology adoption: The case of energy-efficiency audits. *Resource and Energy Economics*, *26*(1), 27–50. https://doi.org/10.1016/j.reseneeco.2003.07.001

Attanasio, O., Boneva, T., & Rauh, C. (2020). Parental Beliefs about Returns to Different Types of Investments in School Children. *National Bureau of Economic Research*. https://doi.org/10.3386/w25513

Austin, D. (2008). *Effects of Gasoline Prices on Driving Behavior and Vehicle Markets*.

Bennett, J., & Blamey, R. K. (2001). *The choice modelling approach to environmental valuation*.

Blasch, J., Filippini, M., & Kumar, N. (2017). Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. *Resource and Energy Economics*, *56*(249), 39–58. https://doi.org/10.3929/ethz-a-010714201

Bollinger, B., Leslie, P., & Sorensen, A. T. (2011). Calorie Posting in Chain Restaurants. *American Economic Journal: Economic Policy*, *3*(1), 91–128. https://doi.org/10.1257/pol.3.1.91

Brennan, T. J. (2011). *Energy Efficiency Policy: Surveying the Puzzles*. https://doi.org/10.2139/ssrn.1977672

Busse, M. R., Knittel, C. R., & Zettelmeyer, F. (2013). Are Consumers Myopic? Evidence from New and Used Car Purchases. *The American Economic Review*, *103*(1), 220–256. https://doi.org/10.1257/aer.103.1.220

Carroll, J., Lyons, S., & Denny, E. (2014). Reducing household electricity demand through smart metering: The role of improved information about energy saving. *Energy Economics*, *45*, 234–243. https://doi.org/10.1016/j.eneco.2014.07.007

Chetty, R., Looney, A., & Kroft, K. (2008a). Salience and taxation theory and evidence. *Social Science Research Network*. https://doi.org/10.17016/feds.2009.11

Chetty, R., Looney, A., & Kroft, K. (2008b). Salience and Taxation: Theory and Evidence. *The American Economic Review*, *99*(4), 1145–1177. https://doi.org/10.1257/aer.99.4.1145

Davis, L. W., & Metcalf, G. E. (2014). Does Better Information Lead to Better Choices? Evidence from Energy-Efficiency Labels. *Journal of the Association of Environmental*

and Resource Economists. https://doi.org/10.1086/686252

Dumortier, J., Siddiki, S., Carley, S., Cisney, J., Krause, R. M., Lane, B. W., Rupp, J. A., & Graham, J. D. (2015). Effects of providing total cost of ownership information on consumers' intent to purchase a hybrid or plug-in electric vehicle. *Transportation Research Part A-Policy and Practice*, *72*, 71–86. https://doi.org/10.1016/j.tra.2014.12.005

Filippini, M., Kumar, N., & Srinivasan, S. (2020). *Nudging the adoption of fuel-efficient vehicles: Evidence from a stated choice experiment in Nepal*. https://doi.org/10.3929/ethz-b-000412797

Gilbert, B., Benjamin Gilbert, Gilbert, B., & Zivin, J. G. (2013). Dynamic Salience with Intermittent Billing: Evidence from Smart Electricity Meters. *National Bureau of Economic Research*. https://doi.org/10.1016/j.jebo.2014.03.011

Gillingham, K., Houde, S., & van Benthem, A. A. (2019). Consumer Myopia in vehicle purchases: Evidence from a natural experiment. *National Bureau of Economic Research*, *13*(3), 207–238. https://doi.org/10.3929/ethz-b-000342759

Gillingham, K., & Palmer, K. (2013). *Bridging the energy efficiency gap: Insights for policy from economic theory and empirical analysis*.

Golove, W. H., Eto, J. H., & J.H. Eto. (1996). *Market barriers to energy efficiency: A critical reappraisal of the rationale for public policies to promote energy efficiency*. https://doi.org/10.2172/270751

Greene, D. L. (2010). *How Consumers Value Fuel Economy: A Literature Review*.

