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Analysis of Eastern Indonesia's Electricity Demand 2014-2019

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Abstract

Electricity is a primary need for all people. Electricity is an essential factor in the development of every country, both in terms of economic and social aspects. This study aims to analyze the effect of connected power capacity, electricity prices, population, GRDP on electricity demand in Eastern Indonesia. The method used in this research is panel data regression analysis. This study indicates that the variables connected to power capacity and per capita GRDP have a positive and significant effect on electricity demand in the Eastern Indonesia region. Meanwhile, the price of electricity has a negative effect on the demand for electricity in Eastern Indonesia areas. Then the population variable has a negative and significant effect on electricity demand Eastern Indonesia areas.

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INTRODUCTION

Electrical energy is one of the energies that influence human life. Electricity plays an essential role in the economy and technology of every nation (Sambo, 2008). Electricity is an essential factor in the development of every country, both in terms of economic and social aspects. Paharate and Sutarta (2013) said that the availability of a country's electrical energy would greatly determine the success of the country's development.

Indonesia has problems with electricity development. Based on the part-time evaluation of the 2015-2019 National Medium-Term Development Plan (RPJMN) conducted by Bappenas, the evaluation of electricity development is based on three indicators, namely power generation capacity, electrification ratio, and electricity consumption per capita. Cumulatively, the power plants built in 2015 and 2016 were 55.5 GW and 59.6 GW, respectively. This result has exceeded the target set in 2015. However, the capacity of power plants built in 2016 could not reach the target set at 61.5 GW, so it is estimated that it is challenging to meet the power plants built-in 2019. Indonesia's electricity consumption in 2015 of 910 kWh/capita, and the estimated realization of electricity consumption in 2016 was 956 kWh/capita. Meanwhile, the target indicator for the electrification ratio is 96.6 percent, and electricity consumption per capita (1,200 kWh/capita) at the end of the 2015-2019 RPJMN is estimated to require more complicated efforts to achieve it (Bappenas, 2017).

Bappenas (2017) states that Indonesia's per capita electricity consumption is still lagging compared to other ASEAN countries. Electricity consumption in Brunei Darussalam reaches 10,133 kWh/capita, while Vietnam reaches 1,439 kWh/capita. This difference indicates the need for increased access to electrical energy in the regions. Based on the 2017 performance report, the Directorate General of Electricity explained that of the 34 provinces in Indonesia, there were still two provinces with electrification ratios below 70% by the end of 2017, namely the provinces of East Nusa Tenggara (NTT) and Papua. The recapitulation results of the electrification ratio show that almost all provinces in Eastern Indonesia have an electrification ratio below the target ratio, which is 92.75%. These results indicate that the distribution of electrical energy in Eastern Indonesia is not evenly distributed. This has resulted in some areas in Eastern Indonesia not being able to consume electrical energy.

The supply of electrical energy in Eastern Indonesia is very minimal. Quoted from beritasatu.com (*Melistriki Indonesia*, n.d.), the construction of electricity networks in Eastern Indonesia is constrained by geographical conditions. Cable connections to new customers in 3T areas (frontier, outermost and disadvantaged) need to explore mountains, hills, and canyons, through swamps, forests, and weeds. In addition, they have to cross seas, lakes, and rivers. Access to electrical energy in the Eastern Region of Indonesia is still not fully distributed. According to the Central Statistics Agency (2019), until 2018, 2,281 villages had no electricity at all. The village is located in the Eastern Region of Indonesia, partly in the provinces of Kalimantan and Sulawesi.

They are considering that electrical energy is a primary need for all people. The electricity demand will continue to increase every year. Connected power capacity, electricity price, population, and GDP growth are factors that affect electricity demand. GDP growth and population positively correlate to electricity consumption (Alawin et al., 2016). Aminuddin's research (2009) shows that electricity prices have a negative relationship to electricity demand. (Aminata & Veromita, 2019) stated that apart from the economic and demographic factors above, the electricity supply factor is thought to influence electricity demand. This is reinforced by research by Fitrantie and Wibowo (2016), which explains that the amount of installed electrical power capacity influences the amount of electricity demand for PT PLN customers.

Based on the background description described above, in this study, the author will analyze the demand for electricity and the factors that affect electricity demand in the Eastern Region of Indonesia.

