**The Impact of Public Incentives for Electric Mobility:**

**A Multidimensional and International Analysis**

Graduation thesis towards the degree ‘Bachelor of Science’

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# List of abbreviations

Adj. MS Adjusted mean squares

Adj. SS Adjusted sums of squares

AC Alternating current

ANOVA Analysis of variance

BEV Battery electric vehicle

BDEW Bundesverband der Energie- und Wasserwirtschaft

(Eng. German Federal Association of the Energy and Water Industries

CI Confidence Interval

CO2 Carbon dioxide

DOE The U.S. department of energy

DF Degrees of freedom

EAFO European Alternative Fuels Observatory

EERE The U.S. Office of Energy Efficiency and Renewable Energy

EESI Environmental and Energy Study Institute

EPA The U.S. Environmental Protection Agency

EV Electric vehicle

EU European Union

Eurostat Statistical Office of the European Communities

FCEV Fuel cell electric vehicle

ICE Internal combustion engine

IEA International Energy Agency

IPCC Intergovernmental Panel on Climate Change

km Kilometer

kW Kilowatt

kWh Kilowatt-hour

HOV lane High-occupancy vehicle lane

n Number of observations

NOK Norwegian Krone

OLS regression Ordinary least squares regression

PHEV Plug-in hybrid electric vehicles

PWC PricewaterhouseCoopers

R-sq R-squared, or coefficient of determination

R-sq (adj) Adjusted R-squared

RE model Random effects model

RMB Renminbi (Chinese currency)

S Standard error of a regression

SE Standard error of a coefficient

TIS Technological Innovation System

UK United Kingdom

U.S. United States

USA United States of America

VAT Value Added Tax

VIF Variance Inflation Factor

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# Introduction

Global warming caused by greenhouse gas emissions has devastating consequences. According to the latest Intergovernmental Panel on Climate Change (IPCC) report, temperature increase must be kept to a maximum of 1.5C, because even 0.5C beyond would put millions of people under risks of drought, flood, extreme heat and food scarcity (Watts, 2018). The transport sector is responsible for about 23 % of global emissions, of which 60 % are produced by passenger traffic (IEA, 2017; Planete Energies, 2017). The shift to e-mobility was introduced by national governments as a main policy measure to decarbonize the transport sector and as an important step towards the Paris agreement. Consequently, over 1 million electric vehicles (EVs) were sold in 2017, with more than half of global sales in China (Bunsen et al., 2018). The total number of EVs on the road surpassed 3 million worldwide, an expansion of over 50% from 2016 (Bunsen et al., 2018). While the number of EVs is notably on the rise, only few countries had significant EV market share in 2017: Norway (39.2%), Iceland (11.7%) and Sweden (6.3%) (Bunsen et al., 2018). No wonder that e-mobility profitability barely reaches 3%–4%, as opposed to two-digit figures in other sectors, despite government support and falling battery prices (Donada & Attias, 2015).

By our study, we intend to investigate if government policy has an impact on the EV adoption rates. The aim of this paper is thus to study the relationship between the demand-side policy incentives and battery electric vehicle (BEV) market adoption. Section 2 reviews existing literature in order to identify other influencing factors and research gaps. It also states research questions, introduces hypotheses and explains why the study is novel. Section 3 explains what data was collected and why, gives a detailed description of the variables included and an overview of existing policy measures. It also describes the method used to analyze the research questions and hypotheses. Section 4 presents the statistical and descriptive analysis, including pairwise comparisons of the countries’ BEV market shares, model results, their interpretation and discussion. Section 5 outlines the limitations of this paper.

# Literature review

## Consumer-perceived disadvantages of electric vehicles

The research on the EV market adoption focuses on the consumer perspective identifying adoption behavior and demand-side barriers. Many studies in the period from 2006 to 2016 examined the disadvantages of EVs perceived by consumers from different countries. In Norway, the range, recharging time and price were emphasized, along with other concerns such as traffic safety, resale value, and functionality in winter (Assum, Kolbenstvedt, & Figenbaum, 2014; Figenbaum & Kolbenstvedt, 2013). In Germany, the barriers are related to the topics of costs, price, range, infrastructure, security of the technology, and practicability (Zaunbrecher, Beul-Leusmann, & Ziefle, 2015; Lieven, Mühlmeier, Henkel, & Waller, 2011). A europe-wide survey found out that the high purchase price is the main obstacle for the adoption of EVs, since respondents were not aware of the EVs’ lower operating costs (Bühne et al., 2015). Surveys from the U.S. and China showed that consumers do not prefer EVs over other alternatives, with issues in terms of price, operating cost, recharging, driving range, and acceleration time diminishing interest in EVs (Helveston et al., 2015; Carley, Krause, Lane, & Graham, 2013). Overall, the results prove that emerging electric drive technology still underperforms existing designs in such important aspects as price and performance. The battery as the most important and expensive component of an EV is a major barrier for a wide market uptake (Hidrue, Parsons, Kempton, & Gardner, 2011).

It is important to discuss driving range as a perceived barrier in more detail. In many studies, range turned out to be the most critical obstacle connected with a rather emotional dead battery problem (Cheron & Zins, 1997) or range anxiety (Franke & Krems, 2013; Gröger, Gasteiger, & Suchsland, 2015). However, research confirmed that the perceived required range is much higher than the one needed (Franke & Krems, 2013). Many studies show, that EVs, even with the limited range, still satisfy the everyday range needs of a sizeable share of the driving population, without recharging in the daytime (Spichartz, Dost, Becker, & Sourkounis, 2015; Pearre, Kempton, Guensler, & Elango, 2011). Furthermore, range preferences decrease with the EV use/experience (Franke & Krems, 2013). It seems like those who have experience with EVs are somewhat less concerned about the range (Figenbaum & Kolbenstvedt, 2013) and can estimate their range needs more accurately (Franke & Krems, 2013). This illustrates the importance of good information regarding features and experiences with EVs (Figenbaum & Kolbenstvedt, 2013).

Battery range, recharging time and cost/price are the biggest concerns, with European consumers prioritizing price, whereas Chinese and U.S. consumers focus more on range and recharging time (Bühne et al., 2015; Carley, Krause, Lane, & Graham, 2013; Egbue & Long, 2012; Figenbaum & Kolbenstvedt, 2013; Helveston et al., 2015; Hidrue, Parsons, Kempton, & Gardner, 2011; Lieven et al., 2011). Overall, sustainability benefits of EVs have less weight compared to EV cost and performance (Bühne et al., 2015; Egbue & Long, 2012).

In addition to the EV-specific performance characteristics, respondents emphasized other disadvantages of EVs that can be grouped as context-related. From the supply-side, a smaller variety of models was mentioned as an obstacle to buy an EV (Bühne et al., 2015). The lack of public fast-charging infrastructure was stressed as a major obstacle for the extensive application of EVs, especially for commuters or people without charging possibility at home and at work (Spichartz, Dost, Becker, & Sourkounis, 2015; Bühne et al., 2015; Helveston et al., 2015; Assum et al., 2014). Experiences from Norway also show that fast-charging stations appear to reduce range anxiety, even though most EV owners use them rarely (Assum et al., 2014; Haugneland & Hauge, 2015). Furthermore, the barrier of the slow recharge time can be overcome by the increased deployment of public fast-charging (Lutsey, 2015).

## Consumer-perceived advantages of electric vehicles

Many studies showed that consumers refer exclusively to environmental friendliness as an advantage of the EV purchase (Egbue & Long, 2012; Helveston et al., 2015; Skippon & Garwood, 2011; Zaunbrecher, Beul-Leusmann, & Ziefle, 2015). Interestingly, European consumers are rather skeptical about the EV environmental benefits (Bühne et al., 2015; Graham-Rowe et al., 2012) and not willing to pay a double price to have a car with zero emissions (Bühne et al., 2015). Consumers from the U.S. are more concerned about the enhancements in the fuel economy than environmental impacts (Carley et al., 2013) or, in contrast, about the ability to recharge an EV with green electricity (Axsen & Kurani, 2013).

Other perceived advantages resulted from the public financial incentives for EV buyers (Figenbaum & Kolbenstvedt, 2013; Krupa et al., 2014; Lane and Potter, 2007; Zhang et al., 2011; Bühne et al., 2015) that are seen to be particularly important at the early stage of technology diffusion (Eppstein, Grover, Marshall, & Rizzo, 2011; Hidrue et al., 2011; IEA, 2013). The research studied consumers’ perception of certain policy measures to promote EVs. Consumers showed high valuation of financial incentives such as tax rebates or government’s cash refunds on EV purchase in the USA, UK and EU (Ozaki and Sevastyanova, 2011; Krupa et al., 2014; Bühne et al., 2015) or value added tax (VAT) and purchase tax exemptions in Norway. These findings confirm that up-front price reduction is the most powerful incentive in promoting EV adoption (Bjerkan, Nørbech, & Nordtømme, 2016; Diamond, 2009; Haugneland & Hauge, 2015). To a substantial number of Norwegian BEV owners , however, exemption from road tolling or bus lane access is the only decisive factor (Langbroek, Franklin, & Susilo, 2016; Bjerkan et al., 2016; Haugneland & Hauge, 2015). The comprehensive global study by Lieven, 2015 showed that the installation of a charging network on freeways is an absolute necessity (Lieven, 2015). High cash grants were appreciated as attractive; however, combinations of lower grants with charging facilities resulted in similar preference shares in market simulations for each country (Lieven, 2015). The same is true for performance attributes that were found to be a more important indicator of EV adoption than financial incentives (Zhang, Wang, Hao, Fan, & Wei, 2013).

Other advantage of purchasing an EV is lower operational costs related to its higher fuel efficiency in comparison to internal combustion engine (ICE) cars (Caperello and Kurani, 2011; Graham-Rowe et al., 2012; Sovacool and Hirsh, 2009; Egbue and Long, 2012; Jensen et al., 2013; Lieven et al., 2011; Zhang et al., 2011). However, many studies show that consumers are not able to calculate and compare the operational costs of ICE and BEV cars (Caperello and Kurani, 2011; Sovacool and Hirsh, 2009; Lane and Potter, 2007; Turrentine and Kurani, 2007).

## Empirical research of the EV adoption

Empirical research using secondary data also studied the effect of policy incentives on EV adoption, and thus, cross-checked the results from the stated preference surveys. As expected, government tax/financial incentives and charging infrastructure are shown to positively influence the intention to adopt EVs (Krupa et al., 2014; Lane and Potter, 2007; Zhang et al., 2011; Sierzchula, Bakker, Maat, & Wee, 2014). In Norway, EV sales were found to be sensitive to exclusive access to bus lanes, and charging stations (Mersky, Sprei, Samaras, & Qian, 2016). The mentioned empirical research studied the cases of specific countries such as Norway, US or China; a few studies examined cross-country samples in their analysis. For example, Vergis, Turrentine, Fulton, & Fulton, 2014 tried to understand the drivers of the EV markets in seven countries applying a qualitative Technological Innovation System (TIS) approach.

Just one study (Sierzchula et al., 2014) was found that conducted a global empirical analysis of the factors identified in the stated preference surveys. However, this analysis lacks multidimensionality since it does not consider the EV-specific variables like driving range, price, variability in EV policy incentives depending on the country (i.e. in some countries, the amount of a government grant is calculated based on the EV driving range) and the variation in the extent to which charging infrastructure was rolled out. In addition, it is rather early to include socio-economic variables, since the market shares are still very small and generated by early adopters. The characteristics of early adopters are not representative of the population and cannot become good indicators of adoption levels when comparing countries. At the current stage of the EV diffusion, EV- and context-specific characteristics are more accurate factors for the estimation of the EV adoption rates.

In turn, numerous studies tried to model the process of EV diffusion with scenario techniques (BCG, 2011; Berhart, Kleimann & Hoffmann, 2011; Bharat Book, 2014; CARB, 2011; Dunne, 2013; Element Energy, 2013; ETS Insights, 2014; Greene et al., 2013, 2014 ; IEA, 2011; IEA, 2013b; Malins et al., 2015; McKinsey, 2014; Navigant, 2013, 2014; NRC, 2013). Studies that assumed greater technical advancement and higher policy support indicated that 20-50% EV market shares were possible in leading markets in 2025-2030. On the other hand, lower policy support and technical advancement would translate into still very low market shares of 5-10% in the same time horizon (Lutsey, 2015). These models aimed at predicting the long-term development of the EV market depending on the changes in technology and policies. However, it is questionable if these models can provide reliable results, given that at this stage electric drive technology and markets develop very fast. In 2025-2030, EVs will presumably have different specifications and prices, not comparable to current models.

