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THE IMPACT OF ELECTRIC ONLINE TAXI INNOVATION ON NON-ELECTRIC ONLINE TAXI DRIVERS IN INDONESIA

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ABSTRACT

Purpose: *This study investigates the direct and indirect effects of electric online taxi service innovation on non-electric online taxi drivers in Indonesia, particularly through competitive dynamics.*

Design/methodology/approach: *A quantitative approach was employed using a survey of 100 non-electric online taxi drivers selected through purposive sampling. Data were collected using a 1–4 Likert-scale questionnaire and analyzed using Structural Equation Modeling (SEM) with SmartPLS.*

Findings: *The results show that environmentally friendly factors do not significantly influence competition, nor does the existence of electric taxis directly affect perceived impact. However, the existence of electric taxis indirectly affects non-electric drivers through competition, while environmentally friendly factors have a significant direct impact.*

Research limitations/implications: *The study is limited by sample size and non-random sampling, which may affect generalizability.*

Practical implications: *Policymakers and platforms should manage competitive transitions toward electric mobility.*

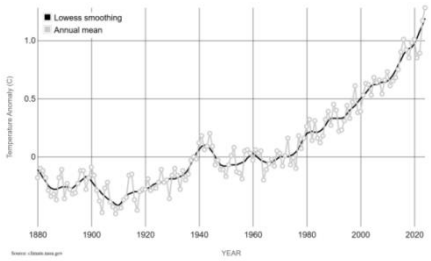
Originality/value: *This study clarifies competitive mediation effects in electric taxi innovation.*

Paper type: *Research paper*

Keyword: *electronic vehicle, online electric taxi, existence, eco-friendly, competition, impact.*

A. INTRODUCTION

Global warming has now become a priority worldwide. In this regard, one of the direct impacts of global warming, which is also a problem for humans and other living things, is climate change. While climate change occurs naturally, the most significant climate change currently occurring is the result of increasing human activity.



Picture 1. *Global Temprature*

Discussing the global temperature increase in more detail, the image above shows that the Earth's surface temperature appeared normal before 1940. After 1940, several fluctuations occurred,

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ultimately leading to a significant increase in surface temperature after 1980, which continues to this day. Temperature increases of less than 2 degrees Celsius are not directly noticeable to humans. However, the temperature increase can be directly felt by other living things and result in extinction. In light of these facts, a disruption in the food chain will pose a threat to human survival.

Turning to the specific causes of global warming, the most significant greenhouse gas is CO2. Besides industrial activities, this greenhouse gas also originates from aspects directly related to daily human activities, namely the transportation sector. Contributing 15% of total CO2, 72% of total transportation emissions come from land transportation (IPCC, 2022, Ch. 10). As the third-largest contributor globally, the transportation sector requires special attention to mitigate environmental problems and improve environmental quality in the future.

Referring to the 72% contribution from land transportation, according to the International Energy Agency (2023), passenger cars are the highest contributor, at 45%, compared to other land transportation. Furthermore, this fact reveals that human daily activities still rely heavily on vehicles. A more sustainable environment in the future requires humans to better manage their transportation use. Fossil fuels, which consist largely of hydrocarbon deposits derived from ancient organic matter, are extracted from underground geological formations in the Earth's crust (Gunawan et al., 2021). Their combustion releases significant anthropogenic pollutants, including carbon dioxide. dioxide (CO_2) and other greenhouse gas (GHG) emissions, which drive atmospheric degradation and climate change (IPCC, 2021).

Picture 2. *Use of Fuel in Transportation*

Transportation emissions accounted for 27% of Indonesia's energy-related CO2 emissions, as the sector was dominated by fossil fuels in 2019. Electrification of the transportation sector, with a high share of renewable energy in the electricity sector, is necessary to reduce emissions. To stay within the 1.5°C temperature increase limit, passenger and freight transport need to be decarbonized.

Decarbonization is the process of reducing carbon dioxide (CO2) and other greenhouse gas emissions from various sectors, particularly those related to energy and industry. The goal is to mitigate the impact of climate change and achieve net-zero emissions.

