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DOES THE BBN KB INCENTIVE POLICY INCREASE OWNERSHIP OF BATTERY-BASED ELECTRIC VEHICLES? INDONESIA CASE STUDY

Risza Galas Ramadhan[1], Khoirunurrofik[2]
Universitas Indonesia
Email: risza.galas@gmail.com

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Tax Incentives, vehicle registration fees, Battery Electric Vehicles, Indonesia

ABSTRACT

Indonesia's commitment by 2060 is to reduce greenhouse gas emissions and realize net zero emissions. The transition of electric vehicles in the transportation sector with renewable energy is a solution to reduce emissions. However, the ownership rate of battery-based electric vehicles in Indonesia is still low. This study empirically discusses the effect of the BBN KB incentive policy designed to encourage ownership of battery-based electric vehicles in Indonesia. To determine the effect of the BBN KB incentive policy on battery-based electric vehicle ownership, a Moderated Regression Analysis (MRA) panel data analysis with Pooled Ordinary Least Square (POLS) estimation technique is used using secondary data from 34 provinces in Indonesia from 2019-2022. The results of the analysis found that the BBN KB incentive policy has a significant effect on increasing ownership of electric vehicles, especially battery-based electric cars in Indonesia. The factors of the number of charging infrastructure (SPKLU), consumer awareness, fuel prices, and open unemployment rates have a significant influence on ownership of battery-based electric motorized vehicles. Analysis on the island of Java explains that there is a significant effect on increasing ownership of battery-based electric car vehicles after the policy is implemented, while on non-Java island the BBN KB incentive policy shows an insignificant impact on increasing ownership of battery-based electric vehicles, especially 4-wheelers.

INTRODUCTION

Climate change has become an international issue in recent years because it poses multidimensional threats to ecology, the environment, the economy, and society. Global temperatures are currently estimated to be about 1.20°C above the average temperature in pre-industrial times (Organization, 2022) and 2022 will be the sixth warmest year since 1880 (National Oceanic and Atmospheric Administration, 2023). Projections by 2100, even if emissions are significantly reduced and global warming is kept to less than 2°C, sea levels could still rise by 30 to 60 centimeters (Affairs, 2022).

One of the main contributors to climate change is greenhouse gas emissions resulting from various human activities. Four gaseous components, namely carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), and Fluorinated gases (F-gases), form greenhouse gas emissions at the global level. CO2 gas is mainly produced from the use of fossil fuels, while waste incineration, energy use, and biomass burning produce methane gas. In addition, agricultural activities such as the use of fertilizers generate N2O gas, while F-gases are sourced due to industrial activities, the use of refrigeration machinery, and other consumer products.

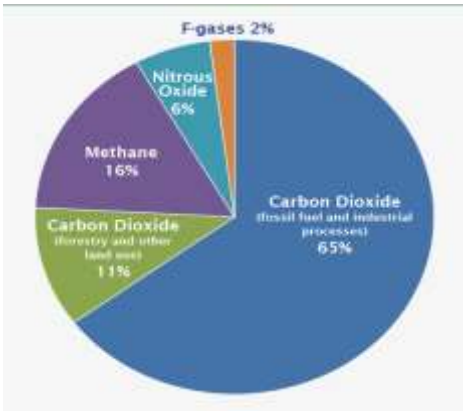

Figure 1
Greenhouse Gas Formers
Source: IPCC (2014)

As shown in Figure 1, CO2 is the largest component in the formation of greenhouse gas emissions with a share of 65% sourced from fossil fuels and industrial processes and 11% from forest burning processes, so that overall it contributes 76% of the amount of greenhouse gases created. Therefore, the main focus in efforts to reduce global climate change is to encourage the reduction of CO2 emissions.

Indonesia's greenhouse gas emissions totaled 950 MtCO2eq and were among the largest in the world in 2018 (Gütschow et al., 2016).

