The Impacts of Government Policies on the Adoption of Electric Vehicles

By

PARK, Jihye

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

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Committee in charge:

Professor Kim, Yeong Jae, Supervisor ____________________

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Executive Summary

The need for Electric Vehicles (EVs) to mitigate greenhouse gas emissions is growing as the climate crisis intensifies. Governments worldwide are adopting diverse measures to promote the widespread adoption of EVs. By using the fixed effect model, this paper demonstrates that the number of public charging points, EPS (Environmental Policy Stringency), installation subsidies for chargers, and purchase subsidies all exhibit a positive impact on EV adoption. Among these, the most influential policy is the provision of a greater number of charging points. Regarding EPS, policies directly addressing financial considerations outperform those that do not. By covering many countries, this paper illustrates the broad impact of government policies on the adoption of EVs and provides insights into policies from a consumer perspective.

Table of contents

List of Figures

List of Tables

1. Introduction

The Earth has experienced rapid warming since the beginning of the Industrial Revolution. The Intergovernmental Panel on Climate Change (IPCC) reports an approximate 1.1 °C increase in the average surface temperature since 1850, primarily linked to increased carbon dioxide (CO2) levels resulting from activities like coal and petroleum combustion.

The Food and Agriculture Organization (FAO) highlights a threefold rise in yearly disasters compared to the 1970s and 1980s due to global warming, leading to various impacts such as droughts and floods, displacing numerous people. As climate change-related harm intensifies, global efforts are accelerating, as seen in the Paris Agreement's call for a gradual reduction in greenhouse gas emissions to prevent a temperature increase beyond 2°C above pre-industrial levels. Unlike the Kyoto Protocol, the Paris Agreement emphasizes the joint responsibility of both developed and developing countries to actively reduce emissions. Many countries and companies are adopting ambitious policies, with 151 countries, 264 cities, and 1,049 companies committing to net-zero targets, covering 88% of global emissions, 92% of GDP, and 89% of the population.

Greenhouse gas emissions stem from various sectors, with the transport sector contributing about 37% in 2020, according to the International Energy Agency (IEA). Light-duty vehicles, particularly automobiles, constitute 46% of this sector's emissions. Given the relative manageability of emissions in transportation, many countries prioritize implementing regulations to reduce emissions, especially from light-duty vehicles.

The term "Life cycle emissions" is widely used to compare carbon dioxide emissions across vehicle types, encompassing manufacturing, usage, and disposal. Notably, Battery Electric

Vehicles (BEVs) emit the least greenhouse gases (39tCO2e), compared to Hybrid Electric Vehicles (HEVs) emitting 47tCO2e, and Internal Combustion Engine Vehicles (ICEVs) emitting over 55tCO2e. Governments incentivize Electric Vehicles (EVs) by offering benefits and penalizing Internal Combustion Engine Vehicle (ICEV) users, recognizing EVs as an environmentally friendly option.

Despite the environmental benefits, recent reports highlight automakers scaling back or delaying EV production due to declining consumer demand. Volkswagen Group abandoned a $2 billion EV factory in Germany, and Ford delayed its $12 billion EV manufacturing, attributed to low consumer confidence influenced by factors such as high interest rates, expensive EVs, reduced purchase subsidies, and insufficient charging infrastructure. Consequently, incentivizing EV adoption becomes crucial in overcoming these obstacles and reigniting interest nationwide.

This study aims to identify variables influencing individuals' willingness to transition from Internal Combustion Engine Vehicles (ICEVs) to Electric Vehicles (EVs). The primary objective is to formulate strategies enabling the government to identify the most appealing EV incentives and strengthen regulations for widespread EV adoption. The study poses the following questions:

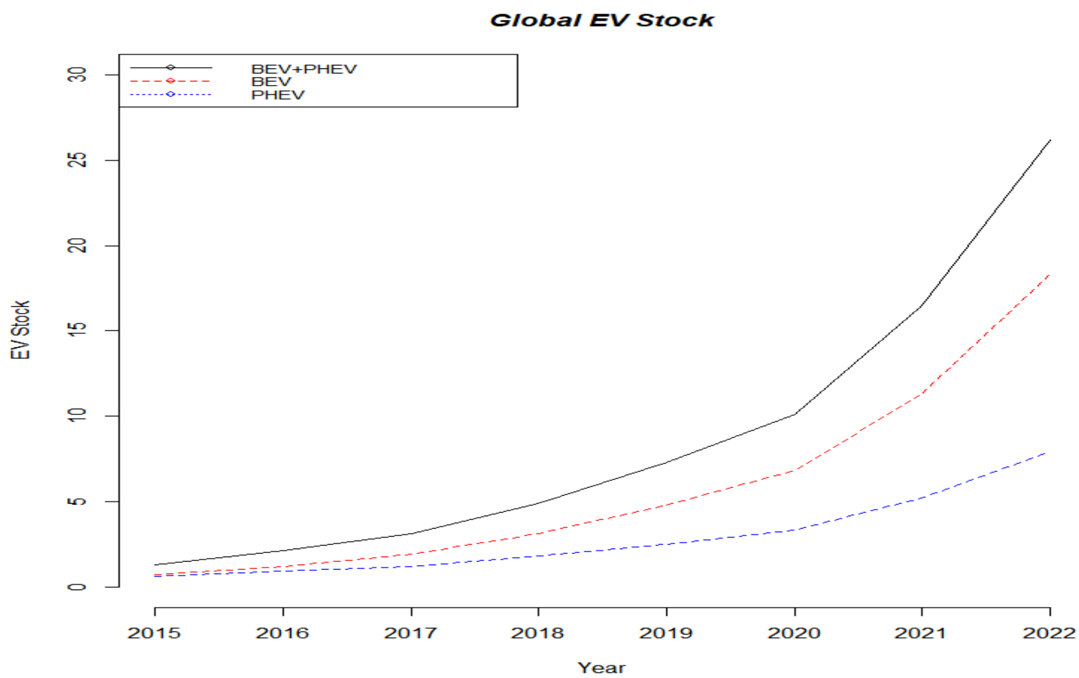
First, is there a positive relationship between the adoption of EV registration and factors such as EV purchase subsidies, the number of public charging points, Environment Policy Stringency (EPS), and grants for charger installation?

Second, to what extent do these factors influence the willingness to adopt EVs, if at all?

2. Background

2.1. The trends of EV

Figure 1. Global EV Stock

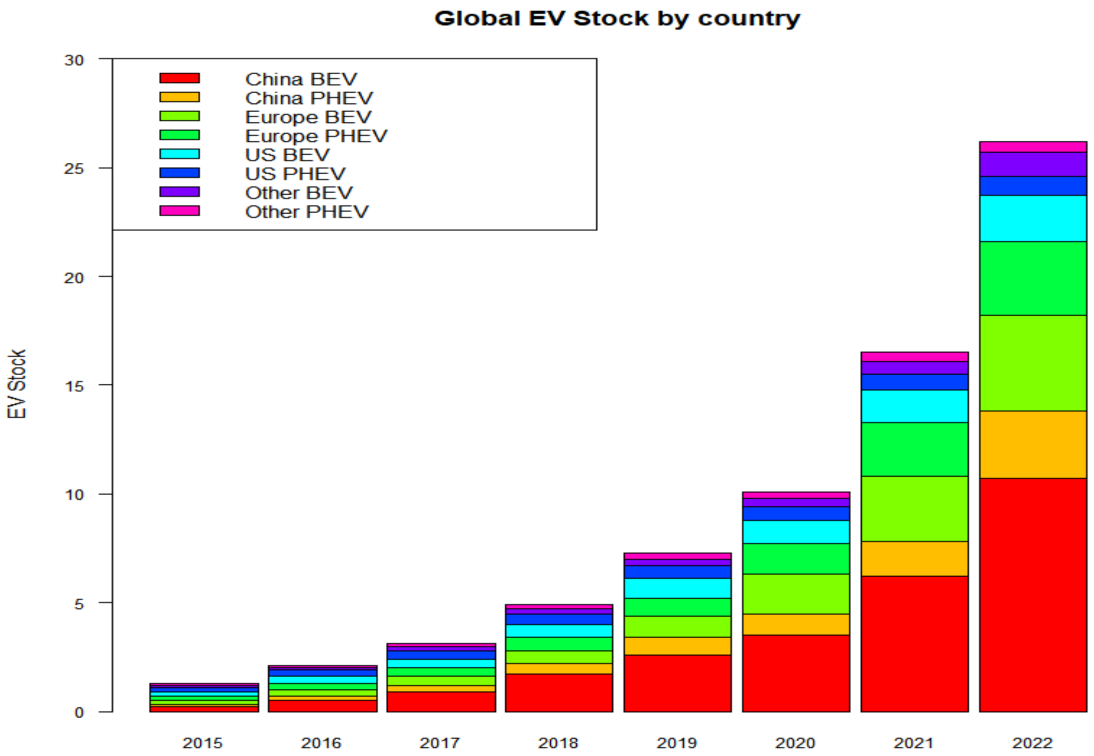


Notes: Unit-Million

Source: Global EV Data Explorer from IEA

The global Electric Vehicle (EV) market is experiencing a substantial surge, driven by growing environmental concerns and the recognition of EV advantages. Despite a decline in the overall automobile market, EV sales have exhibited remarkable growth. The percentage of EV sales out of total vehicle sales increased from 9% in 2021 to 14% in 2022. In 2022, Battery Electric Vehicles (BEVs) constituted more than 70% of the global electric vehicle stock, as illustrated in Figure 1.

Figure 2. Global EV Stock by Country



Notes: Unit-Million

Source: Global EV Data Explorer from IEA

China stands out as a dominant force in the global EV market, maintaining its lead in sales. In 2022, China experienced a remarkable 60% growth in BEV sales compared to the previous year, reaching an impressive 4.4 million units. Plug-in Hybrid Electric Vehicles (PHEVs) also saw a substantial increase, nearly tripling to 1.5 million units. Notably, nearly 60% of all new electric vehicle registrations worldwide occurred in China, surpassing the national target of achieving a 20% sales share by 2025. China is ambitiously aiming for a 50% market share by 2030.

Meanwhile, European countries collectively saw a surge in electric vehicle adoption, with sales reaching 2.7 million units in 2022, reflecting a growth of over 15% from the previous year. BEV sales in Europe rose by 30%, while PHEV sales experienced a slight decline of almost 3%. Europe contributed significantly to the global increase in new electric car sales, accounting for 10% of the surge. In 2022, Europe held a notable position, constituting 25% of worldwide sales and 30% of the global electric car stock, establishing itself as the second-largest market after China.

Table 1. Ranking of EV Sales Share in Europe in 2022

Rank	Country	Percentage
1	Norway	88%
2	Sweden	54%
3	The Netherlands	35%
4	Germany	31%
5	UK	23%
6	France	21%

Source: Global EV Outlook 2023 from IEA

In the United States, electric vehicle sales rose by an impressive 55% in 2022 compared to 2021, driven predominantly by the growth of BEVs. PHEV sales increased by 15%, while BEVs exhibited a remarkable 70% increase. The United States contributed significantly to the global surge in sales, accounting for 10% of the overall increase. This growth underlines the rising global prominence of electric vehicles.

