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DETERMINANTS OF ELECTRICITY CONSUMPTION IN INDONESIA

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ABSTRACT

Electrical energy is one energy source that plays an essential role in human life daily, such as industrial, commercial, government, and household activities. All processes related to public activities can dash effectively and efficiently with electricity. The electricity consumption in Indonesia has reportedly increased every year. This enhancement can be caused by several factors, one of which is the population. The increasing electricity consumption in Indonesia has shown that electricity is the primary driving sector for the development that supports productivity and public activities. It is hoped that the economy will also increase. Based on this statement, this study aimed to analyze the factors which affect electricity consumption in Indonesia during the 2015 – 2019 period. This study used secondary data by taking four independent variables, including GDRP per capita, population, installed power capacity, and electricity tariffs. The dependent variable used in this study is electricity consumption. The research used the estimation technique of the Fixed Effect Model, which was selected based on the result of the Chow Test. The results in the regression analysis showed that the GDRP per capita and population variable both resulted in positive and insignificant effects on the electricity consumption in Indonesia during the 2015 – 2019 period. The installed power capacity variable had a positive and significant influence on the electricity consumption in Indonesia during the 2015 – 2019 period. Meanwhile, the electricity rate variable had a negative and insignificant effect on the electricity consumption in Indonesia during the 2015 – 2019 period.

***Keywords**: Electricity Consumption, GDRP, Population, Installed Power Capacity, Electricity Tariffs*

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ABSTRAK

Energi listrik merupakan salah satu sumber energi yang berperan penting dalam kehidupan manusia sehari – hari baik untuk kegiatan industri, komersial, pemerintah maupun rumah tangga. Dengan adanya listrik maka segala proses yang berhubungan dengan aktivitas masyarakat dapat berjalan dengan cepat, efektif dan efisien. Konsumsi listrik di Indonesia mengalami peningkatan setiap tahunnya. Hal tersebut dapat disebabkan oleh berbagai faktor salah satunya adalah jumlah penduduk. Peningkatan konsumsi listrik di Indonesia menunjukkan bahwa listrik sebagai sektor penggerak utama pembangunan yang dapat mendorong produktivitas dan aktivitas masyarakat lebih berkembang dan diharapkan perekonomian ikut meningkat. Berdasarkan pernyataan tersebut maka penelitian ini bertujuan untuk

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menganalisis faktor – faktor apa yang mempengaruhi konsumsi listrik di Indonesia Tahun 2015 – 2019. Penelitian ini menggunakan data sekunder dengan mengambil empat variabel independen yaitu PDRB perkapita, jumlah penduduk, kapasitas daya terpasang dan tarif listrik. Sedangkan variabel dependen yang digunakan adalah konsumsi listrik. Metode analisis yang digunakan adalah fixed effect model yang dipilih berdasarkan uji chow. Hasil penelitian dalam analisis regresi diperoleh variabel PDRB perkapita dan jumlah penduduk mempunyai pengaruh positif dan tidak signifikan terhadap konsumsi listrik di Indonesia tahun 2015 – 2019. Variabel kapasitas daya terpasang mempunyai pengaruh positif dan signifikan terhadap konsumsi listrik di Indonesia tahun 2015 – 2019. Sedangkan variabel tarif listrik mempunyai pengaruh negatif dan tidak signifikan terhadap konsumsi listrik di Indonesia tahun 2015 – 2019.

Kata Kunci: *Konsumsi Listrik, PDRB, Jumlah Penduduk, Kapasitas Daya Terpasang, Tarif Listrik*
JEL: L94; P23

Introduction

Electrical energy is one of the essential energy sources in everyday human life. Electricity has become a basic need for society because almost every activity in human life depends on the availability of electrical energy. With electricity, all processes related to community activities can dash effectively and efficiently. The use of electrical energy is used by each type of customer group, namely households, industry, businesses, and the public, where the use of each group is different.