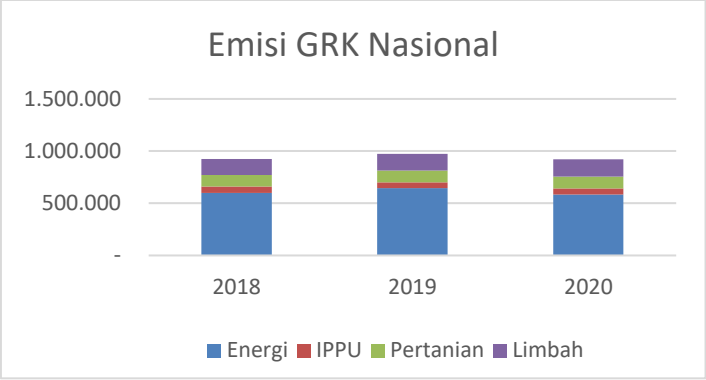

Figure 2
National Greenhouse Gas Emissions Chart

According to data from the 2021 Greenhouse Gas Inventory (GHG) and Monitoring, Reporting, Verification (MPV) report prepared by the Ministry of Environment and Forestry as shown in Figure 2 above, greenhouse gas contributors are dominated by four sectors, namely energy, Industrial Process and Product Use (IPPU), agriculture, and waste. The energy sector as the largest contributor of more than 60% mainly comes from the energy and transportation industry which still depends on the use of fossil energy as the main fuel. The consequence of Indonesia's dependence on fossil fuels is an increase in the National Budget for fuel subsidies and an increase in CO2 emissions.

Fossil fuel use from motor vehicles is a major contributor to pollution and greenhouse gases. Data shows that in Indonesia 90% of traffic activities are motorized vehicles (IESR,

2020). According to (I. C. Setiawan, 2019) 85% of total greenhouse gas emissions are generated by motor vehicles, which include cars and motorcycles. The use of motorized vehicles can cause negative externalities in the form of carbon emissions, air pollution, congestion, and accidents (Kotchen et al., 2019).

Indonesia has committed to reduce greenhouse gas emissions and move towards net zero emissions by 2060. Indonesia's seriousness in mitigating climate change is the basis for the government in formulating Indonesia's NDC (Nationally Determined Contributions). The Indonesian government has integrated mitigation and adaptation elements to achieve the NDC goal of reducing 31.89% of carbon emissions nationally and 43.20% with international assistance by 2030 (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, 2022). The goal is to achieve a low-emission and climate-resilient Indonesia in the future.

The transportation sector consumes 428.61 million BOE (Barrel Oil Equivalent) or about 36.15% of the final energy consumption of 1,185.56 million BOE in 2022 (Ministry of Energy and Mineral Resources, 2023). The high energy use in the transportation sector is reflected in the number of vehicles in Indonesia that are still dominated by conventional vehicles (ICE), namely 126 million motorcycle units, 19 million car units, and 7 million freight car units (Perhubungan, 2023). It is known that the life cycle emissions of battery-based electric motorized vehicles (KBLBB) are the lowest when compared to conventional vehicles. Therefore, to support emission reduction, the government projects as many as 2 million units of electric cars and 13 million units of electric motorcycles operating on the road by 2030 (V. N. Setiawan, 2023). Furthermore, the government targets the production of 9 million units of two-wheeled and three-wheeled electric motorcycles and 600 thousand units of electric cars and electric buses by 2030 (Junida, 2023). It is expected that the use of 2 million electric cars by 2030 will reduce fuel imports by 3 million kiloliters and reduce CO2 emissions by 6.42 million tons/year.

Three types of electric vehicles exist in many countries including Indonesia. First, a Hybrid Electric Vehicle (HEV) is a vehicle that uses an internal combustion engine (ICE) but has electric power as a backup. Second, Plug Hybrid Electric Vehicle (PHEV) is a vehicle that combines two types of engines at once, namely internal combustion engines and batteries. Third, Battery Electric Vehicle (BEV) is a vehicle that entirely uses electricity as an energy source (Hendarmin et al., 2023).

One of the barriers to the adoption of electric vehicles in Indonesia is the high purchase price (Sidabutar, 2020). The price of electric cars is mostly more than Rp. 600 million while the price of conventional cars is mostly priced at less than Rp. 300 million (Santika, 2023). Furthermore (Riyanto et al., 2019) explained that in general, battery-based electric cars (BEVs) still have the highest total cost ownership (TCO) when compared to conventional vehicles (ICE). According to (Tláskalová, 2021) to support the use of electric vehicles (EVs), it is necessary to implement various incentive schemes and policies so that electric vehicles become competitive with conventional vehicles. This is in line with the government which has stipulated Presidential Regulation Number 55 of 2019 concerning the Acceleration of the Battery Electric Vehicle Program for Road Transportation.