Figure 3. Electric Vehicle (BEV) Sales by Country

Source: 2022년 글로벌 전기차 판매 실적 분석 from KATECH

Chinese automakers have successfully slashed costs through years of intense domestic competition, focusing on the development of smaller, more affordable models ahead of their international counterparts. The resultant competitive advantage in offering budget-friendly electric vehicles (EVs) has fueled a substantial global demand for Chinese-made EVs. China's persistent support bolstered supply chains, technological competitiveness, and robust domestic market have collectively contributed to achieving a remarkable 50% global market share in the electric vehicle industry.

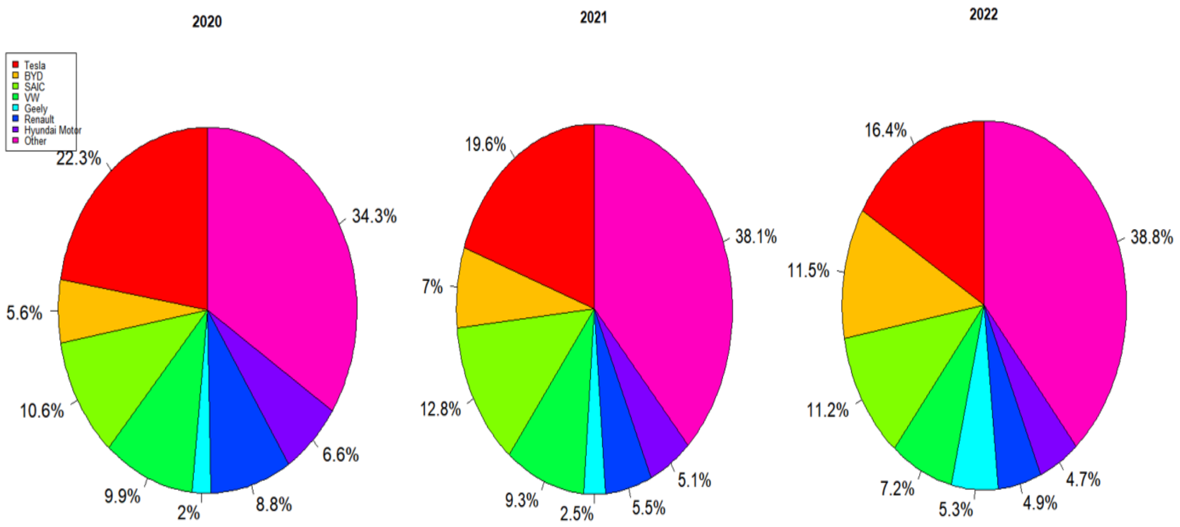
The Chinese government played a pivotal role in this achievement by providing tax reductions and incentives to companies involved in battery, materials, and parts production. Additionally, China engaged in a substantial investment of 100 billion yuan in electric vehicle research and development over ten years starting in 2010.

In the United States, efforts to regulate foreign entities, particularly those with at least 25% Chinese participation, have been reinforced through comprehensive guidelines for the Inflation Reduction Act (IRA). Entities falling under the category of Foreign Entities of Concern (FEOC) with the specified Chinese participation are deemed ineligible for IRA subsidies. Moreover, Chinese electric vehicles face a 27.5% tax when imported into the U.S.

In a parallel development, France has responded to an influx of electric vehicles from China and the United States, posing a threat to both French and European electric vehicle markets. To bolster the domestic industry, France has adjusted its carbon footprint-based subsidies for electric vehicles. This strategic move aims to incentivize consumers to choose vehicles manufactured in France and Europe, with subsidies tailored to account for the carbon footprint generated during the manufacturing process.

Figure 3 illustrates a diminishing market share for European and U.S. manufacturers, highlighting the evolving dynamics in the global electric vehicle market. As Chinese automakers continue to demonstrate cost efficiency and capture international demand, the industry landscape is undergoing a notable shift, emphasizing the need for strategic responses from other major players.

Figure 4. Electric Vehicle (BEV) Sales by Manufacturer



Source: 2022년 글로벌 전기차 판매 실적 분석 from KATECH

Tesla has long held the reputation as a leading electric vehicle manufacturer, known for its reliable autopilot systems, impressive range, and standout safety ratings. These factors have contributed to Tesla's consistent position as a top seller in the electric vehicle market, dominating sales until the first half of 2022. However, a significant shift occurred thereafter.

Reports from The Wall Street Journal (WSJ) and CNN revealed that BYD, a Chinese automaker, outpaced Tesla in sales during the fourth quarter of 2022. BYD sold 525,409 electric vehicles, surpassing Tesla's 484,507 sales. Notably, BYD's achievements were further recognized when it was nominated for the prestigious European Car of the Year award in December, marking the first time a Chinese electric vehicle manufacturer received such recognition. This acknowledgment reflects a growing awareness of the quality of Chinese electric vehicles (EVs).

Chinese automakers, particularly SAIC and BYD, have demonstrated a consistent upward trajectory in sales within the global electric vehicle industry. These notable developments indicate a potential shift in the dynamics of the global EV market, suggesting that Chinese EV manufacturers will exert a more substantial impact in the future. As the reputation and quality of Chinese EVs gain recognition, their influence on the global electric vehicle landscape is expected to strengthen.

2.2. EV policies in major countries

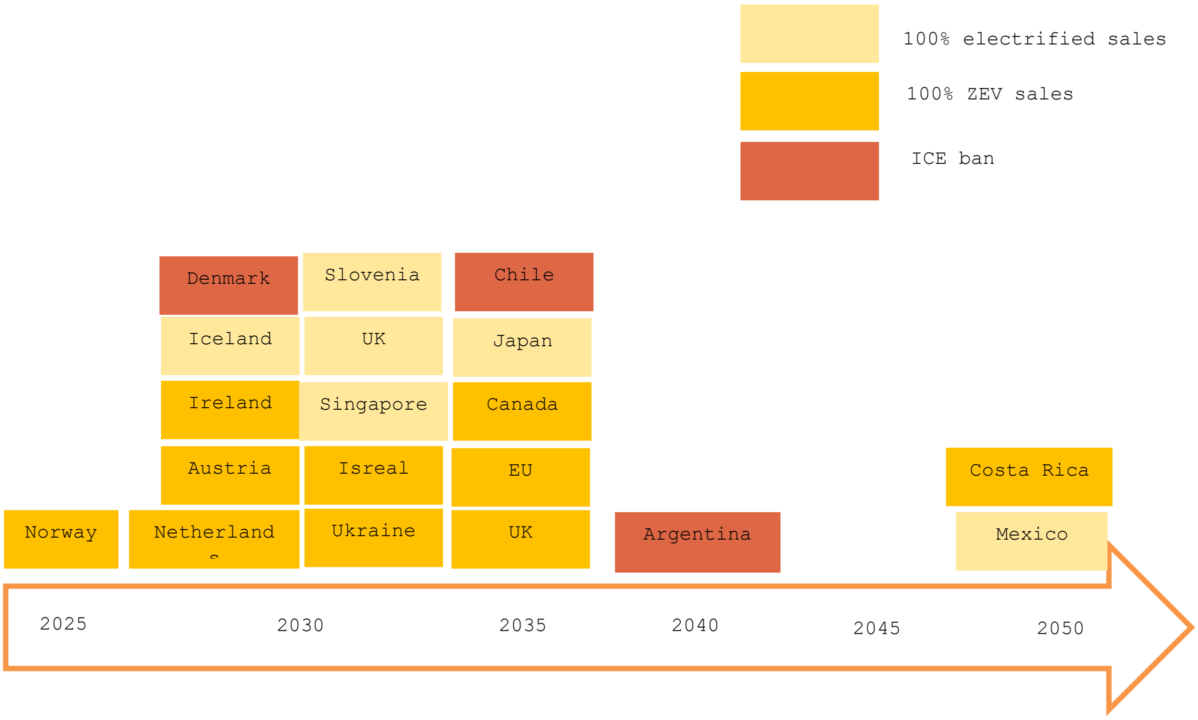
The incentives for electric vehicles (EVs) vary across countries, demonstrating diverse approaches to promote their adoption.

In China, a significant effort has been made to support EV producers and buyers. Between 2009 and 2022, China allocated approximately US $28 billion for tax reductions and subsidies for EVs. Utilizing consumption tax exemptions has been a strategy to reduce the cost of EVs. The country has implemented vehicle purchase tax cuts, vehicle tax waivers, and purchase subsidies to incentivize consumers toward EVs. While China announced the phase-out of subsidies in 2024, tax breaks will continue until 2027. Furthermore, China is actively promoting infrastructure development for EVs by enacting favorable regulations and making substantial expenditures. By 2030, China aims to establish a comprehensive charging network covering highway, rural, and urban areas. Additionally, there are plans to enhance standards, regulations, and market monitoring systems, with a focus on leading in charging technologies globally.

Norway, known for having the highest EV sales in Europe, has implemented a series of incentives since the early 1990s. Battery Electric Vehicles (BEVs) enjoy exemptions from registration tax and are eligible for Value Added Tax (VAT). Norway has introduced a unique E-number plate exclusively for electric vehicles, allowing local governments to grant specific incentives like free parking or the use of bus lanes based on these plates. The country has also established regulations governing new construction and parking lot requirements for EV supply equipment.

In the United States, the government provides tax incentives to encourage EV adoption. Consumers can receive up to $7,500 in tax incentives for new vehicles until December 2032. The National Electric Vehicle Infrastructure (NEVI) Formula Program administers funding for charging infrastructure, and federal programs are driving the installation of chargers across the country. Some states offer EVs access to High Occupancy Vehicle (HOV) lanes, and regulations ensure that designated parking spaces are not occupied by Internal Combustion Engine Vehicles (ICEVs).

Figure 5. Global Zero-Emission Vehicle Mandates and ICEV Bans



Note: European Union countries earlier than the EU 2035 target are included separately

Source: Global EV Outlook 2023 from IEA

The global push towards phasing out Internal Combustion Engine Vehicles (ICEVs) is anchored in the ambition to make Electric Vehicles (EVs) the predominant means of transportation worldwide. Both advanced countries, where EV sales are already high, and Emerging Market and Developing Economies (EMDE) with lower EV adoption rates, have announced bans on ICEV sales.

In European countries, a significant stride has been taken by mandating that all new cars sold after 2035 must be emission-free, contributing to the broader objective of achieving carbon neutrality in the transportation sector by 2050. In the United States, states like California and New York have echoed this commitment by also announcing a ban on ICEVs by the year 2035.

Governments worldwide are implementing various incentives within stringent regulations and policies to facilitate the transition from ICEVs to EVs. This comprehensive approach aims to encourage individuals to make the switch, thereby advancing the collective goal of reducing greenhouse gas emissions in the automotive sector.

3. Literature Review

3.1. The survey of consumer behavior of automobiles

Numerous surveys and literature pieces shed light on consumer behavior in the automotive industry, with the 2023 Deloitte survey standing out as a comprehensive source for global consumer trends in mobility. An emerging trend identified in the survey is the increasing interest in Electric Vehicles (EVs) among consumers, primarily driven by a desire to mitigate running expenses in the face of hyperinflationary conditions.

While lower fuel costs emerged as a top reason for considering EVs in the next vehicle purchase, the survey revealed that in major countries such as Germany, Japan, the Republic of Korea, and the US, consumer preferences still lean towards gasoline or diesel-powered Internal Combustion Engine Vehicles (ICEVs).