Consumption of electrical energy is one indicator that reflects the level of development. According to a 2019 report from the Ministry of Energy and Mineral Resources, electricity consumption in Indonesia increased annually by 1084 GWH in 2019. The increase in electricity consumption shows that electricity can encourage productivity and community activities to develop more, and it is hoped that the economy will also increase. According to Alawin et al. (2016), gross domestic product and population growth are positively related to electricity consumption. This relationship happens because energy and economic growth have an inseparable relationship. After all, energy can provide a stimulus to a country's economy.

In addition to economic and demographic factors, installed power capacity and electricity tariffs affect electricity consumption. The installed power capacity determines how much gWh can be used by all customers; the greater the capacity, the more excellent the opportunity to use more gWh of electricity. The installed power capacity must be greater than the load requirement. However, it will be a problem if the amount of installed power capacity is excessive, leading to high load costs. When the price of electricity rates increases due to the amount of installed power being overloaded, consumers will reduce their consumption.

Conversely, when electricity rates decrease, consumers will increase the amount of their consumption (cateris paribus), regardless of the electricity tariff set by PT. PLN (Persero), as the only electricity company in Indonesia, people will continue to use electricity for various daily needs in their lives even though it will slightly reduce the amount of use. So that, in reality, consuming electricity when electricity rates increase will always be followed by electricity demand. Given that electricity is a basic need of society in carrying out daily activities.

Literature Review

Demand Theory

Demand is the amount of a good that consumers can buy at a certain price level. The price level influences the main factor of demand for an item. Therefore, the theory of demand prioritizes analysis of the relationship between the quantity demanded of an item and the price of the item itself (*cateris paribus*). According to Sukirno (2010), dominant factors influence demand other than price, including the price of the good itself, the price of other goods (substituting and complimentary), income, tastes, population, and forecasts. According to Case & Fair (2017), a change in the demand for a good or service causes a shift in the demand curve. Changes in demand occur due to factors other than price. The nature of the relationship between the quantity demanded of a good can be explained by the law of demand. Demand's law states that the lower the price of a good, the greater the demand for that good. Conversely, the higher the price of good, the less demand for that good (ceteris paribus) (*ceteris paribus*).

Based on the factors that affect demand above, it can be formed into a general demand function, which is as follows:

$$Q_d = f(Px, Py, Y, T, D, E) \quad (1)$$

Where:

Q_d = Quantity of Items Requested

P_x = Price of the Goods Itself (X)

P_y = Goods Price (Y)

Y = Income

T = People taste

D = Total population

E = Expectation

Consumption Theory

Consumption is the activity of purchasing goods and services to meet the needs of each individual. When consuming, every individual in the household, besides aiming to meet their needs, the individual also expects the satisfaction he will receive. The level of consumption of society is strongly influenced by income. According to Keynes, the size of public consumption is strongly influenced by the amount of income. The higher the income earned, the greater the consumption expenditure, and vice versa.

The relationship between consumption and income is known as the consumption function. The consumption function is a curve that describes the nature of the relationship between the level of household consumption in the economy and national income. In general, the consumption function can be expressed in the following equation:

$$C = a + bYD\,; (a > 0, 0 < b < 1) \quad (2)$$

Where:

C = Consumption

a = Household consumption when national income is 0

b = Marginal Consumption Tendency

YD = National Income Level

Research Method

Data Types and Sources

The type of data used in this study is a combination of time series and cross-section data or often called panel data. Cross-section data from 33 provinces and time-series data were used during the 2015 – 2019 period. The dependent variable in this study is electricity consumption, and the independent variables are GRDP per capita, population, installed power capacity, and electricity tariffs. The data is obtained from the relevant agencies.

Operational definition

Electricity Consumption Per capita (Y)

Per capita, electricity consumption is the amount of electrical energy used or utilized directly or indirectly from energy sources divided by the number of residents in an area within one year.

GRDP Per capita (X1)

GRDP per capita is a description and average income each resident receives for one year in a region or region.