Article 17 of the Presidential Regulation mandates that the central government and local governments can provide fiscal and non-fiscal incentives to encourage the transition of battery-based electric vehicles in Indonesia, one of which is the subsidy policy of providing BBN KB

incentives to consumers. This policy provides BBN KB incentives for people who are interested in buying battery-based electric vehicles. In total, this incentive reduces about 12.5% of the selling price of battery-based electric vehicles. With these incentives, consumers will be more interested in owning battery-based electric vehicles in Indonesia. Thus, in theory, the demand curve will shift to the right. This leads to an increase in the quantity of demand for battery-based electric vehicles. However, if people still do not have environmental awareness and there is no policy to limit the use of conventional vehicles, the demand for battery-based electric vehicles will be inelastic.

Indonesia is still very slow in advancing electric vehicles compared to other countries (Yuniza, 2021). The population of electric vehicles in Indonesia has only reached 68 thousand units or 0.04% of the total vehicles in Indonesia (Aszhari, n.d.).

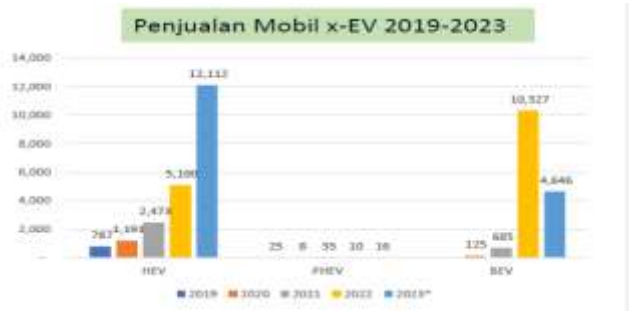

Figure 3
Sales of 4-wheel Electric Vehicles in Indonesia
Source: Gaikindo 2023 "reprocessed"

Based on Figure 3, sales of electric vehicles in Indonesia from 2019 to May 2023 amounted to 37550 units of cars. Of this total, sales of battery-based electric cars (BEV) up to May 2023 sales amounted to 15,783 units. Furthermore, based on data from the Korlantas Polri, the number of electric car ownership in Indonesia amounted to 14881 units from January 2019 to May 2023. DKI Jakarta Province is the province that has the most battery-based electric cars, and the province that does not have a registered electric car in North Maluku.

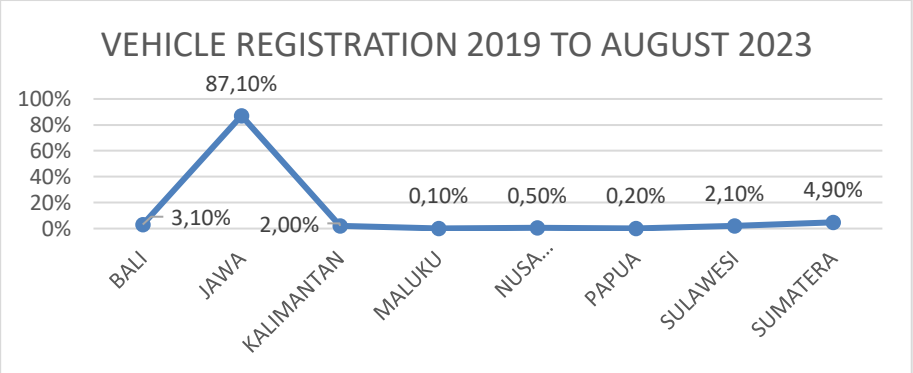

Figure 4
Battery Electric Vehicle Registration
Source: Korlantas Polri, 2023

Furthermore, as shown in Figure 5, the ownership of battery-based electric vehicles on Java Island is 87.1%, and the remaining 13% are on non-Java Island. The graph shows that the distribution of ownership of battery-based electric vehicles in Indonesia is still centered on the island of Java.

Many factors influence the decision to demand battery-based electric vehicles by consumers, one of which is related to purchase costs and operating costs (Gnann et al., 2018). The cost groups of purchase price and operating costs are captured by the concept of total cost of ownership (Danielis et al., 2018). Total Cost Ownership has been defined as a purchasing tool and philosophy, which aims to understand the true cost of purchasing a particular item such as a car (Ellram, 1995). Total Cost Ownership is consumer-oriented which includes all costs borne by vehicle users such as purchase price, fuel consumption, vehicle taxes, maintenance, maintenance, repairs, depreciation, and so on (Danielis et al., 2019).