The survey also uncovered the primary concerns of consumers regarding Battery Electric Vehicles (BEVs). The cost/price premium and charging-related issues, including the time required for charging, lack of public EV charging infrastructure, and the absence of a home charger, were identified as the main obstacles to BEV adoption. Notably, people in Japan and the US highlighted cost and price premiums as their most significant concerns, while those in India and Southeast Asia expressed the greatest worry about the scarcity of public EV charging infrastructure.

The survey results showed that cost and charging issues hold the top four positions in major countries, indicating the magnitude of these concerns. Further analysis revealed that the two primary reasons for not charging an EV at home were the perceived excessive cost of installation and the absence of feasible installation possibilities, accounting for more than 60%.

As the automotive industry seeks to maintain its upward momentum, overcoming these obstacles, particularly those related to cost and charging infrastructure will be crucial. Addressing these concerns is essential for fostering greater consumer confidence and steering the market toward sustained growth.

3.2. Previous analysis of EV incentives

Numerous countries are implementing diverse incentives to boost electric vehicle (EV) registrations, and considering budget constraints, prioritizing the most effective incentives is crucial for efficient resource utilization. Existing literature extensively analyzes the impact of various incentives on EV adoption.

Previous research, including studies by Clinton and Steinberg (2019), and Jenn et al. (2018), indicates the positive effect of purchase subsidies on increasing EV sales. Jianwei et al. (2021) found that federal tax credits contribute to higher EV sales, despite a significant portion benefiting households that would have purchased an EV even without the tax incentive. Income and tax reduction policies are identified as powerful drivers of EV penetration by Chanlei and Huaguo (2021), and Bjerkan (2016). Kim and Heo (2019) suggest that financial incentives, such as subsidies and tax exemptions, influence EV purchases, but alone may not induce a shift away from Internal Combustion Engine Vehicles (ICEVs) towards EVs.

Charging infrastructure emerges as a critical factor influencing EV adoption, with many consumers hesitating due to perceived charging challenges. Governments are responding by investing in public charging points. Égner and Trosvik (2018) observe a correlation between increased charging stations and higher Battery Electric Vehicle (BEV) adoption. Contrasting results emerge from studies by Springel (2016), Shanzun et al. (2017, 2022), and Zunian (2022), indicating that public charging station subsidies may have a more significant impact than purchase price subsidies on increasing EV sales. However, Clinton and Steinberg (2019) assert a positive relationship only between private charging infrastructure and BEV adoption, while Kim and Heo (2019) find no positive correlation between public fast chargers and EV adoption.

Research by Langer and Miller (2013), Jacobsen (2013), Allcott and Wozny (2014), and Grigolon et al. (2013) suggests that market-based policy instruments can enhance the relative profitability of fuel-efficient cars. Additionally, other incentives such as High Occupancy Vehicle (HOV) access and parking benefits are identified as positive contributors to EV adoption (Jenn 2018, Égner 2018).

Despite literature presenting slightly opposing results, especially regarding charging points, this study stands out by offering a comprehensive assessment of the impact of incentives on EV adoption across 30 different countries. By comparing the effects of market-based and non-market-based policies from a consumer perspective, this research provides valuable insights for better policy recommendations for prospective EV buyers. This study aims to be a thorough analysis of government policies' impact on EV adoption, transcending existing research limitations tied to individual countries.

4. Data

Table 2. List of the countries of the analysis

Continent	Country
Europe (22)	Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, UK
Asia (4)	China, India, Japan, South Korea,
North America (2)	Canada, US
South America (1)	Brazil
Africa (1)	South Africa

Table 3. Summary statistics of variables

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Number of accumulated registered BEV	78287.76	325775.8	0	3524000
-Accumulated BEVs per million residents	1475.5	5082.78	0	54148.25
-Number of accumulated registered PHEV	41370.08	113677	0	1004000
-Accumulated PHEVs per million residents	1074.59	2824.60	0	24968.81
Environmental Policy				
-EPS	3.01	0.81	0.58	4.888889
Charging Points				
-Number of accumulated public charging points	16535.77	67858.7	0	810000
Subsidy				
-BEV purchase subsidy ($)	2441.18	3093.17	0	11223.09
-PHEV purchase subsidy ($)	1598.34	2407.89	0	7953.29
-Subsidy for installation of charger ($)	2358.41	14793.31	0	109700

The data in this analysis represent an unbalanced panel of countries. Table 2 lists the countries included in the panel data. The dataset spans eight years, from 2013 to 2020. Table 3 provides a summary of the variables under consideration.

In this analysis, only Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are classified as electric vehicles. The registration data encompass yearly snapshots of electric vehicle registrations across 30 countries, focusing exclusively on new registrations of personal vehicles.

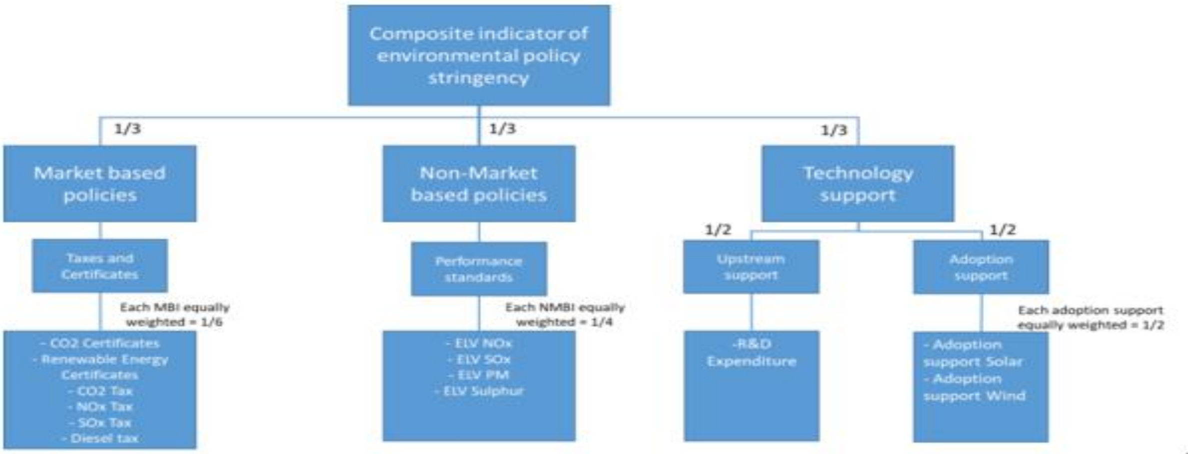
To standardize the impact, this paper employs the cumulative number of BEV/PHEV registrations per million residents as the dependent variable. The independent variables consist of government policies, namely purchase subsidies, the cumulative number of public charging points, the Environmental Policy Stringency Index (EPS), and grants for charger installations.

Purchase subsidies, provided by central governments, vary across countries, and may even differ between BEVs and PHEVs within a country. The EPS is a country-specific indicator of environmental policy stringency, utilizing parameters related to 13 environmental policy tools. The index ranges from 0 (least stringent) to 6 (most stringent), reflecting the degree to which environmental regulations impose costs on polluting behavior.

Market-based policies, directly linked to pollutant prices or certifications, include tax exemptions for electric vehicle purchases and early scrapping subsidies for outdated diesel cars. Non-market-based policies evaluate compliance with standards, such as emission grading systems for vehicles. Non-market-based policies, like specific vehicle criteria, can lead to market-based policies such as taxes or subsidies. Technology support is divided into Research and Development (R&D) expenditures and adoption support for solar and wind technologies.

In terms of EPS, market-based and non-market-based policies are primarily associated with the consumer side of electric vehicles. Public charging points refer to electrical power supply units that recharge BEVs and PHEVs. Grants for electric vehicle charger installation are subsidies provided to individuals who install chargers intended for public use.

Figure 6. Composition of EPS



Source: Measuring environmental policy stringency in OECD countries from OECD

5. Empirical strategy

Building upon the work of Clinton and Steinberg (2019), this study extends the analysis by incorporating adjustments that account for variations in potential adoption factors for Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). To assess the relationship between country-level policies and vehicle adoptions while controlling for GDP and population, this research employs a fixed-effects specification, as outlined in equations (1) and (2).

$$Ln(BEV_{c,t}) = Ln\beta_0(PurchaseSubsidy_{c,t}) + Ln\beta_1(PublicChargingPoints_{c,t}) + Ln\beta_2(ChargerInstallationSubsidy_{c,t}) + \beta_3 EPS_{c,t} + \alpha_c + \theta_t + \epsilon_{ct} \quad (1)$$

$$Ln(PHEV_{c,t}) = Ln\beta_0(PurchaseSubsidy_{c,t}) + Ln\beta_1(PublicChargingPoints_{c,t}) + Ln\beta_2(ChargerInstallationSubsidy_{c,t}) + \beta_3 EPS_{c,t} + \alpha_c + \theta_t + \epsilon_{ct} \quad (2)$$

The dependent variable, $Ln(BEV_{c,t})$, represents the natural logarithm of BEV registrations per million inhabitants in country c in year y. This paper introduces incentive variables, $Ln(PurchaseSubsidy_{c,t})$ and $Ln(ChargerInstallationSubsidy_{c,t})$, showing each country's vehicle at the maximum state incentive. It is essential to note that these findings may be inflated, as they reflect the highest possible subsidy available.

Data on public charging points are categorized by year and denote the total number of charging points in a country. Charging point availability is considered a stock measure, aiming to encompass various types of charging accessibility.

Fixed effects are incorporated in two steps within this analysis. Country-model fixed effects (α_c) are introduced to account for time-invariant, unobserved country-level variables. Additionally, year-model fixed effects (θ_t) are included in the model to accommodate changing national patterns. The assumption in this analysis is that all independent variables in the regression do not correlate with the error term ($\epsilon_{c,t}$).

The PHEV registrations and other independent variables are likewise subject to this.

6. Results

6.1. Primary Results

The estimation results for policy regressions on different sets of explanatory variables are presented in Table 3. Each column includes the GDP of each country and the entire set of fixed effects. Columns (1) and (4) show the regression of log BEV/PHEV registrations per capita on the total number of public charging points, the purchase subsidy, and the EPS. Columns (2) and (5) focus on the regression of log BEV/PHEV registrations per capita on purchase subsidies, EPS, and grants for installing public chargers. Columns (3) and (7) highlight the regression of log BEV/PHEV registrations per capita on purchase subsidies, each component of the EPS, and grants for public charger installation. Finally, columns (4) and (8) present the regression of log BEV/PHEV registrations per capita on purchase subsidies, the total number of charging stations, EPS, and grants for public charger installation.

The results indicate a positive correlation between the number of public charging points and purchase subsidies for BEVs and PHEVs, evident in columns (4) and (8). A 10% increase in purchase subsidies leads to a 1.3% increase in BEV registrations and a 0.9% increase in PHEVs. Higher coefficient estimates for BEVs compared to PHEVs suggest that many countries provide more purchase subsidies to BEV buyers. Additionally, a 10% increase in the number of public charging points results in a 10% increase in BEVs and about a 15% increase in PHEVs.

According to columns (2) and (6), BEV and PHEV adoption exhibit a positive correlation with EPS. A 1-unit increase in the EPS index corresponds to a 0.7 increase in BEV registrations and a 0.5 increase in PHEV registrations. Columns (3) and (7) show that while market-based policies have a positive association with both BEV and PHEV adoption, non-market-based policies only have a positive link with BEV adoption.