## The aim of the paper, research questions, hypotheses and novelty

Having explored previous studies, we will concentrate on the following questions:

1. If and which countries are significantly different from others in terms of the BEV market shares?
2. What are the factors positively influencing adoption rates? Primarily the role of the government policy: if and which public incentives foster EV market penetration.
3. What are the factors negatively influencing adoption rates?

Based on these questions, the following hypotheses are introduced:

1. Null hypothesis: No relationship exists between government grant and BEV market share.

2. Alternative hypothesis: A relationship exists between government grant and BEV market share. The higher the government grant is, the higher BEV sales are.

As found out, there is little empirical analysis so far that would study this relationship, especially on a cross-country sample. Researchers only studied the effects of financial incentives and did not include other incentives that the preference surveys found influential. By our study, we want to correct for this deficiency and investigate all the incentives commonly provided by national governments. Another missing part in the current research is failure to consider fast-charging infrastructure roll-out, even though the surveys confirmed that this is one of the biggest barriers of the EV adoption. We also find it is important to conduct a multi-level international analysis, including country-specific and EV-specific predictors in our model. In our opinion, it is crucial to include actual EV prices for each EV model. On the other hand, it is unsound to include socio-economic variable in our model at this early stage of the EV market development. To measure consumer attention to EVs and study its impact on the EV adoption, we use the search popularity scores provided by Google Trends.

# Methodology

## Data collection

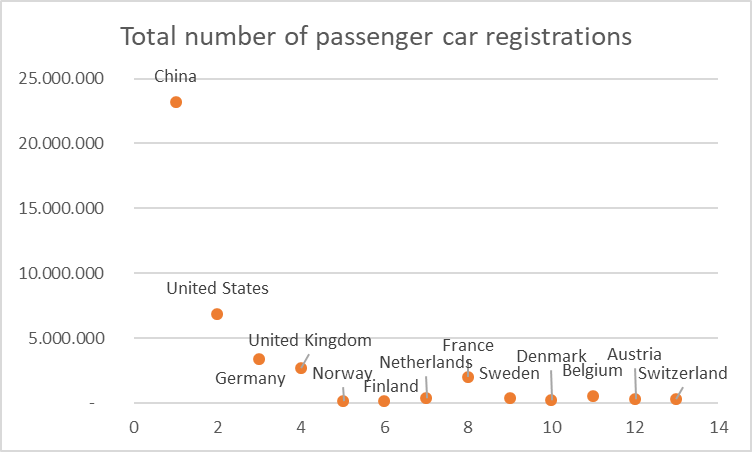
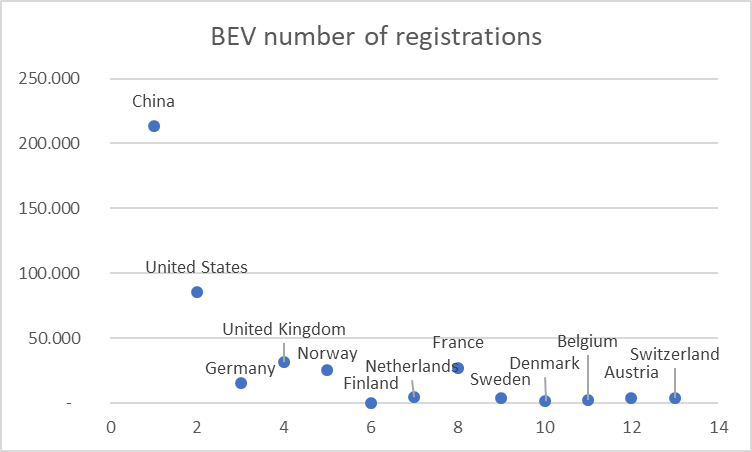
Cross-sectional data for BEV models in 17 countries in 2016 was collected and analyzed. By looking at the year 2016, we studied the status of EV policy measures after the Paris agreement and in many cases, before the announcements of the bans for ICE cars. Besides, in 2016 the number of EVs on the roads exceeded one million, which almost doubled during the last years (IEA, 2016). The front-runner countries were analyzed: China, the United States, France, Belgium, Germany, Denmark, Norway, the Netherlands, Austria, Switzerland, the United Kingdom, Finland, Sweden, Japan, South Korea, Canada, Iceland. Most of these countries have extensive incentive schemes to promote EV adoption; among them are countries which later introduced bans on fossil fuel vehicles.

Secondary data is used because the consumer attitude-action gap is seen as a serious barrier in using primary data. Purchase decisions may deviate from reported choices in a stated preference study (Helveston et al., 2015; Lane and Potter, 2007). With the EV market development, it becomes more feasible and important to focus on the actual adoption behavior and not merely on intentions (Zeinab Rezvani et al., 2015)

In our analysis, we focus on BEVs (and not Plug-in Hybrid Electric Vehicles (PHEVs)) at which government promotion policies are mostly directed. First, because they produce zero-emissions when driving. Secondly, unlike fuel cell electric vehicles (FCEVs), BEVs are not just a few concepts but a range of models that already actively sell on the market.

## Variables

Data was collected for the following variables identified in Section 2: number of BEV registrations, BEV price, driving range, number of charging stations, number of fast-charging stations, urban density, electricity prices, interest score, government grant, reduction (annual circulation tax), reduction (purchase tax), reduction (company car tax), VAT amount, high-occupancy vehicle (HOV)/bus lane access, number of BEV models available. Variable descriptions and their sources are provided in Table 1 (see Appendix 8.1).

EV market uptake is measured by the number of BEV registrations. Note: we use words ‘sales’ and ‘registrations’ interchangeably. As can be seen from Fig. 1.1 and 1.2, the snapshots of global BEV and passenger vehicle markets at the end of 2016, regardless of scale, seem identical or linearly related, suggesting that BEV sales do not have to be corrected for market sizes (checked formally in Section 3.1).

**Fig. 1.1 Number of BEV registrations (Pontes, 2016)[[1]](#footnote-1)**

**Fig. 1.2 Total number of passenger car registrations (ACEA, 2018b; Countryeconomy.com, 2016; Statista, 2017)**

## Public policies: overview

In most of the countries, fiscal incentives such as tax reductions or exemptions are provided to stimulate EV demand. The taxes involve both taxes at the point of sale or registration (purchase tax) and incurred at vehicle usage such as annual circulation tax or company car tax. Some countries exempt or reduce all three taxes: Austria, France, Belgium, Norway, the Netherlands, and France; some countries – exempt just one of them: Denmark, Germany, and UK or two of them: Finland, and Sweden. In addition, the financial incentive package in some countries is strengthened by the purchase grant (South Korea, Japan, Austria, France, Sweden, Germany) or by VAT exemption (Norway, Iceland) (remark: in Europe, valuable incentive, given high VAT rates). Moreover, such countries as Norway or China still extend their generous packages by providing non-financial incentives such as bus lane access, urban or highway toll exemption (Norway) or free access to a highway in a rush-hour, no license fee (China). In some countries, additional monetary benefit is provided, mostly for the installment of a wall charger (Denmark, United Kingdom). Both Switzerland and Canada do not provide any incentives on the federal level. The US government does provide an upfront bonus, but in a form of a tax discount. In Table 2 (see Appendix 8.1), we summarized all the existing EV promotion policies in 2016 worldwide.

## Method

The thorough study of the research questions would require controlling for both country-level and specific BEV-level factors. Therefore, the multilevel dataset was collected, with a natural hierarchy of observations at the car model level nested within a higher level - country. There are basically two approaches to analyze such a dataset: random effects (RE) model or a two-step approach (Bryan & Jenkins, 2016; Gelman, 2006; Wooldrige, Jeffrey, 2011). Both would quantify the extent to which differences in BEV sales are explained by the differences in the effects of country-specific variables. In other words, these models would isolate country effects from car model effects: the differences in BEV sales associated with differences in national policies/countries’ characteristics and car models respectively. However, to tell the differences between countries at least 25 countries are required for a linear model (Bryan and Jenkins 2016). As we only have 17 countries, we refrain from using a RE model and overfitting the data.

Instead, a multiple log-linear ordinary least squares (OLS) regression model was built incorporating the variables from Table 1 (see Appendix 8.1). The logarithmic transformation of the response variable is appropriate when dealing with a skewed distribution of the data (see Appendix 8.1, Graph 1.1 and 1.2). However, the Box-Cox transformation with a natural logarithm did not normalize the distribution of BEV registrations (see Appendix 8.1, Graph 1.3, 1.4 and 1.5). Still, we keep it because it helps to tackle its heteroscedasticity characteristic (see Appendix 8.1, Graph 1.6 and 1.7). Log-linear and log-log model were compared, with the former generating much higher R-squared (24.48 % against 3.12%). Moreover, a log-log model would exclude the countries that did not introduce government grant but some other policy measures. Furthermore, there was no evidence for the non-linearity of the regression function (see Appendix 8.1, Table 3) (Stock & Watson, 2015, pp 323-324). That is why we hold to the log-linear specification.

Besides the variable of interest, the base model includes the variables identified in the stated preference studies as important factors. We take the natural logarithm of these variables for two reasons: interpretation and because they produce a better R-squared, when regressed one by one (Stock & Watson, 2015, p.321). Overall, categorical variables, variables containing zeros and variables giving worse R-squared are not transformed.

The base model specification is given as: , where the subscript BEV denotes a specific-BEV-level variable; c stands for a country-level variable, and is an error term.

The extended model specification is given as:

To address the first research question, sample points for each country were taken to generate sub-samples. The means of those sub-samples were then compared with a one-way ANOVA procedure. We choose this procedure over multiple t-tests because it controls for Type I error. Since the assumption of the homogeneity of variance was violated, with p-value<0.05 (see Appendix 8.1, Table 4), the Welch and the Games-Howell post-hoc tests were run. For the purpose of a valid comparison, the sales of a specific BEV model were normalized for the market size, i.e. all passenger car registrations.

# Results and discussion

## Multiple pairwise comparisons

The boxplot and the interval plot of the market shares of specific BEV models across countries reveal that there must be a difference between Norway and the rest of the countries.

**Graph 2.1. Boxplot ‘Market share of a specific BEV’**

**Graph 2.2. Interval Plot ‘Market share of a specific BEV vs Country’**

Indeed, having run the Welch’s F-test, we reject the null hypothesis, with a p-value<0.05 (see Appendix 8.2, Table 5). In other words, there is some evidence that at least one of the countries is significantly different from others. However, the t-tests done with the Games-Howell post pairwise comparisons show that all countries’ means fall into the same group A (see Appendix 8.2, Table 6). P-values for pairwise comparisons with Norway are smaller than the p-values for comparisons with other countries, but not small enough to reject the null hypothesis.

The results from both the ANOVA and the Games-Howell tests are not comparable. The post tests are more powerful, since they focus on the individual differences between pairs of means, in contrast to the overall ANOVA. The conclusion follows that there are no country differences in terms of the market shares of specific BEV models. From the statistical point of view, the market shares of specific BEV models in Norway do not differ from the shares in other countries. However, Norway still has a substantially higher overall market share of 16,18% which leaves other countries far behind in terms of the EV adoption rates.

## Correlation analysis

With the means of Pearson’s correlation, the relationships between the variables are analyzed (see Appendix 8.2, Table 7). One of the patterns identified is that many of the EV-specific variables are correlated (especially, price and driving range show a strong correlation) which is not that surprising since driving range is a car-specific technical attribute which depends on the BEV’s battery capacity and therefore is directly connected with its price. Moreover, price and VAT Amount are strongly correlated since the latter is calculated as a percentage of the former. On the other hand, context-specific variables are correlated between each other as well (especially, we identify strong correlation between urban density and charging infrastructure, electricity prices and interest score, interest score and HOV/Bus lane access, HOV/Bus lane access and electricity prices). This information is useful when controlling for multicollinearity issues within the model. Another interesting observation was that the BEV sale price had a positive and very weak correlation with BEV sales, whereas government grant has a positive and relatively strong correlation with BEV sales. This suggests that not the price alone, but rather overall costs might be correlated with the sales. In addition, if people decide to buy an EV, they would rather buy a car with good technical characteristics, due to the range anxiety, or as a status symbol (which was confirmed by the stated preference studies). These conclusions are not necessarily complete but can still be considered during model specification.