To reduce emissions, it is necessary to electrify the transportation sector using renewable energy, namely electricity. The battery-based electric motor vehicle (KBLBB) policy is part of the government's long-term efforts to reduce greenhouse gas (GHG) emissions. The battery-based electric motor vehicle (KBLBB) policy was developed to reduce dependence on fossil fuels in the transportation sector. Fiscal incentives provided in the form of exemption and reduction of vehicle registration fees (BBN KB) are regulated by the governor regulations of each local government. It is hoped that these incentives will be able to encourage demand for battery-based electric motorized vehicles and have a positive impact on the electric vehicle industry in Indonesia. However, ownership of battery-based electric vehicles, especially electric cars in Indonesia, is still very low. The number of battery-based electric car achievements is still far from the target set by the government of 400 thousand units by 2025 or a new battery-based electric car population of 3.95%. Therefore, the success of this policy needs to be measured by analyzing the adoption of battery-based electric vehicles in Indonesia.

Research related to government policies and interventions in increasing motor vehicle ownership has been conducted. Such as research conducted (Mannberg et al., 2014) on the effect of congestion tax in Sweden on the purchase of tax-free ethanol cars found that the imposition of congestion tax has a significant impact on the sale of ethanol-fueled cars in the city of Stockholm. The positive impact can be seen from the increase in sales when ethanol car purchases are incentivized by congestion tax exemptions. Another study also found that the impact of fiscal incentives in the form of tonnage tax cuts and green vehicle acquisition taxes had a significant effect on the adoption rate of green vehicles in Japan (Alhulail & Takeuchi, 2014).

In line with the above research, the purpose of this study is to analyze the effect of the BBN KB incentive policy on the ownership of battery-based electric vehicles in Indonesia and how much it affects the increase in ownership of battery-based electric vehicles in Indonesia. It is hoped that this research will contribute to the novelty of methods and studies related to the effect of fiscal incentive policies on the ownership of battery-based electric vehicles in Indonesia. By utilizing the available secondary data, this study uses Moderated Regression Analysis (MRA) with Pooled Ordinary Least Square (POLS) estimation techniques to estimate the role of the BBNKB incentive policy variable. The use of BBNKB incentive interaction variables in this study is expected to enrich the literature on evaluating the impact of fiscal

incentive policies in the form of tax exemptions and reductions. In addition, this research can also be used as a reference for policymakers related to government strategic programs.

RESEARCH METHODS

In this study, the unit of analysis used is the type of vehicle in the form of conventional or electric at the provincial level with secondary data obtained from various sources. The main dependent variable is data on the number of ownership of conventional and electric motorized vehicles from all provinces in Indonesia. The ownership data is obtained from the Korlantas Polri. Furthermore, the control variable data is secondary data obtained from PT PLN Persero, PT Pertamina, Ministry of Energy and Mineral Resources, Central Bureau of Statistics (BPS) Google Trends, and other relevant sources. In detail, the data can be seen in the table below:

Table 1
Types and Sources of Data

No	Variable	Data Source	Unit	Reference
1	Share of Ownership of Battery Electric Cars (Ownership)	Korlantas Polri, processed	Persen	(Tláskalová, 2021); (Wee et al., 2018)
2	Accumulated number of Charging infrastructure (lnspklu)	Ministry of Energy and Mineral Resources, PLN Persero	Unit	(Liu et al., 2021); (Mpoi et al., 2023); (Xue et al., 2021)
3	Total PDRB Per Capita (lnpdrb_kap)	BPS, processed	rupiah	(Ruoso & Ribeiro, 2022); (Xue et al., 2021)
4	Fuel Price (lnbbm)	Pertamina, processed	rupiah	(Bushnell et al., 2022); (Ruoso & Ribeiro, 2022)
5	Total Household Expenditure Per Capita (lnpengel_kap)	BPS, processed	rupiah	Ruoso & Ribeiro, 2022; (Xue et al., 2021)
6	Number of consumers who find out / care about electric cars (cons_awar)	Google Trend, processed	Access	(McElgunn, 2018)
7	Inflation Rate (lninflasi)	BPS, processed	persen	(Nanaki, 2018); (PEHLİVANOĞLU & RİYANTİ, 2018)
8	Open Unemployment Rate (lnunemploy_rate)	BPS, processed	person	(Haidar & Rojas, 2022)

Source: processed by the author (2023)

To process the data with an appropriate empirical model, these data were converted into

a panel data format. Furthermore, the units of analysis were grouped, to distinguish between treated and untreated groups. January 2019 to December 2022 is the research period. Data in 2019 will be used as data before the BBN KB tax incentive policy is implemented. Meanwhile, data from 2020 to 2022 is data after the policy is implemented.