The less favorable outcomes of technology support policies in EPS could be attributed to a decrease in the degree of technology support expenditures over the past 10 years, although the results are statistically insignificant.

Finally, columns (2) and (6) demonstrate a favorable correlation between public charger installation grants and the uptake of BEVs and PHEVs. A 10% increase in grants for installing chargers results in a 1.5% increase in BEVs and a 2% increase in PHEVs.

In conclusion, the impacts of government policies on the adoption of BEV and PHEV align with expectations, with positive relationships evident between all independent variables and dependent variables. Notably, the number of public charging points emerges as the most significant government policy affecting the adoption of electric vehicles. EPS, especially market-based policies directly related to financial gains or fines is more effective. While grants for charger installation are effective, their impact is less than that of the purchase subsidy.

6.2. Robustness Check

$$\mathrm{Ln}(\mathrm{BEV}_{c,t}) = \mathrm{Ln}\beta_0(\mathrm{PurchaseSubsidy}_{c,t}) + \mathrm{Ln}\beta_1(\mathrm{PublicChargingPoints}_{c,t-1}) + \mathrm{Ln}\beta_2(\mathrm{ChargerInstallationSubsidy}_{c,t}) + \beta_3\mathrm{EPS}_{c,t} + \alpha_c + \theta_t + \epsilon_{ct} \quad (3)$$

$$\mathrm{Ln}(\mathrm{PHEV}_{c,t}) = \mathrm{Ln}\beta_0(\mathrm{PurchaseSubsidy}_{c,t}) + \mathrm{Ln}\beta_1(\mathrm{PublicChargingPoints}_{c,t-1}) + \mathrm{Ln}\beta_2(\mathrm{ChargerInstallationSubsidy}_{c,t}) + \beta_3\mathrm{EPS}_{c,t} + \alpha_c + \theta_t + \epsilon_{ct} \quad (4)$$

A significant number of public charging points were established during this period, primarily as a way for businesses to show their commitment to environmental sustainability rather than being a primary revenue source. The charging stations are considered exogenous. However, in the main result, there is a potential issue of reversed causality since the regression is based on the same year for both the number of EV registrations and the number of charging points. As the number of EV registrations increases, the government may construct more public charging points to meet the rising demand. Nevertheless, this paper aims to investigate how the number of charging points influences the number of EV registrations. To address this endogeneity problem, the number of public charging points has lagged by one year, allowing control over the mentioned issue.

Table 5 presents the results of the robustness check. The coefficient estimates from the robustness check are slightly lower than those of the primary result, but the overall outcome remains consistent with the primary result. In the robustness check, the number of public charging points continues to emerge as the most effective government policy among others.

Table 4. Regression results that considered macroeconomic variables.

	Ln(No. of accumulated BEV Registrations per million residents)				Ln(No. of accumulated PHEV Registrations per million residents)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Purchase Subsidy)	0.132*** (0.021)	0.237*** (0.033)	0.215*** (0.030)	0.126*** (0.022)	0.109*** (0.038)	0.275*** (0.056)	0.244*** (0.049)	0.091** (0.041)
Ln(No. of accumulated Public Charging Points)	1.013*** (0.054)			0.995*** (0.056)	1.494*** (0.101)			1.465*** (0.104)
EPS	0.261** (0.111)	0.714*** (0.173)		0.254** (0.112)	-0.189 (0.187)	0.537** (0.260)		-0.210 (0.189)
Market-based policies			0.701*** (0.102)				1.110*** (0.151)	
Non-Market based policies			0.453*** (0.126)				0.233 (0.201)	
Technology support policies			-0.034 (0.066)				-0.242 (0.099)	
Ln(Charger Installation Grants)		0.151*** (0.040)	0.092** (0.037)	0.035 (0.026)		0.198*** (0.063)	0.104* (0.057)	0.056 (0.045)
Observations	230	237	237	228	223	230	230	221
Adjusted R^2	0.732	0.295	0.427	0.729	0.644	0.134	0.338	0.578
Fixed-effects								
Country	Y	Y	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y	Y	Y
Macroeconomic Control								
GDP	Y	Y	Y	Y	Y	Y	Y	Y
Number of Population	Y	Y	Y	Y	Y	Y	Y	Y

Notes: The table reports the coefficient estimates and standard errors from the analysis of EV and governmental measures. The dependent variable is the log of BEV/PHEV registrations per million residents. And independent variables are log (purchase subsidy in dollars), log (number of public charging points), EPS (Environment Policy Stringency, and log (charger installation grants in dollars). The model includes Country and Year fixed effects. *p<0.1; **p<0.05; ***p<0.01

Table 5. Regression results that considered macroeconomic variables. *(Robustness Check)*

	Ln(No. of accumulated BEV Registrations per million residents)				Ln(No. of accumulated PHEV Registrations per million residents)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Purchase Subsidy)	0.133*** (0.021)	0.237*** (0.033)	0.215*** (0.030)	0.115*** (0.022)	0.139*** (0.038)	0.275*** (0.056)	0.244*** (0.049)	0.100** (0.041)
Ln(No. of accumulated lagged Public Charging Points)	0.814*** (0.045)			0.793*** (0.038)	1.173*** (0.083)			1.145*** (0.082)
EPS	0.335*** (0.111)	0.714*** (0.173)		0.309*** (0.110)	-0.107 (0.187)	0.537** (0.260)		-0.156 (0.187)
Market-based policies			0.701*** (0.102)				1.110*** (0.151)	
Non-Market based policies			0.453*** (0.126)				0.233 (0.201)	
Technology support policies			-0.034 (0.066)				-0.242** (0.099)	
Ln(Charger Installation Grants)		0.151*** (0.040)	0.092** (0.037)	0.081*** (0.025)		0.198*** (0.063)	0.104* (0.057)	0.116*** (0.044)
Observations	227	237	237	225	220	230	230	218
Adjusted R^2	0.722	0.295	0.427	0.730	0.568	0.134	0.338	0.574
Fixed-effects								
Country	Y	Y	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y	Y	Y
Macroeconomic Control								
GDP	Y	Y	Y	Y	Y	Y	Y	Y
Number of Population	Y	Y	Y	Y	Y	Y	Y	Y

The table reports the coefficient estimates and standard errors from the analysis of EV and governmental measures. The dependent variable is the log of accumulated BEV/PHEV registrations per million residents. And independent variables are log (purchase subsidy in dollars), log (accumulated number of public charging points which is lagged one year), EPS (Environment Policy Stringency, and log (charger installation grants in dollars). The model includes Country and Year fixed effects. *p<0.1; **p<0.05; ***p<0.01

7. Conclusion

7.1. Summary of Findings and Implications

This study aims to assess the effects of government policies on the adoption of Electric Vehicles (EVs), focusing on 30 different countries. Another distinctive aspect of this paper is its emphasis on grants for installing chargers, an area with limited existing literature. Consequently, this paper provides unique insights.

All government policies examined in this paper, including purchase subsidies, the number of public charging points, Environmental Policy Stringency (EPS), and grants for installing chargers, exhibit positive impacts on EV registrations. Among these, public charging infrastructure is identified as the most effective policy. According to the International Energy Agency (IEA), the ratio of public charging points per Battery Electric Vehicle (BEV) decreases in countries with a higher BEV stock share, emphasizing the crucial role of accessible and affordable charging infrastructure in sustaining EV sales. With budget constraints, prioritizing the construction of public charging points is recommended, alleviating concerns for existing and potential EV buyers.

EPS also influences EV adoption, with market-based policies deemed more impactful than non-market-based policies and technology support. Countries are increasingly strengthening both market and non-market-based policies to incentivize EV purchases. Strict criteria based on non-market-based policies for market-based policies, such as incentives or taxes, and investment in Research and Development (R&D) for EVs are crucial considerations.

Purchase subsidies, widely implemented in many countries, prove to be powerful incentives for EV buyers. Advanced countries with high EV stock have successfully employed these subsidies, as they effectively reduce the overall cost of EVs, influencing purchasing decisions positively.

Lastly, the impact of grants for constructing public charging points on EV registrations, while not as substantial, demonstrates a positive relationship. Overcoming obstacles to installing public charging points near residential areas is a challenge, but once in place, it facilitates easier EV charging. Despite the limited adoption of this policy, grants for charger installation address critical factors, making them a significant consideration in boosting EV numbers on the road.

7.2. Limitations and Further Analysis

This study acknowledges several limitations that should be considered in interpreting the findings. Firstly, the results are confined to the 30 countries examined over the 8-year period, which may not be fully representative of global trends. The predominant focus on European countries, particularly middle to high-income countries, in the analysis, limits the generalizability of the results. Future research should strive for greater diversity by including various countries from different continents and with varying GDPs to ensure a more comprehensive and balanced understanding of the factors influencing EV adoption. Alternatively, research conducted on countries with comparable Electric Vehicle (EV) penetration levels or similar income brackets (GDP) can help validate the effectiveness of specific policies for similar countries.

Secondly, the use of the Environmental Policy Stringency (EPS) index, which encompasses all industries related to climate change and air pollution, may present challenges in isolating the impact specifically on the automobile industry. Further index to make it specifically to the automotive sector could enhance the precision of the findings.

Lastly, the study acknowledges that some individuals may be willing to transition from Internal Combustion Engine Vehicles (ICEVs) to EVs even in the absence of purchase subsidies. To better understand the direct and independent effect of purchase subsidies on EV adoption, future research could explore this aspect more explicitly.

7.3. Recommendation

Despite these limitations, the study highlights the importance of implementing robust policies to address existing concerns and barriers to EV adoption.

Given that charging infrastructure remains a primary concern for EV usage, the construction of charging points emerges as the foremost solution to bolster EV adoption.

Implementing policies in a phased approach, based on the level of EV adoption is also important. During the initial stage of EV adoption, providing purchase subsidies to reduce purchase costs is needed. As the prevalence of EVs has grown, so has the demand for charging infrastructure. So, installing public charging points will help to alleviate the anxiety of charging issues. Now, financial support is available for the installation of chargers, so offering subsidies for the installation of EV chargers at homes or workplaces will facilitate convenient charging. In response to the increasing popularity of EVs, more stringent regulations have been implemented compared to earlier standards for ICEVs. Based on a strict criterion, providing financial incentives to EVs, or levying tax on Internal Combustion Engine Vehicles (ICEVs) may be another viable solution.