RESEARCH METHODS

The data used in this study is secondary data in the form of panel data. Panel data is a combination of time series and cross-section data. The cross-section data analyzed were data from provinces in the Eastern Region of Indonesia and time-series data from 2014-2019. The data sources are obtained from the Central Statistics Agency (BPS), PLN Indonesia Statistics, and other data through articles, journals, or websites from related agencies.

In this study using data from the provinces included in the Eastern Region of Indonesia, namely the provinces of NTB, NTT, West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, North Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi, Gorontalo, Maluku. North Maluku, West Papua, and Papua. The data used in this study are data on electricity demand, connected power capacity, electricity tariffs, population, and GRDP per capita from 2014 to 2019. In this study, the data for East Kalimantan and North Kalimantan provinces were combined into one because the available data sources from the Indonesian Electricity Statistics are presented as such.

In this study, electricity demand is the dependent variable, while the connected power capacity, electricity tariff, population, and GRDP per capita are independent variables.

a. Electrical Energy Demand

   The electricity demand is measured by the total electrical energy sold. This study uses data on electrical energy sold in Eastern Indonesia in 2014-2019.

b. Connected Power Capacity

   Connected electrical power capacity is the electricity network that is distributed to electricity consumers. The connected power capacity is the maximum electricity capacity used by customers(Assagaf, 2018). This study uses data on connected power capacity in Eastern Indonesia in 2014-2019.

c. Electricity Price

   Electricity tariffs are tariffs set by the government on electricity customers. The data used is data on electricity tariffs sold in Eastern Indonesia in 2014-2019.

d. Total population

   Residents are all domiciled in the geographical area of the Republic of Indonesia for six months or more or those who are domiciled for less than six months but aim to settle down. The population data in this study is data on the number of people living in Eastern Indonesia in 2014-2019

e. GDP per Capita

   GRDP per capita is used as a measure of the average level of people's income. This study used per capita GRDP data at constant prices in Eastern Indonesia in 2014-2019.

The analytical method used in this study is panel data regression analysis. Panel data analysis was carried out in several stages, namely determining the best estimation model, the common effect model (CEM), fixed effect model (FEM), and random effect model (REM) using the Chow test and Hausman test, detecting classical assumptions in the model. The regression model used in this study is as follows:

$$EEDit = \beta 0 + \beta 1\ CPCit + \beta 2\ PRICEit + \beta 3\ TPit + \beta 4\ GRDPit + Ui \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Information:

EED : Electrical Energy Demand (GwH-Gigawatt-hour)
CPC : Connected Power Capacity (MVA-Mega Volt-Ampere)
PRICE: Electricity Price (Rp/Kwh-kilowatt-hour)
TP : Total population
GRDP : GDP per Capita
Ui : *Error*
β0 : Constant
β1- β4 : Regression Coefficient

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RESULTS AND DISCUSSION

The results of this study indicate that the best estimation model in this study is the fix effect model (FEM). The best model for panel data regression is selected by using the Chow test and Hausman test. Chow test is used to select the best model between CEM and FEM models. Then the

Hausman test was carried out to select the best model between the FEM and REM models. The following table 1. will show the results of the Chow test and Hausman test:

Table 1. Test Results of Panel Data Model Specifications

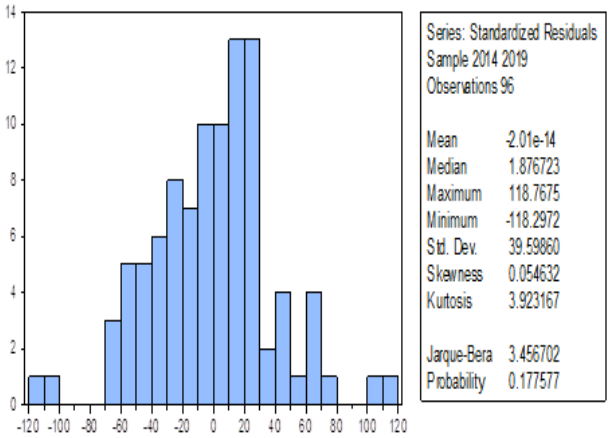
Model Specification Test	Probability	Description
Chow Test	0,0000	Choosing the FEM model over CEM
Hausman Test	0,0000	Choosing the FEM model over REM

Source: data processed

After determining the best model for panel data, the classical assumption will be detected, namely detection of normality, autocorrelation, multicollinearity, and heteroscedasticity.