## OLS model results and sensitivity tests

We summarized the results of four model specifications in Table 8 (see Appendix 8.3). For the step 4, or model specification 4, we used the technique of backward elimination of terms which still yielded the same significant factors. The significance of these factors stayed stable over all model specifications (see Step 1-5). We ensured that final model specification did not violate the OLS assumptions such as homoscedasticity, multivariate normality and independence of errors and lack of multicollinearity (see Graphs 2.1, 2.2 ,3.1, and 3.2 in Appendix 8.3). Thanks to the logarithmic transformation of the response variable, we tackled the skewness in our data and the underlying heteroscedasticity. Homoscedasticity was checked with the plot ‘Residuals against predicted values’ demonstrating randomness, i.e. no pattern in residuals. The same was observed for the plot ‘Residuals against order’ used to check for the independence of errors. A normal probability plot together with the formal Anderson-Darling tests confirmed that residuals are normally distributed, with no violation of multivariate normality assumption. The lack of multicollinearity was checked with the Variance Inflation Factor (VIF) number which stayed under the critical value of 4 and was between 1 and 2.5 for all the significant independent variables (see Appendix 8.3, Table 8 and 10, Step 5). Deleted residual values were used to identify outliers in our dataset and improve the model performance.

The final model’s adjusted R-squared was 58.66 % which means that almost 60% of the variation in the BEV sales in our sample countries was explained by the statistically significant variables, i.e. government grant, driving range, charging stations and HOV/Bus lane access. The coefficients of these variables were not equal to zero, with p-values of 0.003, 0.000, 0.000 and 0.000 respectively. Moreover, the sign of β coefficient for ‘government grant’- the variable of interest - is positive (See Appendix 8.3, Table 8). Thus, with this model specification we reject the null hypothesis at 1% significance level: There is strong evidence to support the claim of a positive relationship between government grant and BEV sales. ‘Government grant’ showed a beta of 0.000074 meaning that 1$ increase in government grant value, ceteris paribus, is associated with 0.0074% increase in BEV sales. For instance, a country with a reported 5,000 BEV registrations would have 370 more BEV registrations if a 1,000$ increase in subsidies were introduced. In terms of driving range and charging stations, 1% increase in driving range of a BEV, ceteris paribus, would cause its sales to increase almost at the same rate of 1.013%, whereas a 1% increase in the number of charging stations would lead to a 0.5631% increase in sales. Comparing government grant and a HOV/Bus lane access, the latter has a greater impact on stimulating BEV sales, with an increase of 7.4% and 272% () respectively. In other words, providing bus lane access is much more effective than increasing government grant by 1,000$. The other question is if these measures and their cost for the country’s budget can actually be compared. Interestingly, other policy measures such as annual or purchase tax reductions did not show significant coefficients, with even wrong coefficient signs, probably because they are weakly correlated with the response variable.

Besides the final estimates of significant coefficients (Step 5), Table 8 provides information about the sensitivity of these estimates and the model robustness through Step 1-4. Step 1 presents the base specification, in which the regressors are the government grant and other influencing factors such as driving range, charging stations and price. All the coefficients are significant, with 53.78% R-squared and 52.88% adjusted R-squared. Steps 2-3 present alternative specifications that examine the effect of the inclusion of other policy measures (Step 2: VAT amount, Reductions, HOV/Bus lane access) and other context-level factors that were also identified as influencing EV adoption (Step 3: urban density, electricity price, BEV models available, interest score). Already at Step 2, the coefficient of price loses its significance, whereas HOV/Bus lane access emerges as a significant factor. Note that both R-squared and adjusted R-squared of Specification 2 are higher than that of Specification 1, with 59.94% and 58.15% respectively. This means that a HOV/Bus lane access is an important influencing factor. On the other hand, the difference between the R-squared of Specification 3 and 2 is negligible (60.07% and 59.94% respectively), with a decreasing adjusted R-squared, suggesting that adding new variables in Step 3 does not improve the model. In Step 4, price, urban density, and both interest score and electricity price were excluded, due to multicollinearity with VAT amount, charging stations and HOV/Bus lane access respectively. Note that the standard errors of the coefficients for correlating variables decreased substantially, e.g. that of HOV/Bus lane access dropped from 0.433 to 0.287 (see Table 8). In Step 5, the final estimates of significant coefficients were calculated. We notice that the estimates of coefficients are numerically similar across different specifications suggesting that they are reliably measured. The adjusted R-squared of Specification 4 (58.21%) and 5 (57.86%) are also approximately the same, showing that insignificant variables do not contribute much to the explanatory power of the model. Furthermore, the influence of the individual significant variables was analyzed. From the analysis summary in Table 9 it can be concluded that ch stations is a much stronger factor in explaining BEV sales than government grant, whereas HOV/Bus lane access and driving range are almost equally influential.

To study the influence of the layout of charging stations, we substituted the variable representing overall charging infrastructure in a country (‘charging stations’) with the more precise variable representing only fast-charging stations (‘fast-charging stations’). The results of new specifications (Step 1 – Step 5) were summarized in Table 10 (see Appendix 8.3). Comparing the goodness-of-fit measures of the specifications with ‘charging stations’ and ‘fast-charging stations’, we see that base models (Step 1) have almost the same R-squared (53.78% and 53.93%). But in the model with ‘fast-charging stations’ both government grant and price become insignificant. We exclude price already at Step 2, to avoid the multicollinearity with ‘VAT amount’, and include ‘VAT Amount’, tax reductions, and ‘HOV/Bus lane access’. Through Step 3-5, we notice that the explanatory power of the model specification with ‘fast-charging stations’ is higher than the one with ‘charging stations’ variable (61.97% and 60.07%; 61.55% and 60.00%, 60.85% and 58.66% respectively). Table 11 presents how the model’s explanatory power is sensitive to deleting the significant variables individually. As in the previous model, charging infrastructure, namely fast-charging stations is the strongest predictor of BEV sales. Driving range is as influential as before, whereas the effect of HOV/Bus lane access is now much reduced. Instead, other factors become significant and contribute to the model’s ability to explain BEV sales, such as urban density, reduction (company car tax), BEV models available and VAT Amount.

From Table 10, we re-estimate the influence of charging infrastructure and other factors on BEV sales. Each 1% increase in driving range, ceteris paribus, would cause sales to increase by 1.337 %, i.e. 0.324% more than in the previous specification, whereas the estimate for HOV/Bus lane access not unexpectedly decreased. In this model, providing a HOV/Bus lane access would mean a 111% increase in sales instead of 272% which seems to be more plausible. Fast-charging stations have a little more impact on sales than charging stations, with 0.5939% and 0.5631% respectively. The rest of the variables would cause the following changes, ceteris paribus: a 1% reduction in the company car tax – a 0.758% increase in sales; introduction of a new BEV model to the market – a 5.8% increase in sales; a 100$ increase in VAT amount due is associated with a 0.55 % decrease in sales.

Overall, the introduction of the fast-charging stations layout tremendously affected results, so that the null hypothesis could not be rejected anymore, neither at 1 nor at 5 or 10% significance level: In other words, there is no evidence to support the claim of a positive relationship between government grant and BEV registrations, given that the influence of fast-charging infrastructure is considered. This sensitivity test confirmed the conclusion that charging infrastructure has a significantly stronger effect on BEV sales than government grant. Furthermore, the availability of fast-charging stations is crucial in predicting BEV adoption. This result is in line with the results obtained by Sierzchula et al., 2014. In this study, charging infrastructure was found out to be a better predictor of EV adoption rates than financial incentives. Our model goes further and shows that the type of charging infrastructure roll-out plays an important role.

Within the scope of this paper, these empirical results shed light on the research questions examined. Countries’ BEV market shares in the sample did not reveal statistically significant differences, even though the overall BEV market share in Norway (as a single value) was dramatically higher, in comparison to other counties. As to research questions 2 and 3, we found out that across the countries fast-charging stations, driving range, urban density, reduction in company car tax, HOV/Bus lane access, and BEV model availability positively influence adoption rates, whereas VAT amount was identified as a negative factor. In other words, both BEV-level and country-level factors affect the BEV market penetration, with fast-charging infrastructure having the highest explanatory power. Unexpectedly, government grant was not found to contribute to the increasing adoption rates when the effect of fast-charging stations was considered. Instead, other public incentives came into play such as reduction in company car tax and VAT amount, with HOV/Bus lane access staying significant. The obtained results show the importance of examining multidimensional factors on an international sample when studying the influence of public policy on the BEV market adoption. Indeed, paying attention to the variability in policy incentives and charging infrastructure roll-out allowed us to look further into the matter. Our findings are confirmed by the stated preference studies which identified fast-charging stations and driving range as by far the most important factors influencing EV purchase decision, along with the model’s availability that was also mentioned. Public incentives including both financial incentives and such special privileges as HOV/Bus lane access were also viewed by respondents as advantages of BEVs over ICEs.

## Descriptive analysis of the significant variables

However, the descriptive analysis of the significant factors shows that we cannot infer the same relationships for all the countries and confirm that the underlying dynamics behind the statistically identical BEV market shares are not the same. A high level of variation in the cross-country sample suggests that there are other country-specific influencing factors that were not included in the model. For instance, both Norway and Netherlands have the highest number of charging stations per million residents, but only Norway demonstrated the highest BEV uptake (see Fig. 2). However, this seeming discrepancy disappears, once the next graph is examined. Norway presents not only the highest density (proportion) of charging stations, but also of fast-charging stations, whereas the Netherlands shows by far the lowest ratio (see Fig. 3). In other countries, the revealed relationship also holds. Namely, the comparably low ratio of fast-charging stations may be related to the low market shares. However, higher ratio is not automatically associated with higher BEV market shares, as confirmed by the cases of Japan, Sweden, Denmark and especially Iceland.

**Fig. 2. Public charging infrastructure and respective BEV market share by country (see Appendix 8.1, Table 1; Pontes, 2016**; **ACEA, 2018b; Countryeconomy.com, 2016; Statista, 2017)**

**Fig. 3. Public fast-charging infrastructure and respective BEV market share by country (see Appendix 8.1, Table 1; Countryeconomy.com, 2016; Statista, 2017)**

The same mixed effects are observed when comparing availability of other policy measurers and BEV sales. Switzerland does not offer any public incentives but has the BEV sales almost as high as in Austria which offers a generous incentives package (see Fig. 4 and 5). Another example is the U.K: and France: BEV market uptake there is approximately the same, whereas France offers clearly larger incentives package than the UK. Note that we normalize (fast) charging stations for population and BEV sales for market sizes to make countries comparable and analyze the relationship between these variables.

**Fig. 4. Government grant and respective BEV market share by country (see Appendix 8.1, Table 1; Pontes, 2016**; **ACEA, 2018b; Countryeconomy.com, 2016; Statista, 2017)**

**Fig. 5. Breakdown of tax incentives by country (see Appendix 8.1, Table 1)**

Model availability was also confirmed to be a significant factor, with Chinese and European markets having a higher model assortment than Japanese, South Korean or American markets. This can be explained by the distribution of car production facilities. Markets are mostly dominated by the models produced by the local manufacturers, with Chinese and European producers outperforming American or Japanese/South Korean ones. Important to note that some models were only available in a certain market, such as the Fiat 300e for the US-American market, the Kia Ray EV for the South Korean one or the Mitsubishi Minicab MiEV in Japan. The reallocation of production facilities to China by foreign car manufacturers also contributed to the higher uptake of the Chinese BEV market, amplified by the concentration of the global EV battery production in China. Thus, this factor also reinforced the observation about the heterogeneity of the EV markets. Some markets (like South Korean or Japanese) with relatively high consumer incentives appear not to have much EV uptake, with one plausible explanation being that these markets are not among the early focus areas for carmaker launches of new models, or that local carmakers do not introduce many BEV models to the market (Lutsey, 2015).