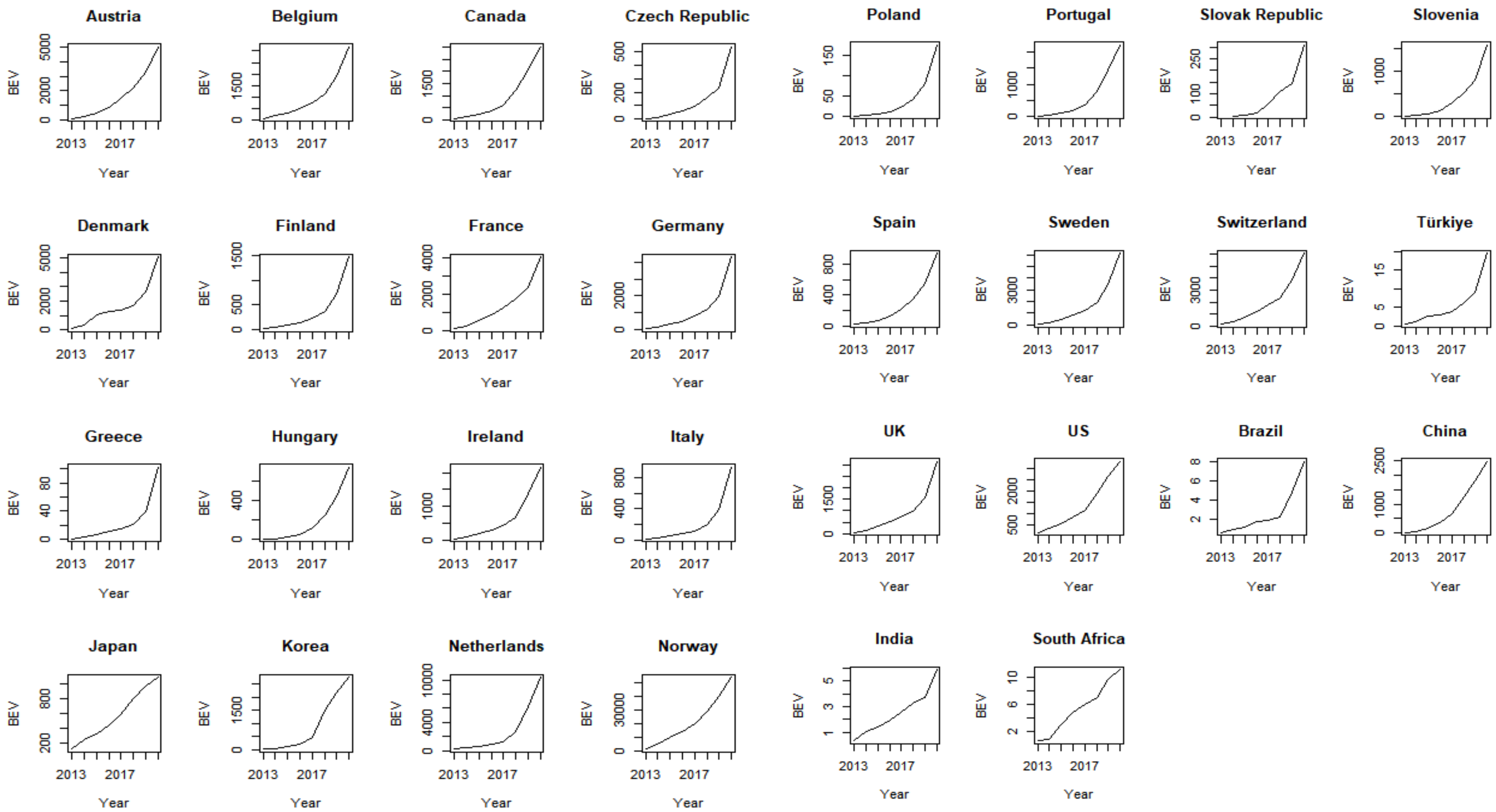
This shift ensures that each country is aware of the specific stage of EV supply, allowing for the enactment of laws tailored to that stage. This strategic approach aims to effectively expand the adoption of EVs and support their integration into the transportation landscape.

Providing financial incentives to EV or EV-related material manufacturers is also important to lower the price itself from production. And setting ambitious targets, such as prohibiting the sale of ICEV, is important for expanding the electric vehicle market.

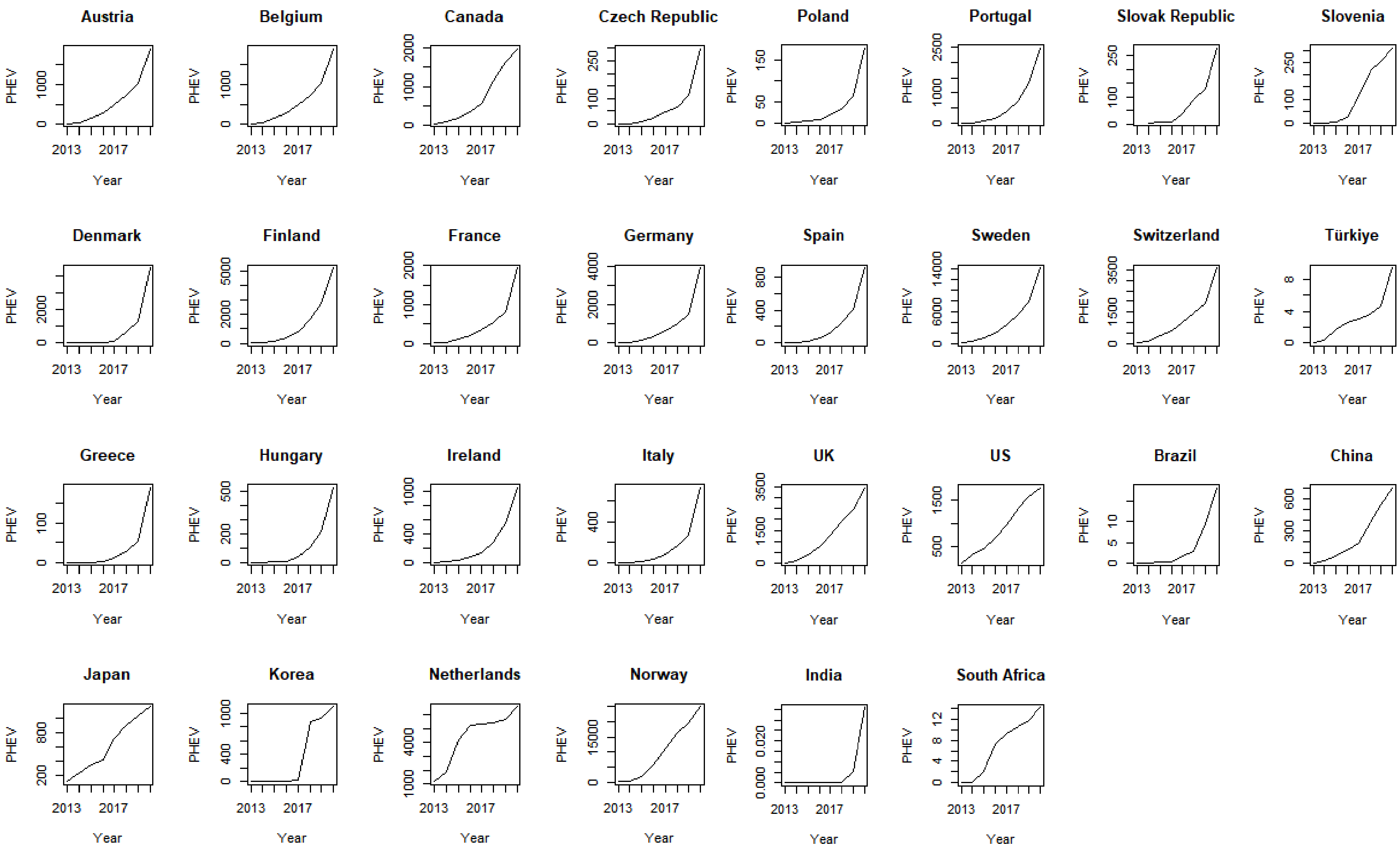
These policies will help meet the demand efficiently, ensuring an extended reach for EVs while staying within financial limitations.

Appendix

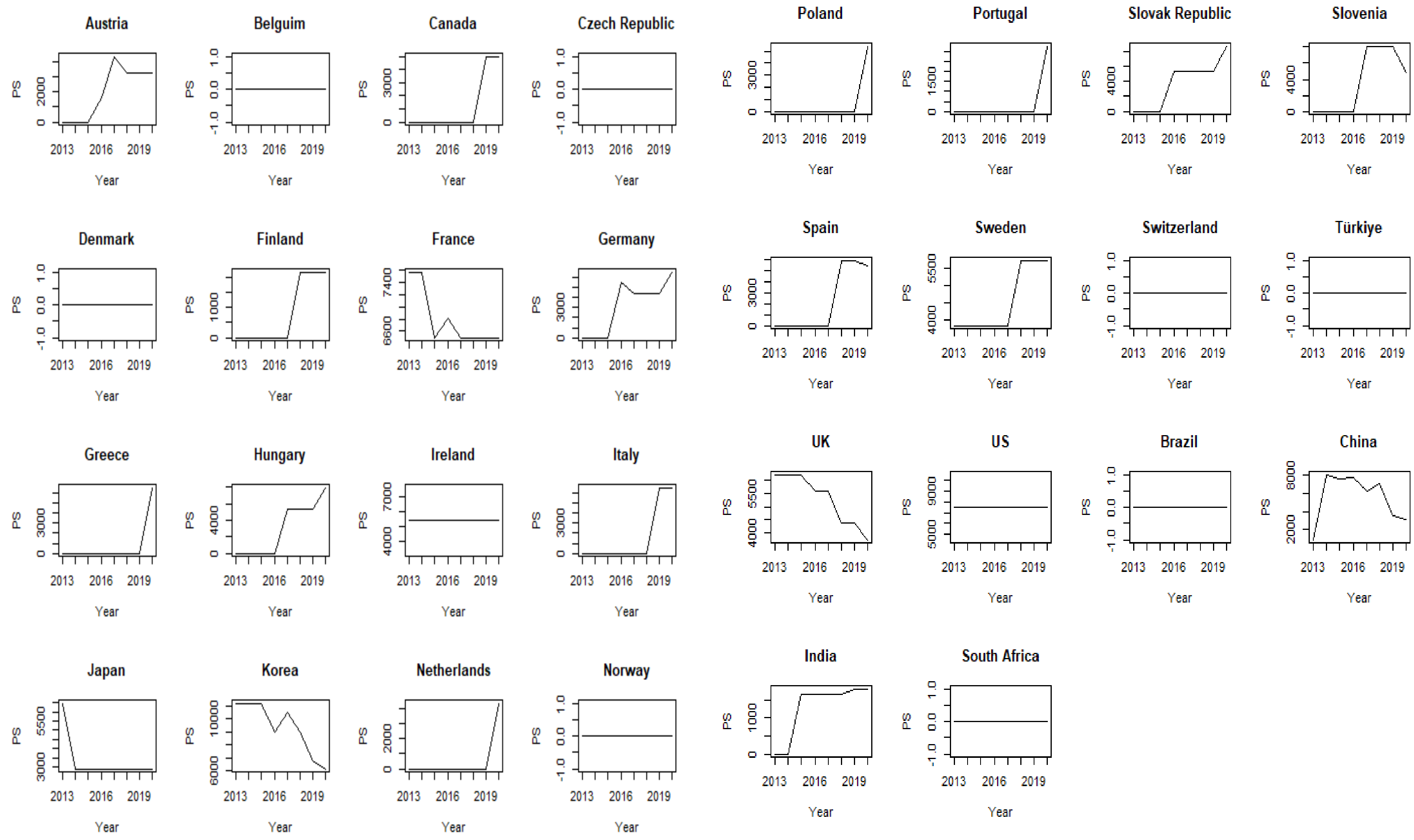
[Registration of BEV (No. of accumulated BEV Registrations per million residents)]