Total Population (X2)

GRDP per capita is a description and average income each resident receives for one year in a region or region.

Installed Power Capacity (X3)

Installed Power Capacity is the power agreed between PLN and consumers from all household groups, industrial, business, and general customers.

Electricity Tariff (X4)

The electricity tariff is the average selling price of electricity for household, industrial, business, and public groups set by PLN.

Analysis Method

The analytical method used in this research is statistical descriptive analysis and panel data regression analysis. Descriptive statistical analysis performed was on the mean, median, minimum, maximal, and standard deviation of each variable. While the panel data regression analysis was carried out in several stages, namely determining the best model specifications, namely the fixed effect model (FEM) and the random effect model (REM) with the Chow test and the Hausman test. Then the classical assumption test and hypothesis testing were carried out on the model. The regression equation in this study can be formulated through the following equation:

$$Y = \alpha + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 - \beta_4 \log X_4 + e \quad (3)$$

Where:

Y = Per capita Electricity Consumption

X_1 = GRDP Per capita

X_2 = Total population

X_3 = Installed Power Capacity

X_4 = Electricity Tariff

α = constant

$\beta_1 \beta_2 \beta_3 \beta_4$ = Independent Variable Regression Coefficient

e = Error

Results and Discussion

Descriptive Statistical Analysis

Descriptive statistical analysis provides an overview of research related to the relationship between the independent variables and the influence of electricity consumption. The results of the descriptive statistical analysis research found are as follows:

Table 1: Descriptive Statistical Results

	Y_Electricity Consumption	X1_GRDP_ Per capita	X2_Tot_Population	X3_Installed_Power_Capacity	X4_Electricity _Tariff
Mean	0.6532	41845.56	7918.26	3705.15	3737.78
Median	0.5417	31302.53	4197.1	1365.22	3607.4
Minimum	0.1462	11087.91	876	197.62	1335.4
Maximum	4.0601	213540.32	49023.2	26161.9	4727.86
Std. Dev.	0.5603	39091.39	10939.87	5912.37	525.63
Observation	165	165	165	165	165

Source: Eviews 10 (processed)

Based on table 1, the results of descriptive statistics can be concluded as follows:
a. The electricity consumption variable has a minimum value of 0.1462 and a maximum of 4.0601. The mean value for 2015 – 2019 is 0.6532, and the standard deviation is 0.5603. This means that the electricity consumption variable is homogeneous. In other words, the deviation is low, and the value is evenly distributed because the standard deviation reflects the deviation from the variable's data being smaller than the average value.

b. Variable GRDP per capita has a minimum value of 11087.91 and a maximum value of 213540.32. The mean value for 2015 – 2019 is 41845.56, and the standard deviation is 39091.39. So the mean value > standard deviation, which means that the level of variation of the data is low or, in other words, the distribution of the values is evenly distributed.

c. Variable population has a minimum value of 876 and a maximum value of 49023.2. The mean value for 2015 – 2019 is 7918.26, and the standard deviation value is 10939.87. So the mean value < standard deviation, which means that the level of variation in the data is high. In other words, the distribution of the values is not evenly distributed.

d. The installed power capacity variable has a minimum value of 197.62 and a maximum of 26161.9. The mean value for 2015 – 2019 is 3705.15, and the standard deviation value is 5912.37. So the mean value < standard deviation, which means that the level of variation in the data is high. In other words, the distribution of the values is not evenly distributed.

Model Specification Test

According to Gujarati & Porter (2012), selecting the best panel data model specifications is carried out with two tests, namely the Chow test and the Hausman test. Both can be done by testing the hypothesis, H0 chooses to use a random effect model, and H1 chooses to use a fixed effect estimate. The results of the regression to obtain panel data with the Chow test and Hausman test are shown in table 2:

Table 2: Model Specification Test Results

Model Specification Test	Probability	Information
Chow Test	0.0000	*H1 is accepted, it means choosing the fixed effect model*
Hausman Test	0.0000	*H1 is accepted, it means choosing the fixed effect model*

Source: Eviews 10 (processed)

Based on the results of the specification test of the two models in table 2, it produces a probability value of 0.0000 < 0.05, meaning that H1 is accepted. So the best panel data model used in this study is the fixed effect model (FEM) (Gujarati, 2012).