Besides the general differences between the analyzed countries, some countries deserve special attention. For instance, Norway as the best case of how the focus of public incentives on early adopters and niche markets can make BEV policies effective (Green, Skerlos, & Winebrake, 2014; Figenbaum & Kolbenstvedt, 2015). The economic incentives reducing BEV user cost (exemption from on average 25% purchase tax and 25% VAT) combined with incentives not available to users of other types of vehicles created niches - the bus-lane access and toll-road user niches (Assum et al., 2014; Bühne et al., 2015). Large incentives together with exogenous factors such as cheap electricity and thus widespread use of electric power by households resulted in the EV-favorable landscape. Overall, high pressure from the landscape and weak ICE regime (no local car production) led to the EV diffusion following a “technological substitution path” (Figenbaum & Kolbenstvedt, 2015). In contrary, the international EV diffusion seems to be on a transformation path where moderate pressure on the ICE regime is leading to a gradual establishment of an EV regime (Figenbaum & Kolbenstvedt, 2015). For example, Japan where the government attempts to artificially create niche markets were unsuccessful (Åhman, 2006) because of the strong ICE regime within the country. Iceland as the second after Norway in the EV European market could also be studied separately. There, BEV sales development is rather flat, instead, a dramatic increase in the PHEV sales is observed over last years. Thus, we assume that there might be a causal relationship between high PHEV sales and the prices of conventional automotive fuels which are among the highest worldwide in Iceland (Wappelhorst & Tietge, 2018). The strong positive correlation between the two was also confirmed by Diamond, 2009. Another case is China where in some municipalities license plate fees can cost as much as a car itself. Therefore, the exemption of EVs from the bidding procedure and related license registration tax puts EV buyers in a much more advantageous position. In contrast, in the US the federal bonus only applies to the outstanding tax debt which a person might or might not have.

# Limitations

There are several limitations in our models which were caused by the data availability and could potentially produce inaccurate results. We attempted to estimate the effect of national policies in driving EV adoption, but not on the local level. Furthermore, we did not try to monetize tax incentives. Prices may also vary for the same BEV model depending on the concrete specifications, dealer discounts or financing conditions. Besides, we did not account for the actual distribution in charging infrastructure and regional/temporal fluctuations in electricity price. Another limitation of our analysis is that supply-side constraints were not considered, even though previous research showed that waiting lists might be a relevant issue influencing demand (Keith, 2012). Therefore, we assume that the model has limitations regarding scope, sample size and misspecification. In respect of backward elimination, it was only used to check the significance of the variables found during the model specification process, respectively recalculate their coefficients, and not as a tool for specifying the final model. We are aware that this procedure is criticized as being an inadequate substitute for expert judgement (Flom & Cassell, 2009; Sainani, 2013).

Moreover, the presented model does not estimate the country-level effects on the adoption rates. The descriptive analysis of the data confirmed that there must be country-specific factors influencing BEV sales. We only focused on the factors that the countries share between each other. Still, they are also unique in some underlying dynamics and landscape. This observation is confirmed by the case of Norway, whose unique policy mix and country characteristics (i.e. cheap electricity from hydroelectric power, high urbanization) led to the highest BEV market share worldwide. In addition, our study does not guarantee the casual relationship between the influencing factors and the BEV sales which would require time series data.

For further research, we suggest conducting a multilevel analysis on a larger cross-country sample over time. Such an analysis might give valuable insights in terms of variability in effectiveness of different policy measures in different countries and identify the optimal mix of incentive measures for each specific country. However, as some authors rightly emphasize, the consumer purchasing incentives shall be reduced over time. The problem of phasing out the incentives while sustaining the market growth might be another question that future research could address.

# Conclusion

The aim of this paper was to explore the relationship between the demand-side policy incentives to BEV market adoption in a cross-country sample. Previous research suggested both financial incentives and charging infrastructure improvements as potential sensible policy approaches to promote BEV adoption. However, further investigation showed that the installation of fast-charging stations would have a greater effect on BEV market uptake. Moreover, the stated preference studies also stressed that the lack of fast-charging infrastructure is a main obstacle for the extensive application of EVs. To address this barrier, national fast-charging strategies must be defined, including a roll-out rate and distribution density. HOV/Bus lane access, reduction (company car tax), decrease in VAT amount, model availability and driving range were also found to be positive and significant in predicting EV adoption rates for our sample countries.

The cause-effect relationship between the identified variables and the response variable is not guaranteed though. As the cross-country descriptive analysis revealed, higher availability of fast-charging infrastructure does not necessarily mean higher BEV market uptake. Therefore, there must be some country-specific factors or rather a combination of factors that positively influence BEV sales. Good example is Norway, with the highest market share of BEVs worldwide in 2016. Not the highest ratio of fast-charging stations per million residents alone, but rather the combination of policy measurers led to the high BEV market uptake. Norway’s policy mix is targeted at the development of market niches, utilizing the country’s ideal prerequisites for electromobility such as the weak ICE regime, small country size, low energy prices, and high urbanization. For other countries, it is not possible to copy the prerequisites, but it is possible to transfer the policies proved to be effective in the cross-country sample, specifically, the expansion of fast-charging infrastructure. However, it should be clearly pointed out that each country must develop a policy mix of their own. Such a mix would include not only an increase in levels of fast-charging infrastructure, but other measures such as HOV/Bus lane access depending on the country-specific prerequisites for e-mobility and market niches. In addition, this customized policy mix should be reinforced by marketing campaigns to increase customer awareness and knowledge. Moreover, important are supply-side policies to overcome limited model availability and performance limitations. If the BEV adoption rates are influenced by model availability and not by consumer demand, the implementation of the demand-side policy measurers will not be effective.

# List of References

ACEA. (2017a). Interactive map: Electric vehicle incentives per country in Europe. Retrieved October 15, 2018, from https://www.acea.be/statistics/article/interactive-map-electric-vehicle-incentives-per-country-in-europe

ACEA. (2017b). Overview on tax incentives for electric vehicles in the EU. Retrieved October 15, 2018, from https://www.acea.be/uploads/publications/EV\_incentives\_overview\_2017.pdf

ACEA. (2018a). ACEA tax guide. Retrieved from https://www.acea.be/publications/article/acea-tax-guide

ACEA. (2018b). Consolidated Registrations - By Country. Retrieved October 15, 2018, from https://www.acea.be/statistics/tag/category/by-country-registrations

Åhman, M. (2006). Government policy and the development of electric vehicles in Japan. *Energy Policy*, *34*(4), 433–443. http://doi.org/10.1016/j.enpol.2004.06.011

Assum, T., Kolbenstvedt, M., & Figenbaum, E. (2014). *The future of electromobility in Norway – some stakeholder perspectives*. Oslo.

Axsen, J., & Kurani, K. S. (2013). Connecting plug-in vehicles with green electricity through consumer demand. *Environmental Research Letters*, *8*(1), 11. http://doi.org/10.1088/1748-9326/8/1/014045

BDEW. (2017). Schon 10.700 Ladepunkte in Deutschland [Already 10,700 charging stations in Germany]. Retrieved from https://www.bdew.de/presse/presseinformationen/schon10700-ladepunkte-deutschland/

Berggreen, J. (2018). It Would Be Virtually Cost Neutral To Lower The Car Taxes In Denmark To Below Current Madness. Retrieved October 15, 2018, from https://cleantechnica.com/2018/04/25/it-would-be-virtually-cost-neutral-to-lower-the-car-taxes-in-denmark-to-below-current-madness/

Bjerkan, K. Y., Nørbech, T. E., & Nordtømme, M. E. (2016). Incentives for promoting Battery Electric Vehicle (BEV) adoption in Norway. *Transportation Research Part D: Transport and Environment*, *43*, 169–180. http://doi.org/10.1016/j.trd.2015.12.002

BMW Group Austria. (2016). Der BMW i3 Preisliste.

Book, K. B. (2016). Kelley Blue Book. Retrieved October 15, 2018, from https://www.kbb.com/bmw/i3/2016/

Bryan, M. L., & Jenkins, S. P. (2016). Multilevel modelling of country effects: A cautionary tale. *European Sociological Review*, *32*(1), 3–22. http://doi.org/10.1093/esr/jcv059

Bühne, J. A., Gruschwitz, D., Hölscher, J., Klötzke, M., Kugler, U., & Schimeczek, C. (2015). How to promote electromobility for European car drivers? Obstacles to overcome for a broad market penetration. *European Transport Research Review*, *7*(3). http://doi.org/10.1007/s12544-015-0178-0

Bunsen, T., Cazzola, P., Gorner, M., Paoli, L., Scheffer, S., Schuitmaker, R., … Teter, J. (2018). *Global EV Outlook 2018. Towards cross-modal electrification*. Retrieved from https://webstore.iea.org/download/direct/1045?filename=globalevoutlook2018.pdf

Carley, S., Krause, R. M., Lane, B. W., & Graham, J. D. (2013). Intent to purchase a plug-in electric vehicle: A survey of early impressions in large US cites. *Transportation Research Part D: Transport and Environment*, *18*(1), 39–45. http://doi.org/10.1016/j.trd.2012.09.007

Chargemap. (2018). No Title. Retrieved October 15, 2018, from https://chargemap.com/map

Countryeconomy.com. (2016). United States - New motor vehicle registrations. Retrieved October 15, 2018, from https://countryeconomy.com/business/car-registrations/usa?year=2016

Department for Transport, & Driver and Vehicle Licensing Agency. (2016). Vehicle licensing statistics: 2016. Retrieved October 15, 2018, from https://www.gov.uk/government/statistics/vehicle-licensing-statistics-2016

Diamond, D. (2009). The impact of government incentives for hybrid-electric vehicles: Evidence from US states. *Energy Policy*, *37*(3), 972–983. http://doi.org/10.1016/j.enpol.2008.09.094

Donada, C., & Attias, D. (2015). Food for thought: which organisation and ecosystem governance to boost radical innovation in the electromobility 2.0 industry? *Int. J. Automotive Technology and Management J. Automotive Technology and Management*, *15*(2), 105–125. http://doi.org/10.1504/IJATM.2015.068545

EAFO. (2018a). No Title. Retrieved October 15, 2018, from http://www.eafo.eu/electric-vehicle-charging-infrastructure

EAFO. (2018b). No Title. Retrieved October 15, 2018, from https://www.eafo.eu/countries/

EERE. (2016). Find EV Models. Retrieved October 15, 2018, from https://www.energy.gov/eere/electricvehicles/find-electric-vehicle-models

EERE. (2018). Electric Vehicle Charging Station Locations. Retrieved October 15, 2018, from https://afdc.energy.gov/fuels/electricity\_locations.html#/find/nearest?fuel=ELEC

EESI. (2018). Comparing U.S. and Chinese Electric Vehicle Policies. Retrieved October 15, 2018, from https://www.eesi.org/articles/view/comparing-u.s.-and-chinese-electric-vehicle-policies

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy*, *48*(2012), 717–729. http://doi.org/10.1016/j.enpol.2012.06.009

Eppstein, M. J., Grover, D. K., Marshall, J. S., & Rizzo, D. M. (2011). An agent-based model to study market penetration of plug-in hybrid electric vehicles. *Energy Policy*, *39*, 3789–3802. http://doi.org/10.1016/j.enpol.2011.04.007

Eurostat. (2018). Electricity prices by type of user. Retrieved October 15, 2018, from https://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=ten00117

Figenbaum, E., & Kolbenstvedt, M. (2013). *Electromobility in Norway -experiences and opportunities with Electric vehicles*. Oslo.

Figenbaum, E., & Kolbenstvedt, M. (2015). *Pathways to electromobility-perspectives based on Norwegian experiences*. Oslo.