Greene, D. L., German, J., & Delucchi, M. A. (2008). *Fuel Economy: The Case for Market Failure*. 181–205. https://doi.org/10.1007/978-1-4020-6979-6_11

Haaland, I., Roth, C., & Wohlfart, J. (2020). Designing information provision experiments. *Social Science Research Network*. https://doi.org/10.2139/ssrn.3638879

Hausman, J. A. (1979). Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables. *The Bell Journal of Economics*, *10*(1), 33–54. https://doi.org/10.2307/3003318

Hensher, D. A. (2010). Hypothetical bias, choice experiments and willingness to pay. *Transportation Research Part B-Methodological*, *44*(6), 735–752. https://doi.org/10.1016/j.trb.2009.12.012

Hossain, T., & Morgan, J. (2006). Plus shipping and handling revenue non equivalence in field experiments on ebay. *Natural Field Experiments*.

Hunt Allcott & Christopher R. Knittel. (2017). *NBER WORKING PAPER SERIES ARE CONSUMERS POORLY INFORMED ABOUT FUEL ECONOMY? EVIDENCE FROM*

TWO EXPERIMENTS Hunt Allcott.

Hunt Allcott & Nathan Wozny. (2009). *Gasoline Prices, Fuel Economy, and the Energy Paradox*.

Jensen, R. T. (2010). The (Perceived) Returns to Education and the Demand for Schooling. *Quarterly Journal of Economics*, *125*(2), 515–548. https://doi.org/10.1162/qjec.2010.125.2.515

Louviere, J. J., Hensher, D. A., & Swait, J. (2000). *Stated Choice Methods: Analysis and Applications*.

Meginnis, K., Burton, M., Chan, R., & Rigby, D. (2018). Strategic bias in discrete choice experiments. *Journal of Environmental Economics and Management*, *109*, 102163. https://doi.org/10.1016/j.jeem.2018.08.010

Mulder, P., de Groot, H. L. F., & Hofkes, M. W. (2003). Explaining slow diffusion of energy-saving technologies: A vintage model with returns to diversity and learning-by-using. *Resource and Energy Economics*, *25*(1), 105–126. https://doi.org/10.1016/s0928-7655(02)00019-2

Newell, R. G., & Siikamäki, J. (2013). Nudging Energy Efficiency Behavior: Role of Information Labels. *Journal of the Association of Environmental and Resource Economists*. https://doi.org/10.2139/ssrn.2467676

Rubin, D. B. (1976). ASSIGNMENT TO TREATMENT GROUP ON THE BASIS OF A COVARIATE. *Psychometrika*, *1976*(1), 99–114. https://doi.org/10.1002/j.2333-8504.1976.tb01095.x

Sallee, J. M., West, S. E., & Fan, W. (2016). Do Consumers Recognize the Value of Fuel Economy? Evidence from Used Car Prices and Gasoline Price Fluctuations. *Journal of Public Economics*, *135*, 61–73. https://doi.org/10.1016/j.jpubeco.2016.01.003

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *Quarterly Journal of Economics*, *69*(1), 99–118. https://doi.org/10.2307/1884852

Sovacool, B. K., Kester, J., Noel, L., & de Rubens, G. Z. (2018). The demographics of decarbonizing transport: The influence of gender, education, occupation, age, and household size on electric mobility preferences in the Nordic region. *Global Environmental Change-Human and Policy Dimensions*, *52*, 86–100. https://doi.org/10.1016/j.gloenvcha.2018.06.008

Stankevich, A. (2017). Explaining the Consumer Decision-Making Process: Critical Literature Review. *Journal of International Business Research*, *2*(6), 7–14. https://doi.org/10.18775/jibrm.1849-8558.2015.26.3001

Train, K. (1985). Discount rates in consumers' energy-related decisions: A review of the literature. *Energy*, *10*(12), 1243–1253. https://doi.org/10.1016/0360-5442(85)90135-5