Global warming defined as the sustained increase in the average temperature of Earth's atmosphere, oceans, and land masses it has increased the frequency and severity of natural disasters, endangering ecosystems and human society (NASA, 2020). This phenomenon is caused by the greenhouse effect, in which long-wave infrared radiation emitted by Earth's surface is trapped by atmospheric greenhouse gases (GHGs), such as CO_2 and methane (CIFOR, 2018). This process is exacerbated by stratospheric ozone depletion, which allows solar radiation to penetrate.

Greater shortwave radiation (e.g., ultraviolet) into the troposphere. Once absorbed, this radiation is re-emitted as longwave heat, further amplifying GHG concentrations (Putri et al., 2025). Collectively, this feedback loop accelerates planetary warming, with dire implications for biophysical and socioeconomic systems (World Bank, 2022).

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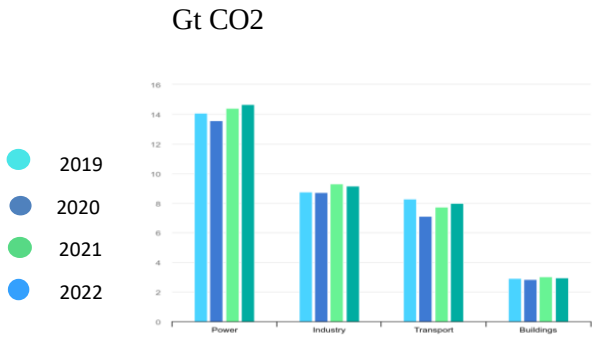

Picture 3. *Global Carbon Emissions Bar Chart*

Although the electricity industry is the largest carbon emitter, the adoption of clean energy in the electricity sector, particularly in Indonesia, is increasingly important for reducing carbon emissions and achieving sustainable development goals. Various efforts are being made to encourage the use of renewable energy (NRE) such as solar, wind, and geothermal power plants, as well as more efficient technologies.

The transportation sector is a major contributor to global CO2 emissions, and emissions continue to increase, although not as rapidly as in some other sectors. This sector is heavily dependent on fossil fuels, with 95% of the world's transportation energy still coming from fossil fuels. Decarbonizing transportation is crucial to achieving global climate goals.

Various efforts have been made to mitigate this impact, one of which is the innovative use of environmentally friendly electric vehicles. Electric vehicles have the potential to reduce greenhouse gas emissions and help realize a green economy. The Indonesian government has encouraged the acceleration of electric vehicle adoption through policies such as Presidential Regulation No. 55 of 2019. This initiative aligns with the national target of reducing greenhouse gas emissions by 41% by 2030 and achieving net-zero emissions by 2060 (Raihan et al., 2022).

Picture 4. *Decarbonization of Transportation in Indonesia* (www.climate-transparency.org)

The reduction in per capita transportation emissions in 2020, and the corresponding changes in the 5-year trend and decarbonization rate, reflect the widespread economic slowdown and imposed transportation restrictions. For a discussion of broader trends at the G20 and the surge in transportation emissions in 2021. Decarbonization in the electricity industry is an effort to reduce or eliminate carbon dioxide (CO2) emissions from the sector, which contribute significantly to global warming. Decarbonization can be achieved through several means, including shifting to renewable energy sources, improving energy efficiency, and developing carbon capture and storage technologies.

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B. LITERATUR REVIEW

Electric Online Taxi

Electric vehicles can reduce fuel costs, especially compared to conventional vehicles, which use fossil fuels as a significant cost component (Kurniawan, 2021; Pratama & Farida, 2025). With the support of SPKLU (Storage Service Stations), electric vehicle users can increase the efficiency of their transportation costs. Here are the main advantages of electric online taxis (vibrasi.co, 2025):

1. Environmentally Friendly with Zero Emissions

   Fully electric vehicles produce no carbon emissions or air pollution. This is very different from fossil-fueled vehicles, which emit harmful gases such as carbon monoxide (CO) and nitrogen oxides (NOx). By using an Electric Taxi, customers not only enjoy a comfortable ride but also contribute to environmental sustainability.
2. Lower Operating Costs

   The operating costs of electric vehicles are much lower than those of gasoline or diesel-powered vehicles. Charging the electric vehicle is cheaper than buying fuel, allowing for more competitive rates. Furthermore, electric vehicles also have lower maintenance costs because they don't have as many components that need to be replaced regularly, such as engine oil or air filters.
3. Contribution to Government Programs

   In Reducing Emissions, the Indonesian government continues to encourage the use of electric vehicles as part of its efforts to reduce greenhouse gas emissions and reduce dependence on fossil fuels.