Flom, P. L., & Cassell, D. L. (2009). Stopping stepwise : Why stepwise and similar selection methods are bad , and what you should use. http://doi.org/10.1.1.110.8353

Gelman, A. (2006). Multilevel (hierarchical) modeling: What It can and cannot do. *Technometrics*, *48*(3), 432–435. http://doi.org/10.1198/004017005000000661

Gomoll, W. (2016). BMW i3 94Ah: Stärkere Akkus und mehr Reichweite [BMW i3 94Ah: Stronger batteries and more range]. *Autorevie.At*. Retrieved from https://autorevue.at/autowelt/bmw-i3-94ah-reichweite

Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R., & Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. *Transportation Research Part A: Policy and Practice*, *46*(1), 140–153. http://doi.org/10.1016/j.tra.2011.09.008

Green, E. H., Skerlos, S. J., & Winebrake, J. J. (2014). Increasing electric vehicle policy efficiency and effectiveness by reducing mainstream market bias. *Energy Policy*, *65*, 562–566. http://doi.org/10.1016/j.enpol.2013.10.024

Helveston, J. P., Liu, Y., Feit, E. M. D., Fuchs, E., Klampfl, E., & Michalek, J. J. (2015). Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the U.S. and China. *Transportation Research Part A: Policy and Practice*, *73*, 96–112. http://doi.org/10.1016/j.tra.2015.01.002

Hidrue, M. K., Parsons, G. R., Kempton, W., & Gardner, M. P. (2011). Willingness to pay for electric vehicles and their attributes. *Resource and Energy Economics*, *33*(3), 686–705. http://doi.org/10.1016/j.reseneeco.2011.02.002

Hiltscher, B. (2017). Ab 36.150 Euro mehr Strecke im i3 [i3 with more driving range from 36,150 euros]. *Autozeitung.De*. Retrieved from https://www.autozeitung.de/bmw-i3-2016-update-127746.html#

ICCT. (2014). Overview of vehicle taxation schemes (including incentives for electric vehicles). Retrieved October 15, 2018, from https://www.cesifo-group.de/ifoHome/facts/DICE/Infrastructure/Transportation/General-Transport-Policy/overview-vehicle-taxation-scheme/fileBinary/Overview-vehicle-taxation-schemes.pdf

IEA. (2013). *Global EV Outlook: Understanding the Electric Vehicle Landscape to 2020*. *IEA publications*. Paris.

IEA. (2017). *Energy Technology Perspectives 2017*. *Technology*.

Kane, M. (2017). Denmark Plug-In Vehicles Sales Tank As Subsidies Vanish. Retrieved October 15, 2018, from https://insideevs.com/denmark-electric-car-sales-tank-as-subsidies-vanish/

Keith, D. R. (2012). *Essays on the Dynamics of Alternative Fuel Vehicle Adoption: Insights from the Market for Hybrid-Electric Vehicles in the United States*. *ProQuest Dissertations and Theses*. Massachusetts Institute of Technology.

Kim, S., & Yang, Z. (2016). Promoting electric vehicles in Korea. Retrieved October 15, 2018, from https://www.theicct.org/blogs/staff/promoting-electric-vehicles-in-korea

Korsvoll, R. (2016). Dette er Norges billigste biler [These are Norway’s cheapest cars]. *Motor.No*. Retrieved from https://www.motor.no/artikler/2016/mai/slik-sparer-du-30.000-i-bilregnskapet/

Kroese, B. (2017, September). BMW plakt prijskaartjes op vernieuwde i3 [BMW puts price tags on renewed i3]. *Autokopen.Nl*. Retrieved from https://www.autokopen.nl/autonieuws/2017/september/43624-bmw-plakt-prijskaartjes-op-vernieuwde-i3

Lieven, T. (2015). Policy measures to promote electric mobility - A global perspective. *Transportation Research Part A: Policy and Practice*, *82*, 78–93. http://doi.org/10.1016/j.tra.2015.09.008

Lieven, T., Mühlmeier, S., Henkel, S., & Waller, J. F. (2011). Who will buy electric cars? An empirical study in Germany. *Transportation Research Part D: Transport and Environment*, *16*(3), 236–243. http://doi.org/10.1016/j.trd.2010.12.001

Lutsey, N. (2015). *Transition to a global zero-emission vehicle fleet: a collaborative agenda for governments*. *The International Council on Clean Transportation*. Washington.

Mersky, A. C., Sprei, F., Samaras, C., & Qian, Z. S. (2016). Effectiveness of incentives on electric vehicle adoption in Norway. *Transportation Research Part D: Transport and Environment*, *46*, 56–68. http://doi.org/10.1016/j.trd.2016.03.011

Ministry of Economy Trade and Industry. (2018). クリーンエネルギー自動車等導入促進対策費補助金 [Subsidies to promote clean energy]. Retrieved October 15, 2018, from http://www.meti.go.jp/policy/automobile/evphv/information/system.html

Planete Energies. (2017). *Sustainable mobility*. Retrieved from https://www.planete-energies.com/en/medias/close/global-transportation-sector-co2-emissions-rise

Pod point. (2018). Company Electric Car Tax. Retrieved from https://pod-point.com/landing-pages/company-electric-car-tax

Pontes, J. (2016). EV Sales. Retrieved October 15, 2018, from http://ev-sales.blogspot.com/2016/

Pressman, M. (2017). Electric Car Incentives In Norway, UK, France, Germany, Netherlands, & Belgium. Retrieved October 15, 2018, from https://cleantechnica.com/2017/09/02/electric-car-incentives-norway-uk-france-germany-netherlands-belgium/

PWC. (2015). 2015 Global Automotive Tax Guide. Retrieved October 15, 2018, from https://www.pwc.com/gx/en/automotive/pdf/pwc-global-automotive-tax-guide-2015.pdf

PWC. (2017). Company car benefit in kind calculation. Retrieved October 15, 2018, from https://news.pwc.be/company-car-benefit-in-kind-calculation/

Sainani, K. L. (2013). Multivariate Regression: The Pitfalls of Automated Variable Selection. *PM and R*, *5*, 791–794. http://doi.org/10.1016/j.pmrj.2013.07.007

Sierzchula, W., Bakker, S., Maat, K., & Wee, B. Van. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy*, *68*, 183–194. http://doi.org/10.1016/j.enpol.2014.01.043

Skippon, S., & Garwood, M. (2011). Responses to battery electric vehicles: UK consumer attitudes and attributions of symbolic meaning following direct experience to reduce psychological distance. *Transportation Research Part D: Transport and Environment*, *16*(7), 525–531. http://doi.org/10.1016/j.trd.2011.05.005

Statista. (2017). Number of new vehicle registrations in China from 2007 to 2017 (in millions). Retrieved October 15, 2018, from https://www.statista.com/statistics/278436/new-vehicle-registration-in-china/

Statista. (2018a). Estimated number of electric vehicle charging stations in South Korea from 2016 to 2020. Retrieved October 15, 2018, from https://www.statista.com/statistics/813542/south-korea-estimated-electric-vehicle-charging-station-number/

Statista. (2018b). Number of publicly available fast electric vehicle chargers (EVSE) in Canada from 2012 to 2017 (in units). Retrieved October 15, 2018, from https://www.statista.com/statistics/572022/number-of-publicly-available-fast-electric-vehicle-chargers-in-canada/

Stock, J. H., & Watson, M. M. (2015). *Introduction to Econometrics*. *Pearson* (3rd editio). Harlow: Pearson Eduaction Limited. http://doi.org/10.2307/2552778

The mobility house. (2018). All relevant charging cable and plug types. Retrieved October 15, 2018, from https://www.mobilityhouse.com/int\_en/knowledge-center/charging-cable-and-plug-types

The world bank. (2018). Urban population. Retrieved October 15, 2018, from https://databank.worldbank.org/data/reports.aspx?source=2&series=SP.URB.TOTL

Torregrossa, M. (2017, November). Nouvelles BMW i3 & i3s : prix, finitions et équipements en France [New BMW i3 & i3s: price, finishes and amenities in France]. *Automobile-Propre.Com*. Retrieved from https://www.automobile-propre.com/nouvelles-bmw-i3-i3s-prix-finitions-et-equipements-en-france/

Trading economics. (2018). Urban land area. Retrieved October 15, 2018, from https://tradingeconomics.com/search.aspx?q=urban

Vergis, S., Turrentine, T. S., Fulton, L., & Fulton, E. (2014). *Plug-In Electric Vehicles : A Case Study of Seven Markets*. Davis.

Wappelhorst, S., & Tietge, U. (2018). Iceland is one of the world’s most interesting electric vehicle markets. Retrieved January 5, 2019, from https://www.theicct.org/blog/staff/iceland-ev-market-201807

WattEV2Buy. (2016). WattEV2Buy. Retrieved October 15, 2018, from https://wattev2buy.com/electric-vehicles/

Watts, J. (2018). We have 12 years to limit climate change catastrophe, warns UN. *The Guardian*. Retrieved from https://www.theguardian.com/environment/2018/oct/08/global-warming-must-not-exceed-15c-warns-landmark-un-report

Wooldrige, Jeffrey, M. (2011). *Econometric Analysis of Cross Section and Panel Data*. *Neurology Secrets* (3rd editio). London: The MIT Press. http://doi.org/10.1515/humr.2003.021

Zaunbrecher, B., Beul-Leusmann, S., & Ziefle, M. (2015). Laypeople’s Perspectives on Electromobility: A Focus Group Study. In *Giaffreda R., Cagáňová D., Li Y., Riggio R., Voisard A. (eds) Internet of Things. IoT Infrastructures. IoT360 2014.* (pp. 144–149). Springer, Cham. http://doi.org/https://doi.org/10.1007/978-3-319-19743-2\_22

Zhang, X., Wang, K., Hao, Y., Fan, J. L., & Wei, Y. M. (2013). The impact of government policy on preference for NEVs: The evidence from China. *Energy Policy*, *61*, 382–393. http://doi.org/10.1016/j.enpol.2013.06.114

# Appendices

## Appendix:

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Measure-ment** | **Description** | **Source** |
| BEV reg-ns | Number of BEV registrations | Year-to-date BEV registrations in a country in 2016 by a BEV model | (Pontes, 2016);  national vehicle licensing statistics, e.g. (Department for Transport & Driver and Vehicle Licensing Agency, 2016) |
| Price | U.S. dollars | The base price of each BEV in 2016, before taxes | 1. BEV databases, such as (Kelley Blue B., 2016) or (WattEV2Buy, 2016); 2. national online car magazines such as Autozeitung.de for Germany (e.g. Hiltscher, 2017), Autorevie.at for Austria (e.g. Gomoll, 2016), Automobile-propre.com for France (e.g. Torregrossa, 2017), Autokopen.nl for the Netherlands (e.g. Kroese, 2017), Motor.no for Norway (e.g. Korsvoll, 2016), etc 3. producer pricelists, e.g. (BMW Group Austria, 2016) |
| Dr range | Kilometer (km) | The combined EPA-rated driving range of the base BEV model where EPA is the U.S. Environmental Protection Agency which estimates each BEV model in terms of a city driving range, highway driving range and a total combined range | The database of EV models from the official website of the U.S. Office of Energy Efficiency and Renewable Energy (EERE) (EERE, 2016), BEV databases, online car magazines |
| Ch st-ns | Number of charging stations | Total number of EV charging stations in a country in 2016, including   1. Level 1 (Type 1 alternating current (AC) plug), 2. Level 2 (Type 2 AC plug) 3. fast chargers (an enhanced version of the type 2 plug) (The mobility house, 2018) | The website of the U.S. department of energy (DOE) (EERE, 2018), the European Alternative Fuels Observatory (EAFO) (EAFO, 2018a), Bundesverband der Energie- und Wasserwirtschaft (BDEW) (BDEW, 2017), Statista (e.g. Statista, 2018a), national charging maps such as (Chargemap, 2018) |
| Fast ch st-ns | Number of charging stations | Number of fast-charging stations in a country in 2016, with electric power of more than 22 kilowatt (kW), Fast chargers provide 60 (96 km) to 80 miles (128 km) of range per 20 minutes of charging. | The website of the U.S. department of energy (EERE, 2018), the European Alternative Fuels Observatory (EAFO) (EAFO, 2018a), Bundesverband der Energie- und Wasserwirtschaft (BDEW) (BDEW, 2017), Statista (e.g. Statista, 2018b) |
| Govern-ment grant | U.S. dollars | Purchase rebates or subsidies provided to BEV buyers by national governments in 2016 | Website of the European Automobile Manufacturers Association (ACEA) (ACEA, 2017a); EAFO (EAFO, 2018b); the International Council on Clean Transportation (ICCT) articles (e.g. Kim & Yang, 2016), Environmental and Energy Study Institute (EESI) (EESI, 2018), national government websites (e.g. Ministry of Economy, Trade and Industry, 2018) |
| VAT Amount | U.S. dollars | Value added tax, calculated as a percentage of the BEV base price (‘Price’ variable) | ICCT tax guide (ICCT, 2014), ACEA tax guides (ACEA, 2017b, 2018a), PricewaterhouseCoopers (PWC) global automotive tax guide (PWC, 2015), EAFO website |
| Reduction (annual tax); Reduction (purchase tax); Reduction (company car tax) | A proper fraction | Automotive tax reductions or exemptions (i.e. 100% reduction), offered by national governments in 2016. The variables were coded as a number from 0 to 1, where 0 stands for ‘no reduction, i.e. conventional car’ and 1 stands for ‘full reduction, i.e. exemption. | ICCT tax guide (ICCT, 2014), ACEA tax guides (ACEA, 2017b, 2018a), PricewaterhouseCoopers (PWC) global automotive tax guide (PWC, 2015), EAFO website |
| Urban density | Urban residents/  square km | Urban population per square km of urban area in a country in 2016 | World Bank (The world bank, 2018), statistics from Statista and Trading economics (Trading economics, 2018) |
| El-ty price | U.S. dollar per kilowatt-hour (kWh) | Average national price including taxes and levies applicable for medium size household consumers in 2016 (Eurostat, 2018) | Statistical Office of the European Communities (Eurostat) (Eurostat, 2018), Statista |
| BEV models available | Number of models | Number of models available on the market by the end of 2016; assumption: geographical markets such as Europe and North America share the same level of model availability. For China, South Korea and Japan, the model availability is determined separately. | BEV databases, such as Kelley Blue Book or Wattev2buy; online car magazines such as Autobild.de, Autozeitung.de, Topspeed.com, Topgear.com, automotive statistics websites |
| Interest score | A number from 0 to 100 | The average popularity score of a search query ‘electric car’ measured weakly for each country by Google Trends. ‘Electric car’ was translated into each country’s language | Google Trends |
| HOV/Bus lane access | 0 or 1 | Dummy variable identifying countries where bus lane access was provided by policy makers | (ACEA, 2017a); (EAFO, 2018b), (EESI, 2018), national government websites |