Classic assumption test

Normality Test

The normality test is posed out to test a regression model whether, an independent, dependent or both variable have a normal or abnormal distribution (Ghozali, 2016). The normality test in this research can be done using the Jarque-Berra method. The results of the normality test using the jarque-fall method are shown in Figure 1.1 below:

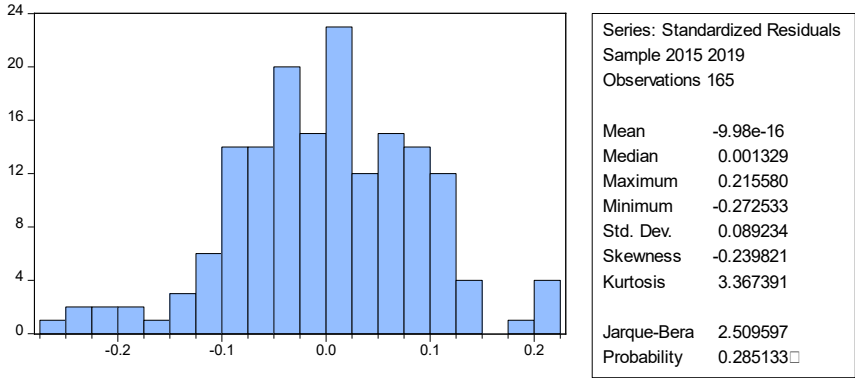

Figure 1: Normality Test Results

Source: Eviews 10 (processed)

Based on the normality test results in Figure 1, it was found that the probability value was 0.285133 > 0.00005. So it can be concluded that the probability value is greater than the

significance level of 0.00005. Thus, testing the distribution of the data shows that the regression model in this study is usually distributed and is feasible to use because it has met the assumption of normality.

Multicollinearity Test

According to Ghozali (2011: 105-106) multicollinearity test's purpose is to test whether the regression model found a correlation between independent variables (independent). The results of the multicollinearity test can be shown in table 3 as follows:

Table 3: Multicollinearity Test Results

Variable	X1_GRDP_Per capita	X2_Tot_Population	X3_Installed_Power_Capacity	X4_Electricity _Tariff
X1_GRDP_Per capita	1.000000	0.083395	0.267455	0.182674
X2_Tot_Population	0.083395	1.000000	0.932281	-0.147863
X3_Installed_Power_Capacity	0.267455	0.932281	1.000000	-0.075383
X4_Electricity _Tariff	0.182674	- 0.147863	-0.075383	1.000000

Source: Eviews 10 (processed)

According to Gujarati (2012), if the correlation coefficient between independent variables is below 0.90, the model is free from multicollinearity deviations. In table 3 above, it can be concluded that all variables have a correlation coefficient of less than 10, so ther is no multicollinearity problems in this study.

Heteroscedasticity Test

A good regression model does not occur in heteroscedasticity (Ghozali, 2011). The heteroscedasticity test in this study was carried out using the Glejser test. Probability results are significant if the significance value is above the 5% confidence level. The results of the heteroscedasticity test can be shown in table 4 as follows:

Tabel 4: Heteroscedasticity Test

Variable	Probability
C	0.6301
X1_GRDP_Per capita	0.8531
X2_Tot_Population	0.5822
X3_Installed_Power_Capacity	0.9019
X4_Electricity _Tariff	0.1853

Source: Eviews 10 (processed)

The results of the heteroscedasticity test shown in table 4. It was found that the probability value of the independent variable was > 0.00005. So it can be concluded that the probability value is greater than the significance level of 0.00005. So that the regression model in this study is free from heteroscedasticity symptoms.