The variables used in this study consist of dependent variables in the form of shares of motor vehicle ownership. motor vehicle ownership is data on motor vehicles that have been registered and determined by the Korlantas Polri per province, per month, and year. The use of ownership/registration data as a dependent variable is in line with research conducted by (Tláskalová, 2021) and (Wee et al., 2018). The use of registration is because this research focuses on taxation, especially local taxes at the regional level. The concept of local tax is local base so it follows where the vehicle is registered. Because it could be that the purchase is made in region A but the use is in region B. Furthermore, 2019 for data before the policy, and 2020 to 2022 is data after the policy is implemented. Then the independent variables consist of variables that are used as proxies for priority interventions in measuring ownership of battery-based electric vehicles. Where the main independent variable is the dummy treatment of conventional or electric vehicle types.

The independent variable in the study is a priority dummy variable that is determined based on the type of vehicle whether battery-based electric vehicles or conventional vehicles. Then, the moderating variable is the BBN KB incentive policy where the dummy will be worth 1 after the policy is implemented from 2020 to 2022 and will be worth 0 before the policy is implemented, namely 2019. While proxies such as the number of charging facilities, GRDP per capita, household expenditure per capita, fuel prices, inflation, unemployment rates, and consumer awareness are used as independent control variables.

RESULTS AND DISCUSSION

Descriptive Analysis

Descriptive statistics generally describe the development of ownership of conventional 4-wheeled motorized vehicles and battery-based electric motorized vehicles in Indonesia. This is shown in the table below.

Table 2
Descriptive Statistics

Variable	Observasi	Mean	Std.Dev.	Min.	Max.
Tahun	3264	2020	1,1182	2019	2022
Id_prov	3264	17,5	9,8122	1	34
lnkepemilikan	3264	0,6966	0,8763	0	4,4647
lnspklu	3264	0,5956	1,0662	0	5,6204
lnpdrb_kap	3264	2,3323	0,5555	1,3815	5,7813
lnpengel_kap	3264	1,7010	0,3902	1,1916	3,8612
lnbbm	3264	9,2658	0,1565	9,1174	9,6881
cons_awar	3264	17,0089	14,8136	0	86,7500
lninflasi	3264	1,1262	0,1758	0	1,8687
lnunemploy_rate	3264	1,5227	0,3641	0,1989	2,3145

Source: processed, STATA 17 (2023)

Based on Table 2, the development of vehicle ownership can be seen from the market share of the number of 4-wheeled motorized vehicle ownerships. The market share of vehicle ownership (lnkepilikan) with the lowest value of 0 and the highest value of 4.46 was in DKI Jakarta Province in 2019. The average market share value of vehicle ownership is 0.70. Furthermore, in terms of control variables, we can see the condition of the number of charging stations (lnspklu), PDRB per capita (lnpdrb_kap), household expenditure per capita (lnpengel_kap), fuel price (lnbm), inflation (inflation), unemployment rate (lnunemploy_rate), and consumer knowledge/concern (cons_awar).

The highest number of charging infrastructure (lnspklu) in Bali Province is 5.62 in 2022. The average value of charging stations is 0.59. Then the lowest PDRB per capita value (lnpdrb_kap) of 1.38 belongs to East Nusa Tenggara Province in 2019, and the highest is in East Kalimantan Province at 5.78 in 2020. The average value of PDRB per capita is 2.33. Meanwhile, for household expenditure per capita (lnpengel_kap), the lowest value of 1.19 was owned by East Nusa Tenggara Province in 2020, and the highest was in East Kalimantan Province at 3.86 in 2020. While the average value of household expenditure per capita (lnpengel_kap) is 1.70.

Then for the fuel price variable (lnbbm), the average value is 9.26. The lowest fuel price was 9.11 and the highest was 9.69 in 2022. Furthermore, for the value of consumer knowledge/concern (cons_awar), the lowest is 0, and the highest is owned by East Java Province 87.25 in 2022 with an average value of 17. The next variable is inflation (inflation) where the lowest value of 0 was in North Sulawesi province in 2019. The highest inflation value was 1.86 in 2022 in West Sumatra province and the lowest was 0 in Papua province. The average inflation rate is 1.12. For the next unemployment rate (lnunemploy_rate) the highest was 2.31 in Riau Islands province in 2021, while the lowest was 0.19 in 2019 in DKI Jakarta province. The average unemployment rate is 1.52.