**Table 1. Model variables: descriptions and sources**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Country** | **Purchase subsidy/grant** | **Annual circulation tax** | **Purchase tax** | **Company car tax** | **VAT** | **HOV/Bus lane access** |
| China | Up to 55,000 Renminbi (RMB) depending on the range (U.S. $8,736) (EESI, 2018) | Exemption | Exemption | no measure | 17% | In some provinces and cities in China, (EESI, 2018) |
| United States of America | U.S. $2,500-$7,500 tax credit depending on the battery capacity (EESI, 2018) | no measure | no measure | no measure | 7,3% | More than 10 states, including California, Florida, Colorado, and New York (EESI, 2018) |
| Germany | €4,000 for BEVs up to €60,000 (Pressman, 2017) | Exemption | no measure | no measure | 19 % | no measure |
| United Kingdom | £4,500 | no measure | no measure | 7% instead of 18% (Pod point, 2018) | 20% | no measure |
| Norway | no measure | Average car: Norwegian Krones (NOK) 2820- 3382; BEV: NOK 455  (ICCT, 2014; Pressman, 2017) | Exemption | 50% discount | 0% | In the whole country (Bjerkan et al., 2016) |
| Finland | € 2,000 for a BEV up to €50,000 (EAFO, 2018b) | Average car: €0.535 per day, BEV: €0.118 per day  (PWC, 2015) | Average car: 33,4 %; BEV: 2,5%  (ICCT, 2014; PWC, 2015) | no measure | 24% | no measure |
| Nether-lands | none | Exemption | Exemption | Average car: 25%; BEV:4%(ACEA, 2017a; PWC, 2015) | 21% | no measure |
| France | €6,300 (ACEA, 2017a) | Exemption | Exemption | Exemption | 20% | no measure |
| Sweden | 40,000 Sweden Krones (EAFO, 2018b) | Exemption | none | 40% reduction (ACEA, 2017a) | 25% | no measure |
| Denmark | 40,000 Danish Krones  (Kane, 2017) | none | 80% reduction  (Berggreen, 2018) | none | 25% | no measure |
| Belgium | € 4,000 for BEVs < €31,000,  € 3,500 for BEVs < €41,000,  € 2,500 for BEVs < €61,000,  € 2,000 for BEVs above €61,000 (EAFO, 2018b) | Minimum tax of around €74 (ACEA, 2017a) | Exemption | Average car: 7%; BEV:4% (PWC, 2017) | 21% | no measure |
| Austria | € 4,000 for BEVs up to €50,000 | Exemption | Exemption | Exemption | 20% | no measure |
| Switzer-land | no measure | no measure | no measure | no measure | 7,7% | no measure |
| Iceland | no measure | Exemption | Exemption | no measure | 0% | no measure |
| Japan | Up to JPY 850,000, depending on the range (U.S.$7,700). | 50% reduction | Exemption | no measure | 5% | no measure |
| South Korea | [14 million won](http://eng.me.go.kr/eng/web/board/read.do?menuId=21&boardMasterId=522&boardId=492190&searchKey=titleOrContent&searchValue=electric) (around U.S.$12,100)  (Kim & Yang, 2016) | Exemption | Exemption | no measure | 10% | no measure |
| Canada | no measure | no measure | no measure | no measure | 7% | no measure |

**Table 2. Summary: EV promotion policies worldwide in 2016**

|  |  |
| --- | --- |
| **Regressor** | **Coefficient** |
| Government grant | 0,000221\*\* |
| Government grant sq | 0,000000 |
|  |  |
| **Summary Statistics** |  |
| SER | 1,79130 |
| R-sq | 24,52% |
| R-sq(adj) | 23,80% |

**^** P < 0,1; \* P<0,05; \*\* P<0,01

**Table 3. Regression output: linear vs polynomial model**

**Method**

|  |  |
| --- | --- |
| Null hypothesis | All means are equal |
| Alternative hypothesis | Not all means are equal |

*Equal variances were assumed for the analysis.*

**Analysis of Variance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **DF** | **Adj SS** | **Adj MS** | **F-Value** | **P-Value** |
| Country | 16 | 0,000744 | 0,000046 | 8,14 | 0,000 |
| Error | 212 | 0,001210 | 0,000006 |  |  |
| Total | 228 | 0,001954 |  |  |  |

**Table 4. Levene’s test calculation**



**Graph 1.1 Histogram of ‘BEV registrations’ Graph 1.2 Probability plot of ‘BEV registrations’**



**Graph 1.3 Box-Cox Plot of ‘BEV registrations’**



**Graph 1.4 Histogram of ‘ln BEV registrations’ Graph 1.5 Probability plot of ‘ln BEV registrations’**



**Graph 1.6 Residual plots for ‘BEV registrations’**



**Graph 1.7 Residual plots for ‘ln BEV registrations’**

## Appendix:

**Welch’s Test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **DF Numerator** | **DF Denumerator** | **F-Value** | **P-Value** |
| Country | 16 | 67,7082 | 2,58 | 0,004 |

**Table 5. Welch’s test**

**Grouping Information Using the Games-Howell Method and 95% Confidence**

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **N** | **Mean** | **Grouping** |
| Norway | 20 | 0,00809 | A |
| Iceland | 9 | 0,001486 | A |
| UK | 11 | 0,001052 | A |
| USA | 14 | 0,000889 | A |
| Netherlands | 14 | 0,000807 | A |
| Austria | 17 | 0,000715 | A |
| Switzerland | 17 | 0,000679 | A |
| France | 20 | 0,000674 | A |
| Sweden | 15 | 0,000639 | A |
| Denmark | 9 | 0,000636 | A |
| South Korea | 7 | 0,000615 | A |
| Japan | 7 | 0,000573 | A |
| China | 17 | 0,000540 | A |
| Belgium | 16 | 0,000284 | A |
| Germany | 16 | 0,000282 | A |
| Canada | 11 | 0,000242 | A |
| Finland | 9 | 0,000222 | A |