Tsvetanov, T., & Segerson, K. (2011). *Re-Evaluating the Role of Energy Efficiency Standards: A Time-Consistent Behavioral Economics Approach*. https://doi.org/10.22004/ag.econ.148295

Turrentine, T., & Kurani, K. S. (2007). *Car buyers and fuel economy*. https://doi.org/10.1016/j.enpol.2006.03.005

van Rijnsoever, F. J., Farla, J., & Dijst, M. (2009). Consumer car preferences and information search channels. *Transportation Research Part D-Transport and Environment*, *14*(5), 334–342. https://doi.org/10.1016/j.trd.2009.03.006

Wood, G., Ong, R., & McMurray, C. (2012). Housing tenure, energy consumption and the split-incentive issue in Australia. *European Journal of Housing Policy*, *12*(4), 439–469. https://doi.org/10.1080/14616718.2012.730218

Appendix

A. Pre-analysis Plan

Description

In this paper, I am investigating whether information provision has an effect on consumers' EV adoption. In order to test my hypothesis, I designed a survey, which asked the participants to imagine they were planning to buy a car. I present several different car models, including both EVs and gasoline cars.

Hypotheses

The research question is: Does information treatment have effects on consumers' decisions on EV adoption?

H1: Information treatment of providing fuel savings on average influences consumers positively on stating that they will choose an EV over a gasoline car.

Design plan

Study type

Experiment – A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding

For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

Personnel who interact directly with the study subjects and will not be aware of the

assigned treatments.

In this experiment, no human being will interact directly with the subjects. The subjects will be randomly assigned to the control or treatment group by the online survey producer. The researcher will only be able to see the results after the experiment has ended.

Study design

The experiment is carried out through an online survey. The tool I am using to execute this online survey is Qualtrics.

In the experiment, participants are randomized into two different groups. There will be one control group and one treatment group, where I am testing the effectiveness of information nudge on EV adoption, e.g. giving participants information on the potential fuel savings of buying the electric vehicle.

In the control group, participants are presented with two cars, one is an electric vehicle, and the other is a traditional petrol car with an internal combustion engine. Each car has a price and main features description on the side. Participants in the control group are shown the prices and main features of these two cars. Participants from the treatment group are shown not only the price and main features of the cars but also the potential savings of using electricity instead of petrol and tax savings.

I used the real price and description features of the Volvo XC 40 mild hybrid and electric version. The reason for choosing these two cars is because they are very similar in their features, except that one is a petrol car and the other one is an electric vehicle. Moreover, the Volvo XC 40 is the third most-sold car model in Sweden in 2020. The participants will not see the real pictures of Volvo XC 40 and they will not be told the car model is Volvo XC 40, but will only see the car sketch, prices and feature descriptions.

All the pictures of the cars that participants get to choose during the experiment are the same for the two groups and the procedures that subjects need to follow during the experiment are exactly the same for all groups. Therefore, there is no counterbalancing required. This means that the independent variable is the treatment, which is the control

group and the treatment group.

I also asked the participants to answer general demographic background questions and their attitudes towards electric vehicles.

Randomization

Since I am doing our experiment in Qualtrics, I can let the program randomise the participants among the treatment and control groups. I chose "Randomizer" and "Evenly Present Elements", which make sure that each element (= each of the nudge treatments/control) is presented a roughly equal number of times across all respondents.

I will not randomize with respect to who we recruit for our experiment. I will ask all students and faculty that I am able to reach. However, once participants have chosen to participate in our survey, they will be randomly assigned to one of the two groups. So, I will randomize the level of participants that we have approached and "choose" to partake in our survey.

Sampling Plan

Existing data
Registration prior to the creation of data

Explanation of existing data
I conducted a pre-study with 10 subjects. I asked 2 people who are students and 8 who recently graduated from Stockholm School of Economics. Some people are not located in Sweden anymore. In this way, I could get close to the target as much as possible. The reason for having most people who are not students anymore is to make sure I get as many responses from the target group as possible.