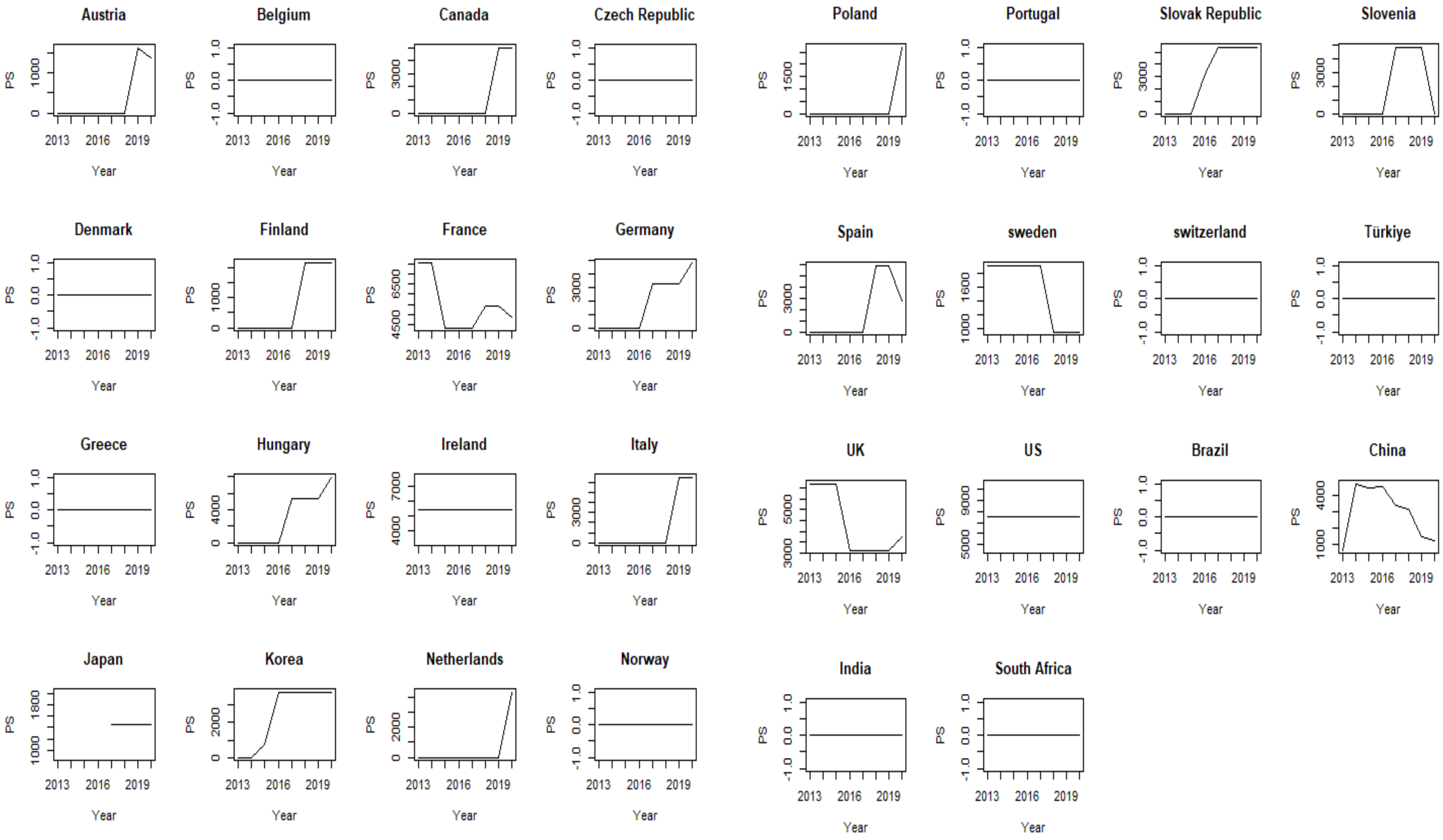
[Registration of PHEV (No. of accumulated PHEV Registrations per million residents)]



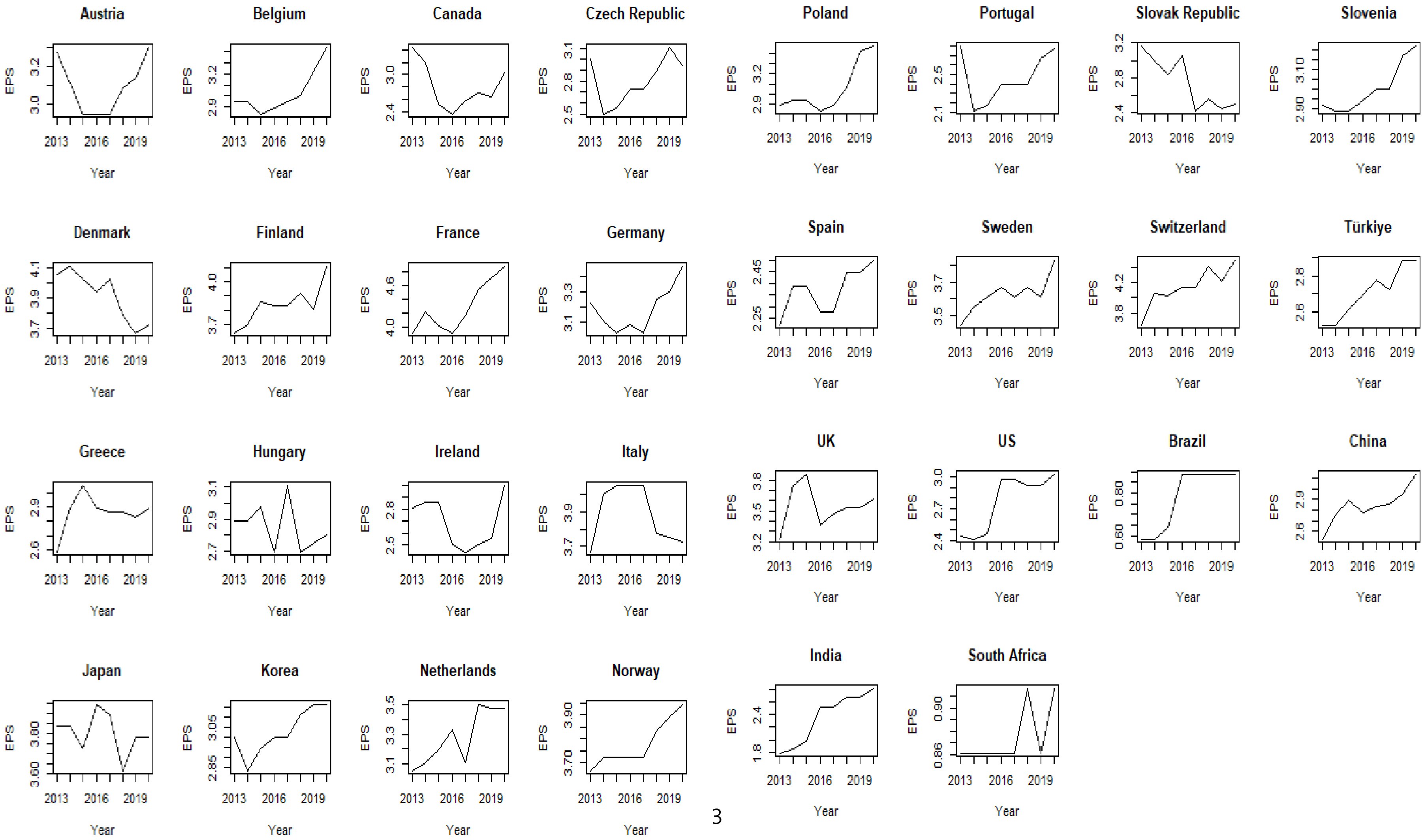
[BEV purchase subsidy ($)]



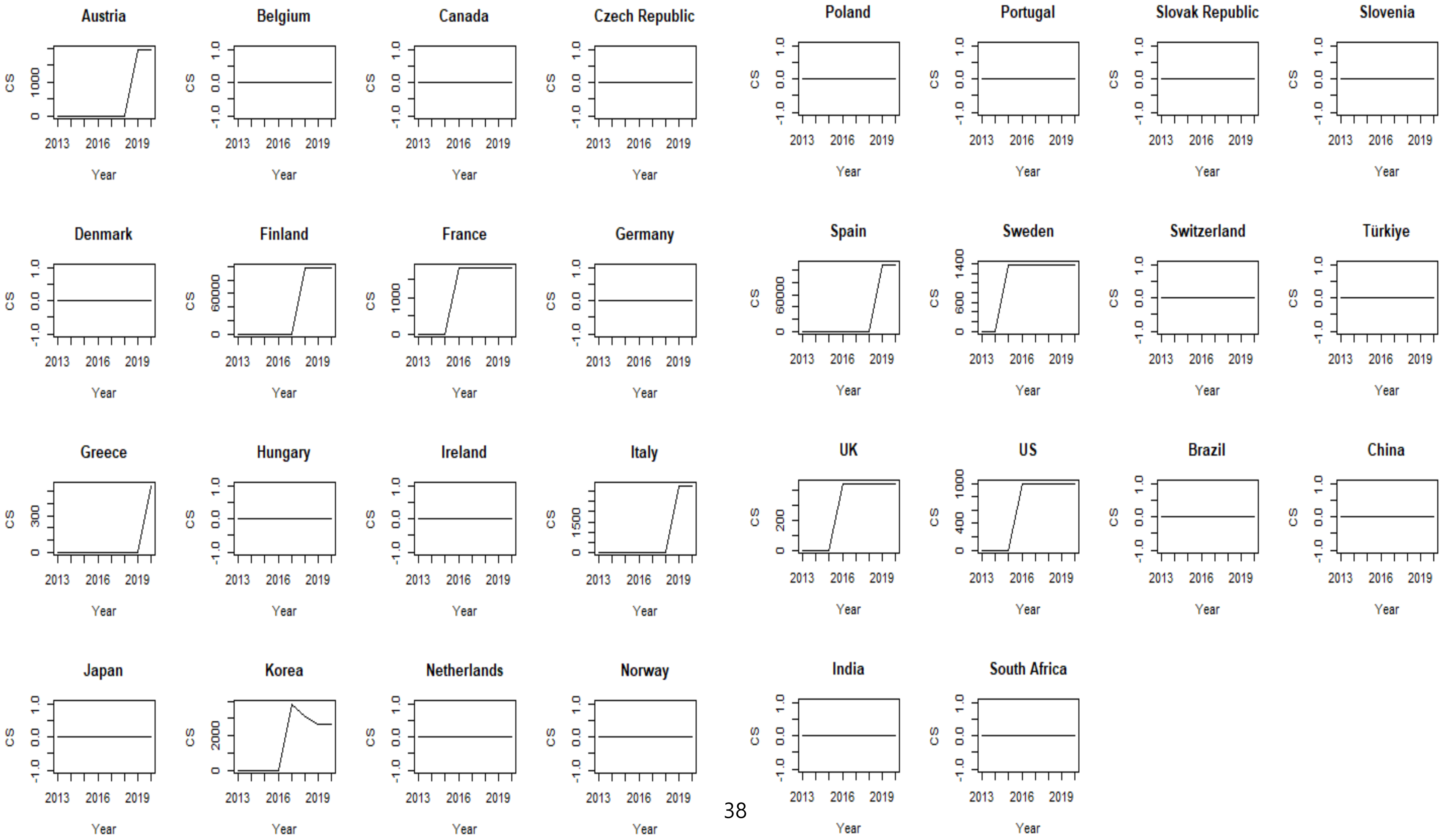
[PHEV purchase subsidy ($)]