*Means that do not share a letter are significantly different.*

**Games-Howell Simultaneous Tests for Differences of Means**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Difference of Levels** | **Difference of Means** | **SE of Difference** | **95% CI** | **T-Value** | **Adjusted P-Value** |
| Belgium - Austria | -0,000432 | 0,000219 | (-0,001280; 0,000417) | -1,97 | 0,837 |
| Canada - Austria | -0,000474 | 0,000218 | (-0,001320; 0,000372) | -2,18 | 0,726 |
| China - Austria | -0,000175 | 0,000205 | (-0,000992; 0,000641) | -0,85 | 1,000 |
| Denmark - Austria | -0,000079 | 0,000346 | (-0,001482; 0,001324) | -0,23 | 1,000 |
| Finland - Austria | -0,000493 | 0,000218 | (-0,001342; 0,000356) | -2,26 | 0,675 |
| France - Austria | -0,000042 | 0,000349 | (-0,001349; 0,001265) | -0,12 | 1,000 |
| Germany - Austria | -0,000434 | 0,000210 | (-0,001260; 0,000393) | -2,07 | 0,787 |
| Iceland - Austria | 0,000770 | 0,000692 | (-0,002335; 0,003875) | 1,11 | 0,997 |
| Japan - Austria | -0,000143 | 0,000537 | (-0,002673; 0,002388) | -0,27 | 1,000 |
| Netherlands - Austria | 0,000091 | 0,000373 | (-0,001355; 0,001538) | 0,24 | 1,000 |
| Norway - Austria | 0,00737 | 0,00213 | (-0,00103; 0,01578) | 3,46 | 0,124 |
| South Korea - Austria | -0,000100 | 0,000419 | (-0,001974; 0,001773) | -0,24 | 1,000 |
| Sweden - Austria | -0,000077 | 0,000280 | (-0,001133; 0,000979) | -0,27 | 1,000 |
| Switzerland - Austria | -0,000037 | 0,000316 | (-0,001226; 0,001153) | -0,12 | 1,000 |
| UK - Austria | 0,000337 | 0,000547 | (-0,001959; 0,002632) | 0,61 | 1,000 |
| USA - Austria | 0,000173 | 0,000387 | (-0,001333; 0,001679) | 0,45 | 1,000 |
| Canada - Belgium | -0,000042 | 0,000128 | (-0,000534; 0,000449) | -0,33 | 1,000 |
| China - Belgium | 0,000256 | 0,000106 | (-0,000151; 0,000664) | 2,42 | 0,579 |
| Denmark - Belgium | 0,000352 | 0,000298 | (-0,000978; 0,001683) | 1,18 | 0,995 |
| Finland - Belgium | -0,000061 | 0,000128 | (-0,000562; 0,000439) | -0,48 | 1,000 |
| France - Belgium | 0,000390 | 0,000302 | (-0,000778; 0,001558) | 1,29 | 0,994 |
| Germany - Belgium | -0,000002 | 0,000114 | (-0,000436; 0,000433) | -0,02 | 1,000 |
| Iceland - Belgium | 0,001202 | 0,000669 | (-0,001910; 0,004313) | 1,80 | 0,880 |
| Japan - Belgium | 0,000289 | 0,000508 | (-0,002282; 0,002860) | 0,57 | 1,000 |
| Netherlands - Belgium | 0,000523 | 0,000329 | (-0,000820; 0,001867) | 1,59 | 0,956 |
| Norway - Belgium | 0,00780 | 0,00212 | (-0,00058; 0,01619) | 3,68 | 0,084 |
| South Korea - Belgium | 0,000331 | 0,000381 | (-0,001558; 0,002220) | 0,87 | 1,000 |
| Sweden - Belgium | 0,000355 | 0,000218 | (-0,000502; 0,001212) | 1,63 | 0,953 |
| Switzerland - Belgium | 0,000395 | 0,000263 | (-0,000634; 0,001424) | 1,50 | 0,975 |
| UK - Belgium | 0,000768 | 0,000518 | (-0,001497; 0,003034) | 1,48 | 0,969 |
| USA - Belgium | 0,000605 | 0,000345 | (-0,000807; 0,002017) | 1,75 | 0,913 |
| China - Canada | 0,000298 | 0,000103 | (-0,000116; 0,000713) | 2,89 | 0,326 |
| Denmark - Canada | 0,000395 | 0,000297 | (-0,000938; 0,001727) | 1,33 | 0,986 |
| Finland - Canada | -0,000019 | 0,000126 | (-0,000522; 0,000484) | -0,15 | 1,000 |
| France - Canada | 0,000432 | 0,000301 | (-0,000734; 0,001598) | 1,44 | 0,984 |
| Germany - Canada | 0,000040 | 0,000112 | (-0,000398; 0,000478) | 0,36 | 1,000 |
| Iceland - Canada | 0,001244 | 0,000668 | (-0,001870; 0,004358) | 1,86 | 0,856 |
| Japan - Canada | 0,000331 | 0,000507 | (-0,002240; 0,002903) | 0,65 | 1,000 |
| Netherlands - Canada | 0,000565 | 0,000328 | (-0,000777; 0,001907) | 1,72 | 0,923 |
| Norway - Canada | 0,00785 | 0,00212 | (-0,00054; 0,01624) | 3,70 | 0,081 |
| South Korea - Canada | 0,000373 | 0,000380 | (-0,001517; 0,002264) | 0,98 | 0,999 |
| Sweden - Canada | 0,000397 | 0,000217 | (-0,000458; 0,001252) | 1,83 | 0,892 |
| Switzerland - Canada | 0,000437 | 0,000262 | (-0,000591; 0,001465) | 1,67 | 0,943 |
| UK - Canada | 0,000811 | 0,000518 | (-0,001452; 0,003073) | 1,57 | 0,953 |
| USA - Canada | 0,000647 | 0,000344 | (-0,000764; 0,002059) | 1,88 | 0,867 |
| Denmark - China | 0,000096 | 0,000288 | (-0,001236; 0,001428) | 0,33 | 1,000 |
| Finland - China | -0,000318 | 0,000104 | (-0,000748; 0,000113) | -3,07 | 0,271 |
| France - China | 0,000134 | 0,000292 | (-0,001013; 0,001281) | 0,46 | 1,000 |
| Germany - China | -0,000258 | 0,000086 | (-0,000582; 0,000066) | -3,01 | 0,241 |
| Iceland - China | 0,000946 | 0,000664 | (-0,002169; 0,004061) | 1,42 | 0,972 |
| Japan - China | 0,000033 | 0,000502 | (-0,002552; 0,002618) | 0,07 | 1,000 |
| Netherlands - China | 0,000267 | 0,000320 | (-0,001063; 0,001597) | 0,83 | 1,000 |
| Norway - China | 0,00755 | 0,00212 | (-0,00083; 0,01593) | 3,56 | 0,105 |
| South Korea - China | 0,000075 | 0,000373 | (-0,001831; 0,001981) | 0,20 | 1,000 |
| Sweden - China | 0,000099 | 0,000204 | (-0,000729; 0,000926) | 0,48 | 1,000 |
| Switzerland - China | 0,000139 | 0,000251 | (-0,000866; 0,001143) | 0,55 | 1,000 |
| UK - China | 0,000512 | 0,000513 | (-0,001750; 0,002775) | 1,00 | 0,999 |
| USA - China | 0,000349 | 0,000337 | (-0,001050; 0,001748) | 1,04 | 0,999 |
| Finland - Denmark | -0,000414 | 0,000297 | (-0,001747; 0,000920) | -1,39 | 0,979 |
| France - Denmark | 0,000038 | 0,000404 | (-0,001524; 0,001600) | 0,09 | 1,000 |
| Germany - Denmark | -0,000354 | 0,000292 | (-0,001684; 0,000976) | -1,21 | 0,993 |
| Iceland - Denmark | 0,000850 | 0,000721 | (-0,002284; 0,003983) | 1,18 | 0,996 |
| Japan - Denmark | -0,000063 | 0,000574 | (-0,002626; 0,002499) | -0,11 | 1,000 |
| Netherlands - Denmark | 0,000171 | 0,000425 | (-0,001490; 0,001832) | 0,40 | 1,000 |
| Norway - Denmark | 0,00745 | 0,00214 | (-0,00097; 0,01588) | 3,48 | 0,118 |
| South Korea - Denmark | -0,000021 | 0,000466 | (-0,002003; 0,001961) | -0,05 | 1,000 |
| Sweden - Denmark | 0,000002 | 0,000346 | (-0,001403; 0,001408) | 0,01 | 1,000 |
| Switzerland - Denmark | 0,000043 | 0,000375 | (-0,001439; 0,001524) | 0,11 | 1,000 |
| UK - Denmark | 0,000416 | 0,000584 | (-0,001965; 0,002797) | 0,71 | 1,000 |
| USA - Denmark | 0,000253 | 0,000437 | (-0,001456; 0,001962) | 0,58 | 1,000 |
| France - Finland | 0,000451 | 0,000301 | (-0,000715; 0,001618) | 1,50 | 0,977 |
| Germany - Finland | 0,000060 | 0,000112 | (-0,000391; 0,000510) | 0,53 | 1,000 |
| Iceland - Finland | 0,001263 | 0,000668 | (-0,001847; 0,004373) | 1,89 | 0,845 |
| Japan - Finland | 0,000351 | 0,000507 | (-0,002222; 0,002923) | 0,69 | 1,000 |
| Netherlands - Finland | 0,000584 | 0,000329 | (-0,000758; 0,001927) | 1,78 | 0,905 |
| Norway - Finland | 0,00787 | 0,00212 | (-0,00052; 0,01625) | 3,71 | 0,080 |
| South Korea - Finland | 0,000393 | 0,000380 | (-0,001498; 0,002284) | 1,03 | 0,998 |
| Sweden - Finland | 0,000416 | 0,000217 | (-0,000441; 0,001273) | 1,92 | 0,857 |
| Switzerland - Finland | 0,000456 | 0,000262 | (-0,000573; 0,001485) | 1,74 | 0,923 |
| UK - Finland | 0,000830 | 0,000518 | (-0,001433; 0,003093) | 1,60 | 0,945 |
| USA - Finland | 0,000666 | 0,000344 | (-0,000745; 0,002078) | 1,94 | 0,843 |
| Germany - France | -0,000392 | 0,000295 | (-0,001545; 0,000761) | -1,33 | 0,992 |
| Iceland - France | 0,000812 | 0,000722 | (-0,002313; 0,003937) | 1,12 | 0,997 |
| Japan - France | -0,000101 | 0,000576 | (-0,002639; 0,002438) | -0,17 | 1,000 |
| Netherlands - France | 0,000133 | 0,000427 | (-0,001477; 0,001744) | 0,31 | 1,000 |
| Norway - France | 0,00741 | 0,00214 | (-0,00100; 0,01583) | 3,47 | 0,122 |
| South Korea - France | -0,000059 | 0,000468 | (-0,001998; 0,001880) | -0,13 | 1,000 |
| Sweden - France | -0,000035 | 0,000349 | (-0,001345; 0,001275) | -0,10 | 1,000 |
| Switzerland - France | 0,000005 | 0,000378 | (-0,001405; 0,001415) | 0,01 | 1,000 |
| UK - France | 0,000378 | 0,000586 | (-0,001982; 0,002739) | 0,65 | 1,000 |
| USA - France | 0,000215 | 0,000440 | (-0,001448; 0,001878) | 0,49 | 1,000 |
| Iceland - Germany | 0,001204 | 0,000666 | (-0,001908; 0,004316) | 1,81 | 0,876 |
| Japan - Germany | 0,000291 | 0,000504 | (-0,002289; 0,002871) | 0,58 | 1,000 |
| Netherlands - Germany | 0,000525 | 0,000323 | (-0,000810; 0,001860) | 1,62 | 0,947 |
| Norway - Germany | 0,00781 | 0,00212 | (-0,00058; 0,01619) | 3,68 | 0,084 |
| South Korea - Germany | 0,000333 | 0,000375 | (-0,001567; 0,002233) | 0,89 | 0,999 |
| Sweden - Germany | 0,000357 | 0,000209 | (-0,000479; 0,001192) | 1,71 | 0,930 |
| Switzerland - Germany | 0,000397 | 0,000255 | (-0,000615; 0,001409) | 1,56 | 0,966 |
| UK - Germany | 0,000770 | 0,000515 | (-0,001493; 0,003034) | 1,50 | 0,966 |
| USA - Germany | 0,000607 | 0,000339 | (-0,000797; 0,002010) | 1,79 | 0,900 |
| Japan - Iceland | -0,000913 | 0,000830 | (-0,004356; 0,002530) | -1,10 | 0,998 |
| Netherlands - Iceland | -0,000679 | 0,000734 | (-0,003824; 0,002466) | -0,92 | 1,000 |
| Norway - Iceland | 0,00660 | 0,00222 | (-0,00200; 0,01521) | 2,97 | 0,273 |
| South Korea - Iceland | -0,000871 | 0,000758 | (-0,004093; 0,002352) | -1,15 | 0,997 |
| Sweden - Iceland | -0,000847 | 0,000691 | (-0,003956; 0,002261) | -1,23 | 0,993 |
| Switzerland - Iceland | -0,000807 | 0,000707 | (-0,003920; 0,002306) | -1,14 | 0,997 |
| UK - Iceland | -0,000434 | 0,000836 | (-0,003827; 0,002960) | -0,52 | 1,000 |
| USA - Iceland | -0,000597 | 0,000741 | (-0,003752; 0,002558) | -0,81 | 1,000 |
| Netherlands - Japan | 0,000234 | 0,000591 | (-0,002332; 0,002800) | 0,40 | 1,000 |
| Norway - Japan | 0,00752 | 0,00218 | (-0,00099; 0,01602) | 3,45 | 0,121 |
| South Korea - Japan | 0,000042 | 0,000621 | (-0,002650; 0,002734) | 0,07 | 1,000 |
| Sweden - Japan | 0,000066 | 0,000537 | (-0,002467; 0,002598) | 0,12 | 1,000 |
| Switzerland - Japan | 0,000106 | 0,000557 | (-0,002425; 0,002637) | 0,19 | 1,000 |
| UK - Japan | 0,000479 | 0,000714 | (-0,002438; 0,003397) | 0,67 | 1,000 |
| USA - Japan | 0,000316 | 0,000600 | (-0,002263; 0,002895) | 0,53 | 1,000 |
| Norway - Netherlands | 0,00728 | 0,00214 | (-0,00115; 0,01571) | 3,40 | 0,138 |
| South Korea - Netherlands | -0,000192 | 0,000486 | (-0,002192; 0,001808) | -0,39 | 1,000 |
| Sweden - Netherlands | -0,000168 | 0,000373 | (-0,001615; 0,001279) | -0,45 | 1,000 |
| Switzerland - Netherlands | -0,000128 | 0,000401 | (-0,001658; 0,001401) | -0,32 | 1,000 |
| UK - Netherlands | 0,000245 | 0,000600 | (-0,002161; 0,002651) | 0,41 | 1,000 |
| USA - Netherlands | 0,000082 | 0,000459 | (-0,001670; 0,001834) | 0,18 | 1,000 |
| South Korea - Norway | -0,00747 | 0,00215 | (-0,01592; 0,00097) | -3,47 | 0,119 |
| Sweden - Norway | -0,00745 | 0,00213 | (-0,01585; 0,00095) | -3,50 | 0,116 |
| Switzerland - Norway | -0,00741 | 0,00213 | (-0,01582; 0,00100) | -3,47 | 0,122 |
| UK - Norway | -0,00704 | 0,00218 | (-0,01555; 0,00148) | -3,23 | 0,181 |
| USA - Norway | -0,00720 | 0,00215 | (-0,01564; 0,00124) | -3,35 | 0,148 |
| Sweden - South Korea | 0,000023 | 0,000419 | (-0,001851; 0,001898) | 0,06 | 1,000 |
| Switzerland - South Korea | 0,000064 | 0,000444 | (-0,001837; 0,001965) | 0,14 | 1,000 |
| UK - South Korea | 0,000437 | 0,000630 | (-0,002114; 0,002988) | 0,69 | 1,000 |
| USA - South Korea | 0,000274 | 0,000497 | (-0,001757; 0,002304) | 0,55 | 1,000 |
| Switzerland - Sweden | 0,000040 | 0,000315 | (-0,001151; 0,001231) | 0,13 | 1,000 |
| UK - Sweden | 0,000414 | 0,000547 | (-0,001880; 0,002707) | 0,76 | 1,000 |
| USA - Sweden | 0,000250 | 0,000387 | (-0,001256; 0,001757) | 0,65 | 1,000 |
| UK - Switzerland | 0,000373 | 0,000566 | (-0,001953; 0,002700) | 0,66 | 1,000 |
| USA - Switzerland | 0,000210 | 0,000414 | (-0,001375; 0,001795) | 0,51 | 1,000 |
| USA - UK | -0,000163 | 0,000609 | (-0,002592; 0,002265) | -0,27 | 1,000 |