In Qualtrics, the system records how long it takes for participants to fill out the survey. Utilizing this function, I am able to set a minimum requirement for the time that participants need to take in order to fill the survey. The quickest respondent took 55 seconds to answer and most respondents took around 4 minutes. Therefore, I decide that 1 minute will be the lower-bound with respect to the time that participants need to

take in order for their response to be analyzed. If they take less than 1 minute to answer, I can reasonably assume that they do not pay enough attention to the questions, or do not understand the questions properly.

I also asked the participants in the pre-study if they found any parts of the survey unclear or something could be improved. Based on their opinions, I shortened the survey by eliminating some questions with less importance and make the experiment prettier visually. Questions regarding how people form their opinions on EV, e.g letting them rate on charging infrastructure, speed, popularity among friends and family, are removed. Another question about testing people's financial literacy is also removed because students in business schools have basic level of financial literacy, assumably.

The pre-analysis make it easier for me to decide when to exclude certain participants' responses. However, I did not analyze the results of pre-study.

Data collection procedures

The population from which I will obtain subjects is students from Stockholm School of Economics. Participants from Stockholm School of Economics are recruited through emails. An email with the link and a simple description of the survey is sent out to all of the students' and faculties' emails. Another channel to send out survey invitations is to post the link in KTH student Facebook groups and group chats, however, this method could not be implemented because KTH Facebook group administrator only allows posts that are related with the engineering field.

For each completed survey, I will donate one Swedish Krona to Rädda Barnen (Save the Children International). Participants are informed about this before they start the survey. The donation acts as a small incentive to recruit participants.

In the survey, I filtered out participants who are not students or faculties anymore. The study is terminated once they choose that they are currently not a student nor faculties. The idea of having faculties is because they are closer to the group of car buyers, however, the number of surveys I received from faculties are not enough, so I will only use surveys from students in the analysis.

Homogeneity among groups are important. Given that students are the easiest group to

reach out for me, I decide to use students as the participants.

The survey is sent out between 16 to 17 on 26th October. I received 410 answers, 262 answers from students by 23:59 on 5th November.

Sample Size

The target sample size is 260 participants and 130 per control and treatment group. For a small-medium effect size (Cohen's d equals to 0.35), this gives a statistical value of 0.8 for an alpha level equivalent of to 0.05. This is caculated by using an online calculator called " A-priori Sample Size Calculator for Student t-Tests" on *Free Statistics Calculators*. By sending out emails to around 3300 individuals, including students, faculties, and other staff at SSE, getting around 260 student participants could be reasonable.

Sample Size Rationale

According to GDPR, I am not allowed to collect personal information such as name and phone numbers. So it is not possible to run a lottery for participants, therefore, charity donation is a good way to incentivize students to fill out the survey. Thus, I expect to get less respondants than running a lottery.

Stopping Rule

I will stop collecting answers after 10 days, which is from October 26th to November 5th. The other situation I will stop is when I get more than 600 answers. This is because I have limited budget for this study.

Variables

Manipulated variables

Participants are shown the features and prices of an Electric vehicle and a petrol car with internal combustion engine in one chart. The treatment group is shown the same chart as the control group, but they are also presented with potential fuel savings of the Electric Vehicle in one year, calculated using average annual prices of diesel and electricity and driving distance for an average car user.

The car features and prices are taken from Volvo XC 40, one of the top-selling cars in Sweden in 2020. The reason to choose this car model is because it's features are proven to be popular among car buyers in Sweden.

Measured variables

The outcome variable is the choice of the participants. They can choose among the EV, the fuel car, and neither of them.

I also asked some demographics questions. I asked for age, gender, education, and cognitive skills. I also ask participants to rate the factors that they value when they considering buy cars. There are questions in the form of multiple choice and integers. For questions that are multiple choice, I have ordinal variables (degree level, cognitive skills, rating questions about the importance of cars) and nominal variables (e.g. gender, university, fuel economy literacy). All the possible nominal and ordinal control variables are coded by Qualtics in a certain way and I will use the coded numbers for statistical analysis.