a. Normality Detect

Normality detection is used to determine whether each of the data used in the research variables usually is distributed or not. Detection of normality can be done by looking at the value of Jarque-Bera (JB Test). Figure 1. shows the results of normality detection as follows:



Source: data processed

Figure 1. Normality Detection Test Results

Figure 1. shows the Jarque-Bera probability value of 0.177577, which is greater than the 0.05 significance level. This means that the regression model in this study is normally distributed.

b. Autocorrelation Detect

Detection of panel data autocorrelation is done by looking at the value of Durbin Watson. The Durbin Watson value will be compared with the value in the Durbin Watson table to determine whether the model in the study has a negative correlation or there is no correlation. Durbin Watson value will be shown in table 2 below:

Table 2 Correlation Detection Results

dL Value	dU Value	DW Value	4-dU Value
1,5821	1,7553	2,097346	2.2467

Source: data processed

Table 2 shows that the dL value is 1.5821 and the dU value is 1.7553 (n = 96 and k = 4). The results of the regression output of the fixed-effect model show the Durbin-Watson (DW) value of 2, 097346. Based on the Durbin Watson test results, the DW value is between dU and 4-dU, namely 1.7553 < 2.097346 < 2.2467. According to the decision-making table, whether there is autocorrelation or not, it is concluded that the data in the study does not have an autocorrelation problem.

c. Heteroscedasticity Detection

Heteroscedasticity detection aims to see whether the regression model in the study has residual inequality from one observation to another observation. Table 3 shows that all independent variables in the study, estimated with the dependent variable absolute residual, showed the probability value was more significant than the significance level of 0.05. This means that this research model does not have symptoms of heteroscedasticity.

Table 3 Heteroscedasticity Detection

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-76.21682	169.6731	-0.44919	0.6546
CPC	-0.012198	0.041943	-0.29081	0.7720
PRICE	0.021849	0.014348	1.522788	0.1320
TP	0.009525	0.059837	0.159174	0.8740
GRDP	0.000596	0.000441	1.349763	0.1811

Source: data processed

d. Multicollinearity Detect

Multicollinearity detection is used to see whether the model has a relationship between

independent variables or correlation. The regression model is said to be good if the model is free from multicollinearity. Table 4 shows the following multicollinearity detection results:

Table 4 Multicollinearity Detect

	CPC	PRICE	TP	GRDP
CPC	1.000000	-0.012949	0.869347	0.709132
PRICE	-0.012949	1.000000	-0.141563	-0.008959
TP	0.869347	-0.141563	1.000000	0.544296
GRDP	0.709132	-0.008959	0.544296	1.000000

Source: data processed

Based on the multicollinearity value using the correlation matrix in table 1.4, the following results are obtained that the value of the correlation coefficient between connected power and the price is -0.012949. The value of the correlation coefficient between connected power and the total population is 0.869347. The value of the correlation coefficient between connected power and GRDP is 0.709132. The value of the correlation coefficient between price and population is -0.141563. The value of the correlation coefficient between price and GRDP is -0.008959. The value of the correlation coefficient between the population and GRDP is 0.544296.

Gujarati (2004) states that if the value of the correlation coefficient between the independent variables is below 0.90, then the regression model is free from multicollinearity deviations. This means that the regression model in this study is free from multicollinearity problems.

Model Significance Test Analysis

Table.5 will show the results of the panel data regression of the FEM model as follows:

Table 5 FEM Panel Data Regression Output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1519.012	341.3874	4.449525	0.0000
DT	1.240972	0.084391	14.70497	0.0000
HARGA	-0.028200	0.028868	-0.976831	0.3318
PEND	-0.447726	0.120394	-3.718829	0.0004
PDRB	0.002411	0.000888	2.714324	0.0082

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.999026	Mean dependent var	1432.650
Adjusted R-squared	0.998782	S.D. dependent var	1268.682
S.E. of regression	44.27258	Akaike info criterion	10.60166
Sum squared resid	148964.6	Schwarz criterion	11.13590
Log likelihood	-488.8797	Hannan-Quinn criter.	10.81761
F-statistic	4101.879	Durbin-Watson stat	2.097346
Prob(F-statistic)	0.000000		

Source: data processed.