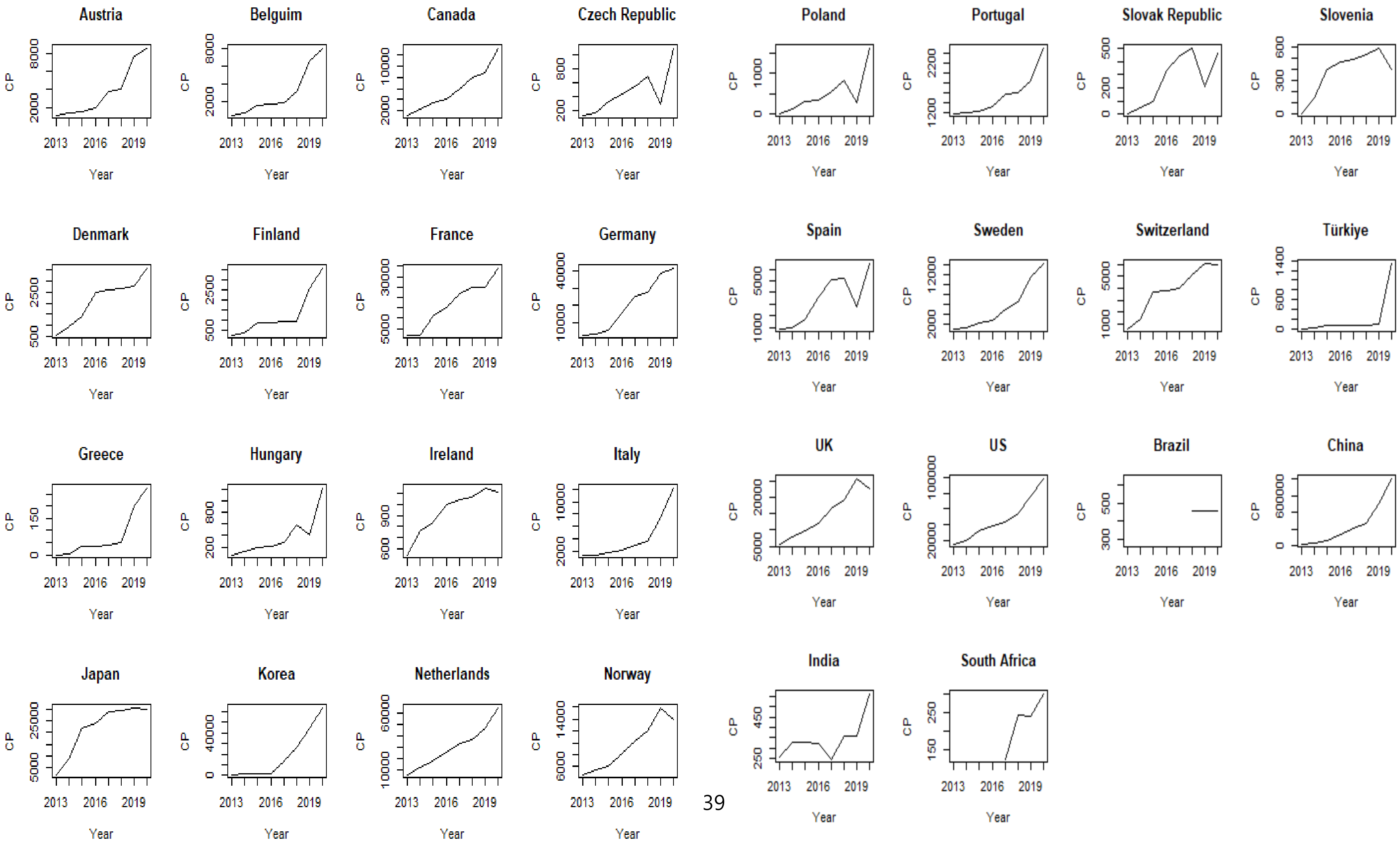
[EPS index]


Austria
Belgium
Canada
Czech Republic
Poland
Portugal
Slovak Republic
Slovenia
Denmark
Finland
France
Germany
Spain
Sweden
Switzerland
Türkiye
Greece
Hungary
Ireland
Italy
UK
US
Brazil
China
Japan
Korea
Netherlands
Norway
India
South Africa
EPS
Year

[Grants for installation of charger ($)]



[Number of accumulated public charging points]



Summary statistics

[Austria]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1697.79	1730.75	77.38	5032.49
-Accumulated PHEVs per million residents	576.81	640.87	9.43704	1898.99
Environmental Policy				
-EPS	3.09	0.14	2.94	3.30
Charging Points				
-Number of accumulated public charging points	3798.87	2899.03	1173	8587
Subsidy				
-BEV purchase subsidy ($)	1961.27	1781.27	0	4328.32
-PHEV purchase subsidy ($)	371.96	692.52	0	1623.12
-Subsidy for installation of charger ($)	493.65	914.06	0	1974.6

[Belgium]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	992.13	1063.18	44.40	3174.60
-Accumulated PHEVs per million residents	1958.52	2189.33	5.39	6338.17
Environmental Policy				
-EPS	3.02	0.20	2.83	3.44
Charging Points				
-Number of accumulated public charging points	2940.62	2851.88	378	8091
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Canada]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	967.49	1069.67	45.60	3015.46
-Accumulated PHEVs per million residents	743.12	736.69	42.75	1963.86
Environmental Policy				
-EPS	2.80	0.37	2.36	3.44
Charging Points				
-Number of accumulated public charging points	5894.37	4007.11	1207	13300
Subsidy				
-BEV purchase subsidy ($)	1250	2314.55	0	5000
-PHEV purchase subsidy ($)	1250	2314.55	0	5000
-Subsidy for installation of charger ($)	0	0	0	0

[Czech Republic]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	141.98	178.62	3.13	538.49
-Accumulated PHEVs per million residents	69.53	99.48	0.38	296.81
Environmental Policy				
-EPS	2.80	0.21	2.5	3.11
Charging Points				
-Number of accumulated public charging points	457.37	318.75	128	1097
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Denmark]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1693.32	1553.45	88.61	5300.95
-Accumulated PHEVs per million residents	820.99	1533.85	1.24	4443.86
Environmental Policy				
-EPS	3.91	0.16	3.66	4.11
Charging Points				
-Number of accumulated public charging points	2133.87	1047.6	552	3607
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Finland]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	379.56	498.39	8.82	1476.25
-Accumulated PHEVs per million residents	1384.06	1808.74	24.45	5172.57
Environmental Policy				
-EPS	3.83	0.14	3.63	4.11
Charging Points				
-Number of accumulated public charging points	1317.87	1165.64	267	3619
Subsidy				
-BEV purchase subsidy ($)	811.56	1120.059	0	2164.16
-PHEV purchase subsidy ($)	811.56	1120.059	0	2164.16
-Subsidy for installation of charger ($)	37023.75	51097.63	0	98730

[France]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1427.98	1304.49	130.56	4042.53
-Accumulated PHEVs per million residents	501.73	642.18	12.32	1930.62
Environmental Policy				
-EPS	4.30	0.37	3.91	4.88
Charging Points				
-Number of accumulated public charging points	16940.5	11688.65	1802	34300
Subsidy				
-BEV purchase subsidy ($)	7574.56	488.86	6792.48	7574.56
-PHEV purchase subsidy ($)	5478.03	1369.88	4328.32	7574.56
-Subsidy for installation of charger ($)	1138.13	942.46	0	1821.02

[Germany]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1171.22	1403.14	67.38	4275.88
-Accumulated PHEVs per million residents	956.31	1312.26	5.51	3932.55
Environmental Policy				
-EPS	3.18	0.15	3.02	3.47
Charging Points				
-Number of accumulated public charging points	20051.25	15815.14	2447	42001
Subsidy				
-BEV purchase subsidy ($)	3110.98	2678.011	0	6492.48
-PHEV purchase subsidy ($)	1826.01	2023.09	0	4869.36
-Subsidy for installation of charger ($)	0	0	0	0

[Greece]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	24.87	33.50	0.27	102.25
-Accumulated PHEVs per million residents	35.74	65.34	0	190.58
Environmental Policy				
-EPS	2.85	0.12	2.58	3.05
Charging Points				
-Number of accumulated public charging points	79.37	102.19	0	276
Subsidy				
-BEV purchase subsidy ($)	811.56	2295.43	0	6492.48
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	68.56	193.92	0	548.5

[Hungary]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	205.38	266.94	1.41	747.68
-Accumulated PHEVs per million residents	112.05	182.31	0	522.24
Environmental Policy				
-EPS	2.85	0.14	2.69	3.11
Charging Points				
-Number of accumulated public charging points	384.87	381.71	63	1231
Subsidy				
-BEV purchase subsidy ($)	3023.06	3337.25	0	7953.29
-PHEV purchase subsidy ($)	3023.06	3337.25	0	7953.29
-Subsidy for installation of charger ($)	0	0	0	0

[Ireland]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	655.90	742.29	36.18	2157.73
-Accumulated PHEVs per million residents	268.55	368.11	1.51	1052.14
Environmental Policy				
-EPS	2.69	0.21	2.44	3
Charging Points				
-Number of accumulated public charging points	937	203.14	551	1145
Subsidy				
-BEV purchase subsidy ($)	5410.4	0	5410.4	5410.4
-PHEV purchase subsidy ($)	5410.4	0	5410.4	5410.4
-Subsidy for installation of charger ($)	0	0	0	0

[Italy]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	229.63	309.09	14.02	934.28
-Accumulated PHEVs per million residents	164.09	247.76	2.68	732.83
Environmental Policy				
-EPS	3.88	0.17	3.66	4.05
Charging Points				
-Number of accumulated public charging points	4106.37	3885.95	1356	12303
Subsidy				
-BEV purchase subsidy ($)	1623.12	3005.43	0	6492.48
-PHEV purchase subsidy ($)	1623.12	3005.43	0	6492.48
-Subsidy for installation of charger ($)	822.75	1523.43	0	3291

[Japan]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	570.11	351.58	117.72	1086.04
-Accumulated PHEVs per million residents	611.65	388.46	109.87	1152.63
Environmental Policy				
-EPS	3.79	0.10	3.61	3.94
Charging Points				
-Number of accumulated public charging points	22037.5	10994.8	1800	30900
Subsidy				
-BEV purchase subsidy ($)	3347.18	1260.18	2901.64	6565.99
-PHEV purchase subsidy ($)	725.41	775.49	0	1450.82
-Subsidy for installation of charger ($)	0	0	0	0

[Republic of Korea]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	904.31	1087.58	11.89	2752.9
-Accumulated PHEVs per million residents	367.11	499.20	0	1092.86
Environmental Policy				
-EPS	3.02	0.11	2.83	3.16
Charging Points				
-Number of accumulated public charging points	19264	23897.75	892	63800
Subsidy				
-BEV purchase subsidy ($)	9371.28	2043.86	6135.29	11223.09
-PHEV purchase subsidy ($)	2431.67	1821.78	0	3741.03
-Subsidy for installation of charger ($)	1540.39	1684.90	0	3850.99

[Netherlands]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	2820.31	3641.25	185.54	10377.38
-Accumulated PHEVs per million residents	4423.85	1915.59	1170.70	6551.90
Environmental Policy				
-EPS	3.28	0.18	3.05	3.5
Charging Points				
-Number of accumulated public charging points	30451.88	19261.71	5878	64583
Subsidy				
-BEV purchase subsidy ($)	540.77	1529.54	0	4326.2
-PHEV purchase subsidy ($)	540.77	1529.54	0	4326.2
-Subsidy for installation of charger ($)	0	0	0	0