**Table 6. Games-Howell pairwise comparisons**



**Table 7. Pearson correlations between model variables**

## Appendix:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Regressor** | **---Step 1---** | **---Step 2---** | **---Step 3---** | **---Step 4---** | **---Step 5---** |
| Government grant | 0,000086\*\* | 0,000078\*\* | 0,000085\*\* | 0,000089\*\* | 0,000074\*\* |
|  | (0,000026) | (0,000026) | (0,000033) | (0,000029) | (0,000025) |
| ln dr range | 1,729\*\* | 1,522\*\* | 1,515\*\* | 1,367\*\* | 1,013\*\* |
|  | (0,372) | (0,363) | (0,370) | (0,258) | (0,194) |
| ln ch st-ns | 0,6628\*\* | 0,5579\*\* | 0,568\*\* | 0,5915\*\* | 0,5631\*\* |
|  | (0,0677) | (0,0715) | (0,104) | (0,0738) | (0,0670) |
| ln price | -0,754\* | -0,250 | -0,215 |  |  |
|  | (0,341) | (0,373) | (0,380) |  |  |
| VAT Amount |  | -0,000039 | -0,000044 | -0,000051\*\* |  |
|  |  | (0,000028) | (0,000029) | (0,000025) |  |
| Reduction (annual tax) |  | 0,203 | 0,154 | 0,179 |  |
|  |  | (0,282) | (0,296) | (0,285) |  |
| Reduction (purchase tax) |  | -0,457**^** | -0,396 | -0,372 |  |
|  |  | (0,249) | (0,279) | (0,265) |  |
| Reduction (company car tax) |  | 0,196 | 0,102 | 0,057 |  |
|  |  | (0,280) | (0,419) | (0,327) |  |
| Urban density |  |  | 0,000066 |  |  |
|  |  |  | (0,000382) |  |  |
| ln el-ty price |  |  | -0,024 |  |  |
|  |  |  | (0,541) |  |  |
| BEV models available |  |  | 0,0218 | 0,0223 |  |
|  |  |  | (0,0313) | (0,0260) |  |
| Interest score |  |  | -0,0009 |  |  |
|  |  |  | (0,0186) |  |  |
| HOV/Bus lane access |  | 1,187\*\* | 1,177\*\* | 1,157\*\* | 1,314\*\* |
|  |  | (0,287) | (0,433) | (0,287) | (0,240) |
| **Summary Statistics** |  |  |  |  |  |
| SER | 1,40857 | 1,32747 | 1,33853 | 1,32653 | 1,33211 |
| R-sq | 53,78% | 59,94% | 60,07% | 60,00% | 58,66% |
| R-sq(adj) | 52,88% | 58,15% | 57,45% | 58,21% | 57,86% |
| n | 212 | 212 | 212 | 212 | 212 |

**^** P < 0,1; \* P<0,05; \*\* P<0,01

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Regressor \ VIF** | **---Step 1---** | **---Step 2---** | **---Step 3---** | **---Step 4---** | **---Step 5---** |
| Government grant | 1,33 | 1,43 | 2,31 | 1,79 | 1,34 |
| ln dr range | 3,31 | 3,55 | 3,64 | 1,80 | 1,01 |
| ln ch st-ns | 1,38 | 1,73 | 3,64 | 1,85 | 1,51 |
| ln price | 3,36 | 4,51 | 4,61 |  |  |
| VAT Amount |  | 2,67 | 2,88 | 2,19 |  |
| Reduction (annual tax) |  | 1,67 | 1,81 | 1,70 |  |
| Reduction (purchase tax) |  | 1,64 | 2,03 | 1,86 |  |
| Reduction (company car tax) |  | 1,46 | 3,23 | 2,00 |  |
| Urban density |  |  | 5,99 |  |  |
| ln el-ty price |  |  | 5,10 |  |  |
| BEV models available |  |  | 3,70 | 2,58 |  |
| Interest score |  |  | 4,22 |  |  |
| HOV/Bus lane access |  | 1,81 | 4,06 | 1,81 | 1,26 |

**Final Regression Equation**

|  |  |  |  |
| --- | --- | --- | --- |
| HOV/Bus lane access |  |  |  |
| 0 | ln BEV reg-ns | = | -5,13 + 0,000074 Government grant + 1,013 ln dr range+ 0,5631 ln ch st-ns |
| 1 | ln BEV reg-ns | = | -3,81 + 0,000074 Government grant + 1,013 ln dr range+ 0,5631 ln ch st-ns |

**Table 8. Regression outputs with charging infrastructure**

**Graph 2.1. Residual plots for model specification with charging infrastructure (Step 5)**

**Graph 2.2. Anderson-Darling test of residuals for model specification with charging infrastructure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Significant variable** | **Adj. R-squared**  **before deletion** | **Adj. R-squared**  **after deletion** | | **Adj. R-squared drop** |
| ln ch stations | 57,86% | | 43,77% | 14,09% |
| HOV/Bus lane access | 57,86% | | 52,00% | 5,86% |
| ln dr range | 57,86% | | 52,56% | 5,3% |
| government grant | 57,86% | | 56,28% | 1,58% |

**Table 9. Sensitivity tests of the model with charging stations**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Regressor** | **---Step 1---** | **---Step 2---** | **---Step 3---** | **---Step 4---** | **---Step 5---** |
| Government grant | 0,000017 | 0,000026 | -0,000041 | -0,000030 |  |
|  | (0,000030) | (0,000031) | (0,000036) | (0,000034) |  |
| ln dr range | 1,446\*\* | 1,249\*\* | 1,433\*\* | 1,406\*\* | 1,337\*\* |
|  | (0,376) | (0,264) | (0,259) | (0,254) | (0,252) |
| ln fast ch st-ns | 0,6979\*\* | 0,6113\*\* | 0,5871\*\* | 0,5773\*\* | 0,5939\*\* |
|  | (0,0709) | (0,0842) | (0,0891) | (0,0842) | (0,0720) |
| ln price | -0,506 |  |  |  |  |
|  | (0,347) |  |  |  |  |
| VAT Amount |  | -0,000034 | -0,000062\* | -0,000060\* | -0,000055\* |
|  |  | (0,000026) | (0,000026) | (0,000025) | (0,000025) |
| Reduction (annual tax) |  | 0,247 | -0,050 | -0,005 |  |
|  |  | (0,289) | (0,287) | (0,285) |  |
| Reduction (purchase tax) |  | -0,282 | -0,409 | -0,392 |  |
|  |  | (0,260) | (0,267) | (0,267) |  |
| Reduction (comp. car tax) |  | 0,674\* | 0,958\*\* | 1,084\*\* | 0,758\*\* |
|  |  | (0,285) | (0,346) | (0,321) | (0,267) |
| Urban density |  |  | 0,001308\*\* | 0,001177\*\* | 0,000995\*\* |
|  |  |  | (0,000275) | (0,000255) | (0,000223) |
| BEV models available |  |  | 0,0663\* | 0,0448**^** | 0,0580\* |
|  |  |  | (0,0315) | (0,0266) | (0,0251) |
| Interest score |  |  | 0,0263 |  |  |
|  |  |  | (0,0177) |  |  |
| ln el-ty price |  |  | 0,220 |  |  |
|  |  |  | (0,505) |  |  |
| HOV/Bus lane access |  | 0,891\*\* | 0,555 | 0,824\*\* | 0,747\* |
|  |  | (0,320) | (0,455) | (0,307) | (0,297) |
| **Summary Statistics** |  |  |  |  |  |
| SER | 1,40627 | 1,36429 | 1,30302 | 1,30378 | 1,30582 |
| R-sq | 53,93% | 57,48% | 61,97% | 61,55% | 60,85% |
| R-sq(adj) | 53,04% | 55,80% | 59,68% | 59,63% | 59,51% |
| n | 212 | 212 | 212 | 212 | 212 |

**^** P < 0,1; \* P<0,05; \*\* P<0,01

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Regressor \ VIF** | **---Step 1---** | **---Step 2---** | **---Step 3---** | **---Step 4---** | **---Step 5---** |
| Government grant | 1,75 | 1,94 | 2,87 | 2,56 |  |
| ln dr range | 3,40 | 1,77 | 1,88 | 1,81 | 1,77 |
| ln fast ch st-ns | 1,88 | 2,82 | 3,46 | 3,09 | 2,25 |
| ln price | 3,48 |  |  |  |  |
| VAT Amount |  | 2,10 | 2,29 | 2,25 | 2,21 |
| Reduction (annual tax) |  | 1,65 | 1,79 | 1,76 |  |
| Reduction (purchase tax) |  | 1,69 | 1,96 | 1,95 |  |
| Reduction (company car tax) |  | 1,43 | 2,32 | 1,99 | 1,37 |
| Urban density |  |  | 3,28 | 2,82 | 2,15 |
| BEV models available |  |  | 3,93 | 2,81 | 2,49 |
| Interest score |  |  | 4,03 |  |  |
| ln el-ty price |  |  | 4,69 |  |  |
| HOV/Bus lane access |  | 2,13 | 4,72 | 2,15 | 2,00 |

**Final Regression Equation**

|  |  |  |  |
| --- | --- | --- | --- |
| HOV/Bus lane access |  |  |  |
| 0 | ln BEV reg-ns | = | -8,48 + 1,337 ln dr range + 0,5939 ln fast ch st-ns - 0,000055 VAT Amount  + 0,758 Reduction (company car tax) + 0,000995 Urban density + 0,0580 BEV models available |
| 1 | ln BEV reg-ns | = | -7,74 + 1,337 ln dr range + 0,5939 ln fast ch st-ns - 0,000055 VAT Amount  + 0,758 Reduction (company car tax) + 0,000995 Urban density + 0,0580 BEV models available |

**Table 10. Regression outputs with fast-charging infrastructure**

**Graph 3.1. Residual plots for model specification with fast-charging infrastructure (Step 5)**

**Graph 3.2. Anderson-Darling test of residuals for model specification with fast-charging infrastructure**

|  |  |  |  |
| --- | --- | --- | --- |
| **Significant variable** | **Adj. R-squared**  **before deletion** | **Adj. R-squared**  **after deletion** | **Adj. R-squared drop** |
| ln fast ch st-ns | 59,51% | 46,27% | 13,24% |
| ln dr range | 59,51% | 54,15% | 5,36% |
| Urban density | 59,51% | 55,78% | 3,73% |
| Reduction (company car tax) | 59,51% | 58,11% | 1,4% |
| HOV/Bus lane access | 59,51% | 58,45% | 1,06% |
| BEV models available | 59,51% | 58,65% | 0,86% |
| VAT Amount | 59,51% | 58,77% | 0,74% |

**Table 11. Sensitivity tests of the model with fast-charging stations**

# Declaration of authorship of an academic paper

I hereby declare that I have written this paper myself and used no other sources or resources than those indicated, have clearly marked verbatim quotations as such, and clearly indicated the source of all paraphrased references, and have observed the General Study and Examination Regulations of Reutlingen University for bachelor and master programmes, the specific regulations for study and examinations of my study programme, and the Regulations for Ensuring Good Academic Practice of Reutlingen University.

Neither this paper nor any part of this paper is a part of any other material presented for examination at this or any other institution.

Reutlingen, 15.01.2019 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Maria Kholopova

1. Please note that all the numbers in graphs, figures and statistical tables are in European format, due to the software settings. We apologize for the inconvenience. [↑](#footnote-ref-1)