Non-Electric Online Taxi

In Indonesia, especially in Jabodetabek area, there are several online taxi companies that still use non-electric fleets, including:

1. Bluebird: This taxi company has a fleet of conventionally fueled vehicles that can be booked online through its official app.
2. GrabCar: Although Grab also offers electric taxi services, the majority of its fleet still uses non-electric vehicles.
3. GoCar: Like Grab, Gojek also offers an online taxi service, the majority of whose fleet consists of non-electric cars.

Current trends show an increasing use of electric taxis, as evidenced by the expansion of electric taxi operators like Green SM and the expansion of electric fleets by Bluebird, GrabCar, and GoCar. Many online searches now highlight electric taxis due to their perceived environmental friendliness. However, non-electric taxis still dominate the streets in many cities and can still be booked online through the methods mentioned above.

C. METHODOLOGY

In this study, we used Structural Equation Modeling (SEM) to analyze the data. The SEM model is suitable for evaluating the influence of intermediary variables. In this study, the Eco-friendly (ECO) and Existency (EXT) variables are two Independent variables (X) and the Competition (COM) variable becomes the variable (Z) or mediator in the hypothesis, then the variable Impact of the existence of electric taxis on non-electric taxis (IMP) becomes the dependent variable (Y). To test the model, primary data was collected through an online questionnaire sent to non-electric taxi drivers in Jabodetabek area, Indonesia. We surveyed the drivers because we wanted to know the impact that occurred by involving the drivers by looking at the perspective of new innovative services. Some experts such as Kerlinger and Lee (2000) recommend a minimum of 30 respondents for quantitative research, including those using PLS-SEM. The questionnaire uses a Likert scale of 1-4 with values, 1 = strongly disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly agree.

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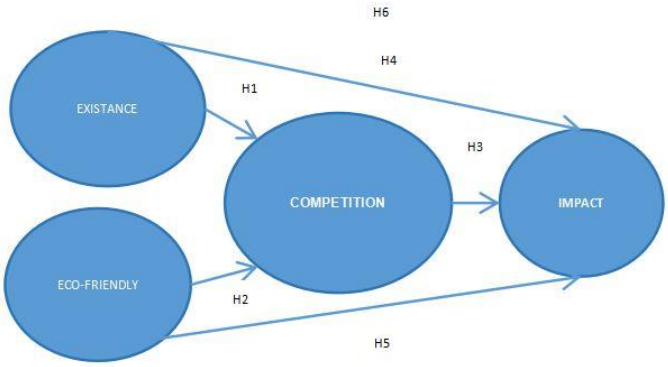

Picture 5. *Hipotesis Penelitian*

Table 1. Research Statement/Question

Code	Indicators	Score
	Keberadaan Taksi Listrik (EXISTANCE)	Skala Likert
EXT1	You're aware of the existence of electric taxis.	
EXT2	You often see electric taxis operating in your neighborhood.	1-4
EXT3	The existence of electric taxis has caught your attention.	
	Persepsi Ramah Lingkungan Taksi Listrik (ECO-FRIENDLY)	
ECO1	Do you think electric taxis are better for the environment?	
ECO2	Do you think electric taxis can help combat climate change?	1-4
ECO3	Do you think electric taxis have a positive impact on global warming?	
	Persepsi Persaingan / Tekanan Persaingan (COMPETITION)	
COM1	Do you think electric taxis are already competing with non-electric taxis?	
COM2	Are you worried about losing customers?	1-4
COM3	Are you going to compete with electric taxis?	
	Dampak Terhadap Taksi Non-Elektrik (IMPACT)	
IMP1	Electric taxis have contributed to a decrease in the number of passengers compared to non-electric taxis.	
IMP2	Electric taxis have contributed to a decrease in income for non-electric taxis.	1-4
IMP3	I want to switch to electric taxis.	
IMP4	I am dissatisfied with my performance as a non-electric taxi driver.	