[Norway]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	21834.43	18219.4	1550.14	54148.25
-Accumulated PHEVs per million residents	10076.98	9498.34	96.25	24968.81
Environmental Policy				
-EPS	3.77	0.09	3.66	3.94
Charging Points				
-Number of accumulated public charging points	9568.37	4188.53	4655	15947
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Poland]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	42.41	59.86	0.67	175.36
-Accumulated PHEVs per million residents	38.47	60.12	0.12	177.58
Environmental Policy				
-EPS	3.05	0.24	2.83	3.47
Charging Points				
-Number of accumulated public charging points	504.25	525.40	4	1639
Subsidy				
-BEV purchase subsidy ($)	675.96	1911.92	0	5407.75
-PHEV purchase subsidy ($)	337.98	955.96	0	2703.88
-Subsidy for installation of charger ($)	0	0	0	0

[Portugal]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	642.46	802.31	15.96	2215.38
-Accumulated PHEVs per million residents	645.36	868.56	0.66	2472.35
Environmental Policy				
-EPS	2.46	0.26	2.11	2.80
Charging Points				
-Number of accumulated public charging points	1553.12	457.39	1171	2515
Subsidy				
-BEV purchase subsidy ($)	405.58	1147.15	0	3244.65
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Slovak Republic]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	80.94	106.09	0	308.12
-Accumulated PHEVs per million residents	68.64	96.28	0	276.61
Environmental Policy				
-EPS	2.74	0.30	2.41	3.17
Charging Points				
-Number of accumulated public charging points	384.87	381.71	63	1231
Subsidy				
-BEV purchase subsidy ($)	3785.42	3321	0	8652.4
-PHEV purchase subsidy ($)	3109.45	2676.7	0	5407.75
-Subsidy for installation of charger ($)	0	0	0	0

[Slovenia]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	423.92	545.97	0	1585.14
-Accumulated PHEVs per million residents	114.93	128.10	0	309.50
Environmental Policy				
-EPS	3	0.12	2.88	3.22
Charging Points				
-Number of accumulated public charging points	382.75	203.04	4	596
Subsidy				
-BEV purchase subsidy ($)	3650.23	4044.21	0	8111.63
-PHEV purchase subsidy ($)	1825.11	2518.90	0	4866.98
-Subsidy for installation of charger ($)	0	0	0	0

[Spain]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	289.02	319.22	20.08	941.21
-Accumulated PHEVs per million residents	221.01	307.85	1.56	901.18
Environmental Policy				
-EPS	2.36	0.09	2.22	2.5
Charging Points				
-Number of accumulated public charging points	3335.5	2135.13	897	6537
Subsidy				
-BEV purchase subsidy ($)	2163.09	2990.02	0	5948.52
-PHEV purchase subsidy ($)	1838.63	2715.89	0	5948.52
-Subsidy for installation of charger ($)	27425	50781.23	0	109700

[Sweden]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1788.97	2068.61	47.18	6114.10
-Accumulated PHEVs per million residents	4345.66	4805.95	114.89	14200.4
Environmental Policy				
-EPS	3.62	0.11	3.44	3.83
Charging Points				
-Number of accumulated public charging points	5565.62	4982.81	1020	14450
Subsidy				
-BEV purchase subsidy ($)	4529.38	987.02	3814.22	5721.33
-PHEV purchase subsidy ($)	1549.52	493.51	953.55	1907.11
-Subsidy for installation of charger ($)	1039.62	641.67	0	1386.17

[Switzerland]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	2046.38	2031.31	122.87	6072
-Accumulated PHEVs per million residents	1131.02	1194.73	20.520	3589.65
Environmental Policy				
-EPS	4.14	0.26	3.63	4.5
Charging Points				
-Number of accumulated public charging points	3841.37	1985.96	627	6103
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[Türkiye]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	5.70	6.24	0.40	19.53
-Accumulated PHEVs per million residents	3.16	2.97	0.01	9.39
Environmental Policy				
-EPS	2.70	0.14	2.52	2.88
Charging Points				
-Number of accumulated public charging points	221.62	458.88	1	1354
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[UK]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	936.51	1023.16	39.60	3157.27
-Accumulated PHEVs per million residents	1293.36	1215.79	14.07	3430.31
Environmental Policy				
-EPS	3.54	0.20	3.22	3.86
Charging Points				
-Number of accumulated public charging points	14968	7237.91	5691	25840
Subsidy				
-BEV purchase subsidy ($)	5288.63	997.72	3733.15	6221.92
-PHEV purchase subsidy ($)	4355.34	1559.91	3110.96	6221.92
-Subsidy for installation of charger ($)	280.84	232.56	0	449.35

[US]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	1361.55	1131.61	151.86	3285.05
-Accumulated PHEVs per million residents	906.75	599.34	155.03	1758.66
Environmental Policy				
-EPS	2.76	0.27	2.41	3.02
Charging Points				
-Number of accumulated public charging points	47275	28637.28	15000	99000
Subsidy				
-BEV purchase subsidy ($)	7500	0	7500	7500
-PHEV purchase subsidy ($)	7500	0	7500	7500
-Subsidy for installation of charger ($)	625	517.54	0	1000

[Brazil]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	2.72	2.50	0.64	8.02
-Accumulated PHEVs per million residents	4.22	6.43	0.16	18.07
Environmental Policy				
-EPS	0.78	0.14	0.58	0.88
Charging Points				
-Number of accumulated public charging points				
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[China]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	845.05	915.69	10.90	2473.1
-Accumulated PHEVs per million residents	252.80	263.03	0	704.59
Environmental Policy				
-EPS	2.84	0.17	2.52	3.13
Charging Points				
-Number of accumulated public charging points	256500	275876.3	19000	810000
Subsidy				
-BEV purchase subsidy ($)	5577.10	2693.84	853.91	8112.15
-PHEV purchase subsidy ($)	2943.32	1657.95	597.74	4732.09
-Subsidy for installation of charger ($)	0	0	0	0

[India]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	2.51	1.76	0.31	5.87
-Accumulated PHEVs per million residents	0.005	0.01	0	0.03
Environmental Policy				
-EPS	2.36	0.42	1.77	2.83
Charging Points				
-Number of accumulated public charging points	344.37	98.25	245	565
Subsidy				
-BEV purchase subsidy ($)	1290.23	798.87	0	1817.22
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

[South Africa]

	Mean	S.D.	Min	Max
Yearly vehicle registrations				
-Accumulated BEVs per million residents	5.355	3.798	0.635	11.018
-Accumulated PHEVs per million residents	6.87	5.49	0	14.05
Environmental Policy				
-EPS	0.87	0.02	0.86	0.91
Charging Points				
-Number of accumulated public charging points				
Subsidy				
-BEV purchase subsidy ($)	0	0	0	0
-PHEV purchase subsidy ($)	0	0	0	0
-Subsidy for installation of charger ($)	0	0	0	0

Regression results by continent (European Countries)

	Ln(No. of accumulated BEV Registrations per million residents)				Ln(No. of accumulated PHEV Registrations per million residents)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Purchase Subsidy)	0.139***	0.266***	0.249***	0.127***	0.107*	0.276***	0.269***	0.084
Ln(No. of accumulated Public Charging Points)	0.965***			0.954***	1.486***			1.463***
EPS	0.326*	0.921***		0.327*	0.018	0.883**		0.022
Market-based policies			0.633***				1.082***	
Non-Market based policies			1.174***				1.623***	
Technology support policies			0.038				-0.218	
Ln(Charger Installation Grants)		0.095*	0.049	0.041		0.162*	0.059	0.071
Observations	175	175	175	175	172	172	172	172
Adjusted R^2	0.704	0.343	0.484	0.705	0.574	0.145	0.402	0.577
Fixed-effects								
Country	Y	Y	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y	Y	Y
Macroeconomic Control								
GDP	Y	Y	Y	Y	Y	Y	Y	Y
Number of Population	Y	Y	Y	Y	Y	Y	Y	Y

Notes: The table reports the coefficient estimates and standard errors from the analysis of EV and governmental measures. The dependent variable is the log of BEV/PHEV registrations per million residents. And independent variables are log (purchase subsidy in dollars), log (number of public charging points), EPS (Environment Policy Stringency, and log (charger installation grants in dollars). The model includes Country and Year fixed effects. *p<0.1; **p<0.05; ***p<0.01

Regression results by continent (Asia Countries)

	Ln(No. of accumulated BEV Registrations per million residents)				Ln(No. of accumulated PHEV Registrations per million residents)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Purchase Subsidy)	0.104	-0.076	-0.144	0.101	0.245	0.229	0.044	0.226
Ln(No. of accumulated Public Charging Points)	0.941***	1.114*		0.886***	1.286***			1.202**
EPS	0.391	0.350***		0.402	-1.170*	-0.680		-1.149*
Market-based policies			1.162**	0.039			0.982	
Non-Market based policies			0.363				-0.524	
Technology support policies			0.074				-0.471	
Ln(Charger Installation Grants)			0.197*			0.007***	0.393	0.059
Observations	31	31	31	31	27	27	27	27
Adjusted R^2	0.866	0.541	0.672	0.863	0.592	0.415	0.404	0.572
Fixed-effects								
Country	Y	Y	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y	Y	Y
Macroeconomic Control								
GDP	Y	Y	Y	Y	Y	Y	Y	Y
Number of Population	Y	Y	Y	Y	Y	Y	Y	Y

Notes: The table reports the coefficient estimates and standard errors from the analysis of EV and governmental measures. The dependent variable is the log of BEV/PHEV registrations per million residents. And independent variables are log (purchase subsidy in dollars), log (number of public charging points), EPS (Environment Policy Stringency, and log (charger installation grants in dollars). The model includes Country and Year fixed effects. *p<0.1; **p<0.05; ***p<0.01

Regression results by continent (American Countries)

Notes: The table reports the coefficient estimates and standard errors from the analysis of EV and governmental measures. The dependent variable is the log of BEV/PHEV registrations per

	Ln(No. of accumulated BEV Registrations per million residents)				Ln(No. of accumulated PHEV Registrations per million residents)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Purchase Subsidy)	0.037	0.263**	0.139	0.052	0.040	0.237	0.129	0.053
Ln(No. of accumulated Public Charging Points)	1.668***			1.562***	1.481***			1.385***
EPS	-0.042	-0.345		-0.123	-0.124	-0.100		-0.198
Market-based policies			0.929				0.808	
Non-Market based policies			0.586				1.537**	
Technology support policies			-0.280**				-0.277*	
Ln(Charger Installation Grants)		0.325**	-0.092	0.041		0.224	-0.604**	0.037
Observations	19	24	24	19	19	24	24	19
Adjusted R^2	0.935	0.393	0.670	0.933	0.841	0.030	0.593	0.830
Fixed-effects								
Country	Y	Y	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y	Y	Y
Macroeconomic Control								
GDP	Y	Y	Y	Y	Y	Y	Y	Y
Number of Population	Y	Y	Y	Y	Y	Y	Y	Y

million residents. And independent variables are log (purchase subsidy in dollars), log (number of public charging points), EPS (Environment Policy Stringency, and log (charger installation grants in dollars). The model includes Country and Year fixed effects. *p<0.1; **p<0.05; ***p<0.01

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