Motor Vehicle Ownership in Indonesia

Indonesian motor vehicle ownership is still dominated by conventional vehicles. However, after the battery-based electric vehicle policy began to increase.

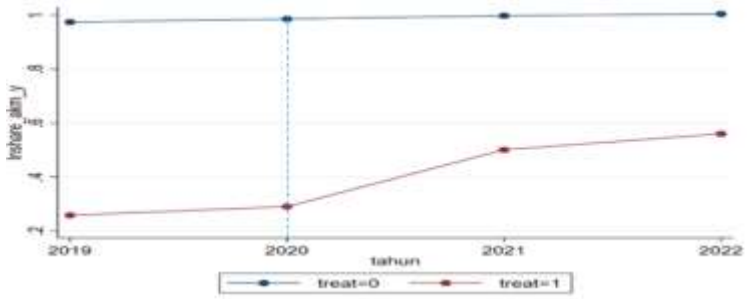

Figure 5
Trend in Total Vehicle Ownership Share
Source: processed, STATA 17 (2023)

As Figure 5 shows, before the existence of the BBN KB incentive policy, the number of vehicle ownership between battery-based electric vehicles and conventional vehicles had the same trend from 2019 to 2020. Then, there was a significant increase in the number of vehicle ownership in Indonesia from 2020 to 2021, where 2020 was the time when the policy was implemented. The number of vehicle owners for vehicle types that receive BBN KB incentives shows a better growth trend and tends to

increase. This is in line with demand theory (Pindyck & Rubinfeld, 2014) that the quantity of demand for a good will change if there are factors that influence it, such as the provision of BBN KB subsidies/incentives. Meanwhile, vehicle types that do not receive incentives experience stagnant growth. In this case, for the unit of analysis that does not receive incentives, the trend in the number of vehicle ownership does not seem to have increased either before the policy or after the policy.

Furthermore, a robustness test is also carried out to further ensure that the assumptions of the OLS interaction model estimation in the analysis of the effect of the BBN KB incentive policy are met. To test this assumption, a new group variable (treatment) is created with a random value for all units of analysis. Furthermore, the variable that has a random value is regressed on the OLS interaction model.

Table 3
Robustness Test Results

Variables	Ownership	Ownership
treat	-0.716***	
	(0.0577)	
time	0.0216	0.106***
	(0.0471)	(0.0355)
teatime	0.171**	
	(0.0666)	
treat new		-0.159
		(0.393)
treatime2		0.181
		(0.439)
Constant	0.974***	0.617***
	(0.0408)	(0.0307)
Observations	3,264	3,264
R-squared	0.117	0.003

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: processed, STATA 17 (2023)

Based on Table 3, the results of the robustness test show that the treatime2 interaction variable has analysis results that have no significant effect. Thus it can be concluded that the model can be applied to estimate the effect of the BBN KB incentive policy on increasing ownership of battery-based electric motorized vehicles. This means that the results of empirical panel data processing and testing can produce fairly strong policy analysis findings.

Estimation Results

This research initially wanted to see the causal inference between the provision of the BBN KB incentive policy and the level of ownership of battery-based electric vehicles in Indonesia using the staggered DiD model. However, due to limited access to data related to the variation of provinces implementing the policy, this study cannot see the impact of the causal inference relationship. Therefore, this study aims to identify the effect of policies on the growth of battery-based electric vehicle ownership in Indonesia. By using the sample data that has been obtained and grouping the units of analysis, an analysis will be carried out regarding the effect of the BBN KB incentive on the growth of ownership of battery-based electric motor

vehicles throughout Indonesia, Java, and non-Java using the OLS interaction regression model. Where the results focus on the treatment variable which is the interaction between the treatment dummy and the time dummy in this study.

Data Analysis Results for All Provinces in Indonesia

The results of panel data analysis in 34 provinces in Indonesia from 2019 to 2022 using the OLS interaction model can be described in Table 4 as follows.