D. RESULTS AND DISCUSSION

The population used in this study were non-electric online taxi drivers in the Jabodetabek area, Indonesia. A total of 100 respondents completed the online research questionnaire. The questionnaire was distributed via Google Form, targeting 100 respondents. All respondents were male and had 1 year or more of experience driving non-electric online taxis. The research data was processed using outer model and inner model testing.

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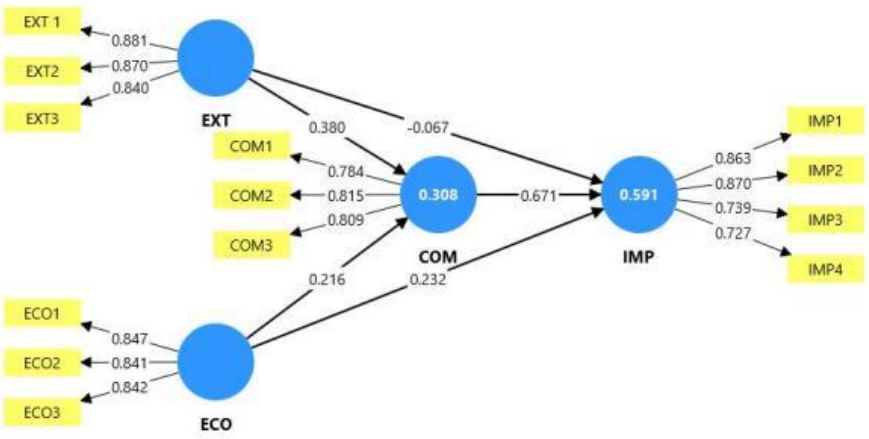

Picture 6. Structural Equation Model (SEM) Analysis Result

A validity test is used to determine the validity of the data obtained from the questionnaire. A questionnaire is considered valid if its statements reveal the impact, existence, eco-friendliness, and competition of non-electric online taxi drivers (Azwar, 2012). The variables to be measured by the questionnaire are measured. The validity of each questionnaire item can be assessed using its loading factor value. Validity is determined if the loading factor value is >0.70, but if the loading factor value is <0.70, the variable is invalid. The loading factor value limit of >0.70 was chosen because it can explain a strong relationship between the latent variable and its indicator. Validity checks were conducted using the smartPLS application, which then processed and compared the results.

Table 2. Outer Loading

Variable	Indikator	Loading Factor Value	Result
Existance	EXT1	0.881	Valid
	EXT2	0.870	Valid
	EXT3	0.840	Valid
Eco-friendly	ECO1	0.847	Valid
	ECO2	0.841	Valid
	ECO3	0.842	Valid
Competietion	COM1	0.784	Valid
	COM2	0.815	Valid
	COM3	0.809	Valid
Impact	IMP1	0.863	Valid
	IMP2	0.870	Valid
	IMP3	0.739	Valid
	IMP3	0.727	Valid

Based on the table 1. if the loading factor value is >0.70, the instrument question is considered valid. This indicates a strong relationship between the latent variable and its indicator, making it suitable for further analysis. The outer loading value for all variables is >0.70, indicating that all variables are valid.

Reliability is a tool to measure the extent to which a questionnaire produces consistent results when repeated measurements are taken on the same object. A construct is considered reliable if its composite reliability or Cronbach's alpha value is above 0.7. (Ghozali, 2018)

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Tabel 2. Reliability Test

Variable	COM	ECO	EXT	IMP
COM				
ECO	0.612			
EXT	0.690	0.862		
IMP	0.968	0.624	0.565	

The table shows the reliability test for the items, which were declared reliable, indicating good data consistency. All four instrument variables met Cronbach's Alpha values > 0.6, indicating the instrument was reliable for all statements and could be used for further analysis. Furthermore, all AVE results were ≥ 0.50, indicating good convergent validity. (Arifin et al., 2023; Pratama et al., 2025)

According to Hair et al. (2021), the inner model describes the relationships between latent constructs (independent, dependent, and mediating variables) in a PLS-SEM model. Its purpose is to evaluate the quality of the structural relationships, namely how well the exogenous constructs explain the endogenous constructs. According to Henseler, Ringle, & Sarstedt (2015), the HTMT (Heterotrait-Monotrait Ratio of Correlations) method is a more accurate approach to testing discriminant validity than the Fornell-Larcker method. A value of ≤ 0.85 indicates excellent discriminant validity, ≤ 0.90 indicates acceptable, and > 0.90 indicates inadequate discriminant validity.