B. Survey

This survey is part of an experiment, conducted as part of my Master's Thesis project in Economics at the Stockholm School of Economics. I am studying people's vehicle choices. The survey is completely anonymous, in compliance with GDPR, and the information collected is handled carefully and studied in the aggregate. Completing the survey should take circa five (5) minutes, and for every adequately submitted survey, I will donate one (1) Swedish krona to Rädda Barnen.

Q1 For this study, I am targeting university students and faculties in Sweden.
Yes, I am currently a student at a university in Sweden (1)
Yes, I am currently a faculty at a university in Sweden (3)
No, I am currently not a student / faculty at a university in Sweden (2)

Skip To: End of Survey If For this study, I am targeting university students and faculties in Sweden. = No, I am currently not a student / faculty at a university in Sweden
End of Block: Default Question Block

Q2 Gender
Female (1)
Male (2)
Non-binary (3)
Prefer not to say (4)

Q3 How old are you? (Please submit your age as integers, for example, "25")

Q4 Which university are you studying/working in?
SSE (1)
KTH (2)
SU (3)
Other, please specify (5)
_____

Q5 What is the highest degree or level of schooling you have attended or are currently attending?

Bachelor (1)
Master (2)
PhD or advanced graduate studies (3)
Other (4)

End of Block: Socio-demographic

Start of Block: Experiment

Q6a Let's assume a hypothetical situation. You are commuting a long distance by public transport on a daily basis, and you want to buy a car to commute instead. The options you are looking at are an EV and a gasoline car. Which one would you choose?

Option A: Electric Vehicle		**Option B**: Gasoline Car	
			
Fuel type	Electric	Fuel type	Gasoline
Purchase price	560 000 kr	Purchase price	440 000 kr
• 5 seats SUV	• Automatic	• 5 seats SUV	• Automatic
Acceleration	7.3s (0-100 km/h)	Acceleration	7.6s (0-100 km/h)
Engine Power	238 hp	Engine power	197 hp
Electricity consumption	16.8 kWh/100km	Fuel consumption	6.7 L/100 km
Emissions CO2	0g/km	Emissions CO2	151g/km
Pure electricity driving range	569 km		

Average annual fuel prices: Diesel: 23.79 kr/L, Electricity: 2.54 kr/kWh

Option A (4)
Option B (5)
Neither (7) _____

Q6b Let's assume a hypothetical situation. You are commuting a long distance by public transport on a daily basis, and you want to buy a car to commute instead. The options you are looking at are an EV and a gasoline car. Your friend who owns a car tells you that **Total cost = purchase cost + running cost**, where the running cost depends on km/day, price of the fuel, and lifetime of the car. Which one would you choose?

Option A: Electric Vehicle		**Option B**: Gasoline Car	
			
Fuel type	Electric	Fuel type	Gasoline
Purchase price	560 000 kr	Purchase price	440 000 kr
Potential fuel savings in a year*	13 100 kr		
• 5 seats SUV	• Automatic	• 5 seats SUV	• Automatic
Acceleration	7.3s (0-100 km/h)	Acceleration	7.6s (0-100 km/h)
Engine Power	238 hp	Engine power	197 hp
Electricity consumption	16.8 kWh/100km	Fuel consumption	6.7 L/100 km
Emissions CO2	0g/km	Emissions CO2	151g/km
Pure electricity driving range	569 km		

Average annual fuel prices: Diesel: 23.79 kr/L, Electricity: 2.54 kr/kWh
*For an average user

Option A (1)

Option B (2)

Neither (4) _____

End of Block: Experiment

Start of Block: Purchase Decision of a new car

Q7 What was your math score in the National Test in high school? If you did not take such a test, please indicate your average math grade in high school.