Based on table 5, it can be analyzed as follows:

a. T-statistic test

The connected power capacity variable has a probability value of 0.0000, which is smaller than the significance level of 0.05. This means that the connected power variable affects the electricity demand. Then the population variable has a probability value of 0.0004, which is smaller than

the significance level of 0.05. This means that the population variable affects the electricity demand, likewise with the GRDP variable, which has a probability value of 0.0082, smaller than a significance value of 0.05. The GRDP variable affects electricity demand. Meanwhile, the electricity price variable has a significance level of 0.3318, more significant than a significance level of 0.05. This means that the electricity price variable does not affect electricity demand.

b. F test

The regression results shown in table 1.5 show that the calculated F probability value of 0.000000 is smaller than the significance level of 0.05. It can be concluded that the connected power capacity variables, electricity prices, population, and GRDP per Capita affect electricity demand simultaneously In Eastern Indonesia.

c. Coefficient of Determination Test

Table 1.5 shows the coefficient of determination (R-squared) of 0.999026, which means that the connected power capacity, electricity price, population, and GRDP per Capita influence 99.90% on electricity demand. While other variables outside the research model influence the remaining 0.10%.

Interpretation

Based on the panel data analysis of the FEM model in table 1.5, the following regression equation is obtained:

EED = 1519,012 + 1,24CPC – 0,0282PRICE – 0,4477TP + 0,0024GRDP + Ui

The results of estimation and detection of classical assumptions in the analysis of electricity demand in Eastern Indonesia that have been carried out show that there is no multicollinearity, heteroscedasticity, autocorrelation, and normally distributed data.

The Effect of Connected Power on Electricity Demand

Based on the estimation results, it is shown that the connected power capacity variable has a positive and significant relationship to electricity demand in the Eastern Region of Indonesia. The corresponding power variable coefficient is 1.24 and is significant at the 5% significance level with a probability of 0.0000. The magnitude of the variable coefficient of connected power capacity shows that every increase in connected power capacity of one MVA will increase electricity demand in the Eastern Region of Indonesia by 1.24 GWh. These results are supported by research conducted by Veromita (2019) and Fitriantie and Wibowo (2016), which explains a positive and significant relationship between connected power capacity and electricity demand, where every additional connected power will increase electricity demand.

The Effect of Electricity Prices on Electricity Demand

The regression results in this study indicate the electricity price coefficient is -0.0282 and has a negative and insignificant relationship to electricity demand. This is indicated by the probability value of the electricity price coefficient of 0.3318, more than the 5% or 0.05 significance level. This means that every 0.0282 increase in electricity prices will reduce electricity demand by 0.0282 GWh. The regression results follow the theory of demand, where if the price of an item increases, the demand for that item will decrease.

Effect of Population on Electricity Demand

The coefficient of the population in this study is -0.4477. It has a negative and significant relationship because it has a probability value of 0.0004, smaller than the significance level of 5% or 0.05. This means that if there is an increase in population by one unit, the electricity demand will decrease by 0.4477. This result is not following the theory of demand. If the population increases, it will increase the electricity demand. This is due to the uneven distribution of electrical energy in Eastern Indonesia.

Effect of GRDP per capita on Electricity Demand

The GRDP coefficient per capita is 0.0024 and has a positive and significant relationship to electricity demand in the Eastern Region of Indonesia. The probability value of this coefficient is 0.0082, which is smaller than the significance level of 5% or 0.05. This means that if there is an increase in GRDP by one unit, it will increase the

electricity demand by 0.0082. These results are consistent with (Al-Bajjali & Shamayleh, 2018) research that GDP (Gross Domestic Product) is positively and significantly related to electricity consumption. An increase will follow every increase in GDP in electricity consumption. Another study also explains that GDP growth is positively related to electricity consumption (Alawin et al., 2016).

CONCLUSION

Based on the results of this study, it can be concluded that the connected power capacity variable and GRDP per capita have a positive and significant effect on electricity demand in the Eastern Region of Indonesia. Meanwhile, electricity prices have a negative effect on electricity demand in the Eastern Region of Indonesia. Then the population variable has a negative and significant influence on electricity demand in the Eastern Region of Indonesia. This result is due to the supply of electrical energy in the Eastern Region of Indonesia that is not evenly distributed. Based on the findings of this study, it is hoped that the government will be able to build an even supply of electrical energy, especially in the Eastern Region of Indonesia, which has a low electrification ratio. This is intended so that the community can carry out economic activity in the Eastern Indonesia Region and meet their daily needs. Then for further researchers are expected to be able to improve this research by adding research variables.

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