Tabel 3. Discriminant Validity (HTMT)

Variable	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	AVE	Reliability
EXT	0.829	0.830	0.898	0.746	Reliabel
ECO	0.802	0.828	0.881	0.711	Reliabel
IMP	0.814	0.825	0.878	0.644	Reliabel
COM	0.742	0.724	0.845	0.644	Reliabel

Most pairs are below the 0.90 threshold, but COM — IMP = 0.968 — this exceeds the 0.90 threshold, indicating a discriminant validity issue between Competence (COM) and Impact (IMP). This means that COM and IMP are highly correlated/too similar, so the constructs may not be truly separate (or there is a problem with high item cross-loading).

According to Hair et al. (2021), an inner model (structural model) describes the causal relationships between latent constructs, namely how independent variables influence dependent variables either directly (direct effect) or indirectly (indirect effect) through mediating variables. The purpose of testing the inner model is to assess the strength and significance of the relationships between latent variables in the research model.

The decision-making criteria used are:

1. t-statistic ≥ 1.96 and p-value ≤ 0.05 → significant effect (hypothesis accepted)
2. t-statistic < 1.96 and p-value > 0.05 → insignificant effect (hypothesis rejected)

Three relationship paths (H1, H3, H5) were found to be significant, while two paths (H2 and H4) were not significant.

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Tabel 4. Path Coeficient

Variable	Original Sample (O)	Sample Mean (M)	Standart Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values	Result
EXT -> COM (H1)	0.38	0.374	0.133	2.849	**0.004**	Valid
ECO -> COM (H2)	0.216	0.237	0.143	1.510	**0.131**	Not Valid
COM -> IMP (H3)	0.671	0.684	0.083	8.115	**0.000**	Valid
EXT -> IMP (H4)	-0.067	-0.069	0.117	0.574	**0.566**	Not Valid
ECO -> IMP (H5)	0.232	0.222	0.110	2.108	**0.035**	Valid

Tabel 5. Indirect Effect

Hipotesis	Original Sample (O)	Sample Mean (M)	Standart Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values	Result
EXT -> IMP (H6)	0.255	0.255	0.095	2.686	**0.007**	Valid
ECO -> IMP (H7)	0.145	0.163	0.102	1.415	**0.157**	Not Valid

Since (H3) COM → IMP is significant, the Competition construct has the potential to be a mediating variable. With the results that (H1) EXT → COM is significant and (H3) COM → IMP is significant, there is a significant indirect effect of Existence on Impact through Competition (partial mediation) with the result of H6. Meanwhile, (H2) ECO → COM is not significant, so the indirect effect of ECO → IMP through Competition is likely not significant with the result of H7. Overall, the structural model shows a strong relationship and supports most of the research hypotheses.

E. CONCLUSION

Factors that influence or impact (IMP) on non-electric online taxi drivers with the existence (EXT) of online electric taxis here include the environmental friendly benefits (ECO) and competition (COM) between non-electric online taxi drivers and online electric taxis. It can be seen from the results of the analysis above that the environmental friendly factor (ECO) does not have much influence on competition (COM) between electric and non-electric online taxis (H2). Then the existence (EXT) of electric taxis also does not have a direct effect on the impact (IMP) caused to non-electric online taxi drivers (H4). Meanwhile, the existence (EXT) of online electric taxis has an indirect effect or through mediation of competition (COM) on (IMP) impacts on non-electric online taxi drivers (H6). So, the existence (EXT) of online electric taxis and their environmental friendly benefits (ECO) have a direct effect on non-electric taxi drivers in terms of competition (COM) (H1) & (H3). Finally, the environmental friendly factor (ECO) has a significant direct effect (H5) and without mediation variable competition (COM) (H7).

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