Less than 50th percentile (1)

Between 50th - 80th percentile (2)

Above 80th percentile (3)

Don't remember (4)

Not Applicable (5)

Q8 What was your total score in the National Test in high school? If you did not take such a test, please indicate your average grade in high school.

Less than 50th percentile (1)

Between 50th percentile- 80th percentile (2)

Above 80th percentile (3)

Don't remember (4)

Not Applicable (5)

Q9 Did you compute and compare total cost (sum of purchase and fuel cost over the expected lifetime of the vehicle) when making the decision to buy?

Yes (1)

No (2)

Q10 Rate the following factors in terms of their importance in determining your purchasing decision (1=not important, 2=somewhat important, 3=very important)

Design and apperance (1)	☆	☆	☆
Purchase Price (2)	☆	☆	☆
Fuel Economy (km/litre) (3)	☆	☆	☆
Engine Power (4)	☆	☆	☆
Brand (5)	☆	☆	☆
Environmental Friendly (6)	☆	☆	☆
Resale Value (11)	☆	☆	☆
The popularity of the model (among your friends and family) (12)	☆	☆	☆
Vehicle safety (15)	☆	☆	☆
Expense for fuel per year and over the lifetime	☆	☆	☆

(operating cost over the lifetime) (16)

Other factors (20)

End of Block: Purchase Decision of a new car

Start of Block: Fuel Economy Literacy

Q11 Suppose you buy a car for 300 000 kr. Your annual cost of fuel is 20 000 kr. You expect to use the car for 5 years (lifetime of the car). What would be the total cost over the lifetime of the car?

340 000 kr (1)

400 000 kr (2)

500 000 kr (3)

Don't know (4)

Q12 How did you reach your conclusion in the last question?

I did not understand the question (1)

I do not know how to do the calculation (2)

I chose randomly (3)

I calculated the total cost as the sum of purchase cost and the lifetime fuel cost (4)

Other reason (5) _____

Q13 What is this survey about?

Vehicle Choice (1)

Computer games (2)

How to save energy (3)

End of Block: Fuel Economy Literacy

C. Email

Dear students and faculties,

My name is Lanxi Ji. Currently, I am researching people's vehicle choices, as part of my master's thesis project in Economics here at Stockholm School of Economics. Therefore, I am inviting you to take a survey, which is fully anonymous and takes circa five (5) minutes to complete. By doing so, you will be part of a digital experiment. For every complete survey, I donate money to the Rädda Barnen (Save the Children International).

Link to the survey:[Link]

Your participation will be extremely helpful! A large sample is crucial to draw valid conclusions. For any queries, please e-mail me at 42125@student.hhs.se.

Many thanks!

Best regards,
Lanxi Ji

Data Protection: The survey is anonymous, and I will not store any contact information after completing this project. If you have any questions about how I handle data, send me an e-mail to 42125@student.hhs.se.

D. Full sample

Table 3. Comparison of means for full sample

Group	Control	Treatment
Proportion of choosing Electric Vehicle	0.802	0.764
	0.041	0.427
Proportion of choosing Electric Vehicle (full sample)	0.822	0.746
	(0.384)	(0.437)
Observations	129	130