Table 4
Estimation Results of the OLS Interaction Model

Variables	Without Control Variables	Control Variables
	Ownership	Ownership
treat	-0.716***	-0.716***
	(0.0577)	(0.129)
time	0.0216	0.0295
	(0.0471)	(0.0611)
teatime	0.171**	0.171*
	(0.0666)	(0.0936)
lnspklu_akm	No	0.111*
		(0.0630)
lnpdrb_kap	No	-0.133
		(0.154)
pengel_kap	No	0.158
		(0.170)
lobby	No	-0.217*
		(0.118)
cons_awar	No	0.000780*
		(0.000391)
lninflasi	No	0.00835
		(0.00691)
lnunemply_rate	No	-0.293**
		(0.130)
i.provinsi	No	Yes
i.tahun	No	Yes
Cluster province	No	Yes
Constant	0.974***	3.143**
	(0.0408)	(1.186)
Observations	3,264	3,264
R-squared	0.117	0.859

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: processed, STATA 17 (2023)

As the results of the analysis in Table 4 above, it can be seen that according to column 1 in the absence of control variables and the addition of fixed effects of province and year, the variable treatment illustrates a positive and significant value. The coefficient number on the teatime variable shows a result of 0.171. These results explain that when the policy is implemented, it will increase the number of owners of battery-based electric motor vehicles (electric cars) by 17.1% with a significance level of 5%. Furthermore, if the test is carried out with the addition of control variables and fixed effects on the province and year variables as in column 2, it will produce the same or consistent coefficient value. The positive and significant findings are in line with (Wee et al., 2018) and (Tláskalová, 2021). Both studies state that tax incentives significantly affect the growth of electric vehicle registrations by 5% - 11% in the United States and increased sales of battery-based electric vehicles in Europe. Then the findings of significant results are in line with (Riley, 2023) which states that government incentives, in the form of tax credits or rebates, can make electric cars more affordable for consumers and increase demand.

Meanwhile, in terms of control variables, the variable number of charging infrastructure (lnspklu_akm) has a positive and significant coefficient. This suggests that if the availability of charging stations increases, it can make EVs more attractive to consumers, leading to higher demand (Riley, 2023). This result is consistent with (Narasimhan & Johnson, 2018); (Liu et al., 2021); and (Mpoi et al., 2023) found that the availability of charging infrastructure will have a positive impact on consumer interest in owning an electric vehicle. Then, the consumer care variable (cons_awar) produces a positive and significant coefficient value on the number of ownership of electric motorized vehicles. This means that the more consumers or people who care about battery-based electric vehicles find out the benefits and advantages either through social media, YouTube, Google, or directly to electric vehicle dealers, it will have an impact on the growing number of ownership of battery-based electric vehicles. This is in line with the findings of (McElgunn, 2018), which show a significant positive correlation between consumer knowledge/concern and electric vehicle purchasing patterns.

Furthermore, the open unemployment rate variable (lnunemply_rate) has a negative and significant coefficient. This result explains that the higher the unemployment rate in a province, it will have a decreasing impact on the number of battery-based electric vehicle owners. These findings are in line with (Haidar & Rojas, 2022) who found that the unemployment rate hurts electric vehicle sales. This is related to income, where buying a battery-based electric vehicle requires a fixed income due to the high price of electric vehicles. Other control variables such as GRDP per capita and expenditure per capita do not show significance at the 1%, 5%, or 10% level. However, GRDP per capita has a negative coefficient, meaning that declining income from groups such as private companies and the government has an impact on reducing the number of battery-based electric vehicle owners. While per capita expenditure has a positive value, this indicates that if individual / community income rises, it affects increasing the number of battery-based electric vehicle ownership.

The next control variable is fuel oil (lobby), the coefficient value shows a negative and significant result. This means that the price of fuel has a decreasing impact on the number of owners of battery-based electric vehicles. This could happen in Indonesia considering that the price of electric vehicles is still high so people respond to rising fuel prices by continuing to

buy conventional vehicles that tend to be more affordable and fuel-efficient. This result is different from (Bushnell et al., 2022) and (Ruoso & Ribeiro, 2022) who found that fuel prices have a positive and significant impact on driving electric vehicle adoption. Meanwhile, the inflation variable depicts a positive but insignificant result. This suggests that the inflation rate does not have an impact on driving the number of battery electric vehicle ownership.

Results of Data Analysis in Java and Non-Java Islands

To find out the differences in the results of the analysis of the effect of the BBN KB incentive policy between non-Java Island and Java Island, the analysis will be carried out as shown in Table 6 below:

Table 5
Results of OLS interaction model in Java Island and Non-Java Island

Variables	Without Control Variables		Control Variables	
	Java ownership	ownership nonjava	Description Java	ownership nonjava
treat	-1.326***	-0.586***	-1.326*	-0.586***
	(0.205)	(0.0358)	(0.591)	(0.0854)
time	-0.0150	0.0295	0.222	0.109***
	(0.167)	(0.0293)	(0.554)	(0.0258)
teatime	0.874***	0.0199	0.874*	0.0199
	(0.237)	(0.0414)	(0.415)	(0.0379)
lnspklu_akm	No	No	Yes	Yes
lnpdrb_kap	No	No	Yes	Yes
pengel_kap	No	No	Yes	Yes
lobby	No	No	Yes	Yes
cons_awar	No	No	Yes	Yes
lninflasi	No	No	Yes	Yes
lnunemply_rate	No	No	Yes	Yes
i.provinsi	No	No	Yes	Yes
i.tahun	No	No	Yes	Yes
Cluster province	No	No	Yes	Yes
Constant	2.070***	0.740***	15.28***	0.807
	(0.145)	(0.0253)	(3.142)	(0.492)
Observations	576	2,688	576	2,688
R-squared	0.108	0.275	0.806	0.840

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: processed, STATA 17 (2023)

Based on the results of the analysis that has been done above, there is a difference in the level of significance between Java Island and non-Java Island. The island of Java shows results with a positive and significant coefficient value. The estimated result on the treatment variable coefficient is 0.874. This explains that the provision of BBN KB incentives increases the number of ownership of battery-based electric car-type vehicles by 87.4% on the island of Java with a significance level of 1%.

Then in non-Java Island, the estimation of the coefficient value of the treatment variable

produces a positive and insignificant coefficient value. This result shows that the provision of BBN KB incentives does not have a significant impact on the number of ownership of battery-based electric car vehicle types in non-Java Island when the policy is implemented. After that, testing was carried out with the addition of control variables and fixed effects on province and year variables. The results obtained illustrate relatively similar and consistent estimates for both Java Island and non-Java Island, only the level of significance is different.

The difference in the results of the role of BBN KB incentives on ownership of battery-based electric vehicles on Java Island and non-Java Island can be caused by various factors. Some of the factors driving demand for electric vehicles include the availability of charging infrastructure (SPKLU) on the island of Java when compared to non-Java islands.

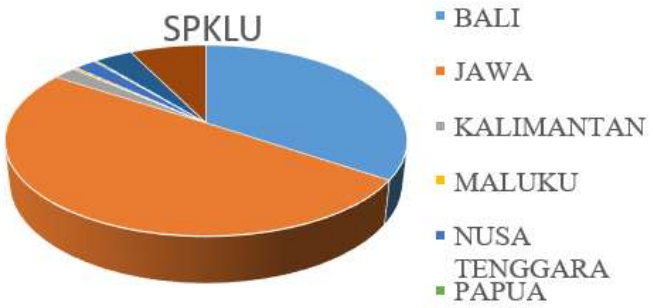

Figure 6
Number of SPKLUs in Indonesia by April 2023
Source: Ministry of Energy and Mineral Resources, processed by the author

Figure 6 shows that almost 50% of the total charging infrastructure (SPKLU) in Indonesia is located on the island of Java. The remainder is distributed across non-Java islands, with the most on the island of Bali, then Sumatra, Sulawesi, and the lowest on the island of Papua. Furthermore, there are other privileges on the island of Java for battery-based electric vehicles, namely odd-even free and the availability of maintenance workshops. Therefore, the existence of supporting infrastructure for battery-based electric vehicles and various privileges obtained causes electric cars to become more attractive so it has an impact on increasing demand for electric cars, especially on the island of Java.

CONCLUSION

Based on the results of the analysis of the effect of BBN KB incentives on the growth of ownership of battery-based electric vehicles with OLS interaction model panel data, it shows that there is a positive and significant effect of providing BBN KB incentives on battery-based electric vehicles on the number of ownership of battery-based electric vehicles in Indonesia. Since the policy was implemented, the number of battery-based electric cars has continued to increase. The impact of BBN KB incentives has an influence on the increase in the number of ownership of battery-based electric vehicles by 17.1%. Furthermore, there is heterogeneity in the impact by island where the BBN KB incentive has a positive and significant effect on increasing ownership of battery-based electric vehicles by 87.4% in Java, while in non-Java the BBN KB incentive policy does not have a significant effect on battery-based electric vehicle ownership. The addition of control variables produces the same and consistent estimation value in all provinces, Java Island and non-Java Island, only the significance level is different.

Meanwhile, the number of charging infrastructure (SPKLU), consumer awareness, fuel price, and open unemployment rate have a significant influence on ownership of battery-based electric motorized vehicles. All of these variables are demand-supporting factors so consumers are interested in adopting electric vehicles.

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