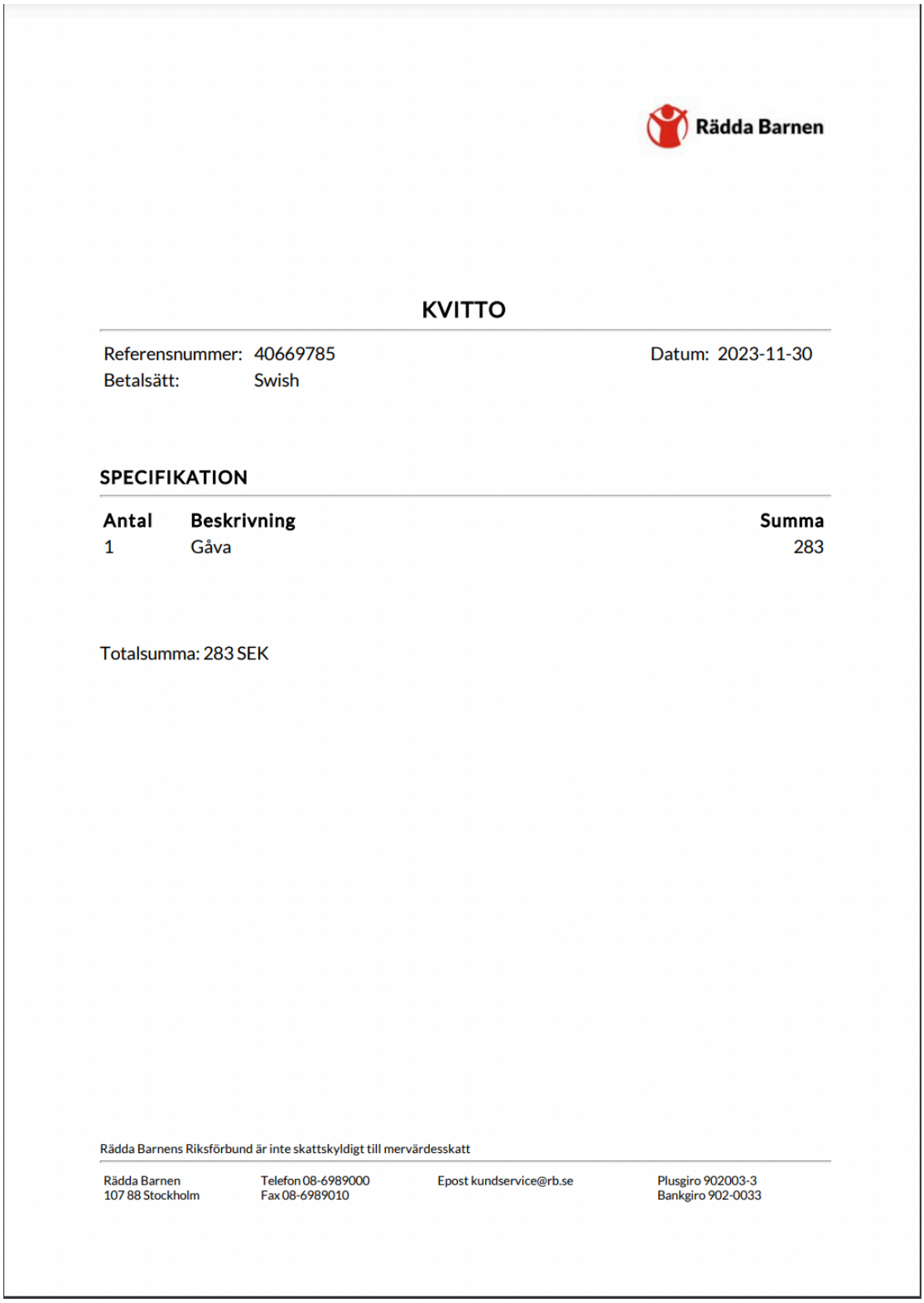
Note: Standard error in paratheses. *p<0.1, **p<0.05, ***p<0.01.

Table 4 Regression Model

Model column	
Treatment	-0.125
	(0.203)
Female	0.642***
	(0.229)
Constant	0.653
Observations	202

Note: Standard error in paratheses. *p<0.1, **p<0.05, ***p<0.01.

E. Donation



Rädda Barnen

KVITTO

Referensnummer: 40669785 Datum: 2023-11-30
Betalsätt: Swish

SPECIFIKATION

Antal	Beskrivning	Summa
1	Gåva	283

Totalsumma: 283 SEK

Rädda Barnens Riksförbund är inte skattskyldigt till mervärdesskatt

Rädda Barnen
107 88 Stockholm

Telefon 08-6989000
Fax 08-6989010

Epost kundservice@rb.se

Plusgiro 902003-3
Bankgiro 902-0033