Autocorrelation Test

In this study, Durbin-Watson test (DW test) carried out to test the presence or absence of autocorrelation symptoms. After that, the value of the Durbin-Watson test is compared

with the value of the Durbin-Watson table to determine whether the regression model has a positive correlation, negative correlation or no correlation (Gujarati & Porter, 2012). The results of the Durbin-Watson test with a fixed effect regression model are shown in table 5 below:

Tabel 5: Autocorrelation Test Results

dL Value	dU Value	dW Value	4-dU Value
1.1927	1.7298	2.265616	2.2702

Source: Eviews 10 (processed)

It is known that the dL value is 1.927, and the dU value is 1.7298 (n = 33 and k = 4). The values of dL and dU can be obtained from the Durbin Watson table. The output of the fixed effect regression model in the table shows that the DW value is 2.265616. So based on the results of the Durbin-Watson test above, it shows that the DW value is between the dU and 4-dU values, namely 1.7298 < 2.265616 < 2.2702. Therefore, according to the decision-making table, whether or not there is autocorrelation, it can be concluded that the data in this study does not have an autocorrelation matter.

Hypothesis Testing Analysis

Coefficient of Determination Test (R-Square/ R2)

The regression results show the R2 value of 0.984202, which means that the contribution of all independent variables in the study can explain 98.4202%. Other variables outside the study explain the remaining 1.5798%.

Test F Statistics

Based on the regression test results of the fixed-effect model used in the study, the F-count value was 221.5100, and the probability value was 0.000000. The F-table used is based on a significance level of 5%, 2,922 with df1 (k-1) and df2 (n-k) worth 3 and 30. From the results obtained, it can be seen that the F-count > F-table with the value 221.5100 > 2.922 and a probability value that is smaller than the significance level = 5% with a value of 0.000000 < 0.05, it can be concluded that the dependent variable has a joint influence on the electricity consumption variable.

Test T

1. Variable GRDP Per capita

The results of the per capita GRDP variable test show that the t-count value is lower than the t-table with a value of 0.231529 < 1.69913, and the probability value is greater than the significance level = 5% with a value of 0.8173 > 0.05, so it can be concluded that the variable GRDP per capita has no significant effect on the electricity consumption variable.

2. Variable Number of Population

The results of the population variable test show that the t-count value is lower than the t-table with a value of 0.742668 < 1.69913, and the probability value is greater than the significance level = 5% with a value of 0.4590 > 0.05, so it can be concluded that the variable population has no significant effect on the electricity consumption variable.

3. Variable Installed Power Capacity

The test results of the installed power capacity variable show that the t-count value is higher than the t-table with a value of 8.665744 > 1.69913, and the probability value is smaller than the significance level of = 5% with a value of 0.0000 <0.05, so it can be concluded that The installed power capacity variable has a significant effect on the electricity consumption variable.

4. Variable Electricity Tariff

The electricity tariff variable test results show that the t-count value is lower than the t-table with a value of -0.040093 > 1.69913. The probability value is greater than the significance level = 5% with a value of 0.9681 > 0.05, so it can be concluded that the electricity tariff variable has no significant effect on the electricity consumption variable.

Interpretation Results

The Influence of Per capita Gross Regional Domestic Product (GRDP) on Electricity Consumption in Indonesia in 2015 – 2019

Based the test results in this study produce a regression equation that shows that the coefficient value on the variable GRDP per capita (X1) is 0.038973, which means that every increase or increase in GRDP per capita (thousands/rupiah) will increase electricity consumption in Indonesia in 2015 - 2019 by 0.038973 percent. Judging from the results of the t-test that the t-count value is 0.231529 lower than the t-table value of 1.69913, the GRDP per capita variable has no significant effect on electricity consumption. So it can be concluded that the GRDP per capita variable had a positive and insignificant effect on the electricity consumption variable in Indonesia from 2015 to 2019.

The results of this study are in line with research conducted by Fatin Damayanti et al. (2020), which says that GDP per capita has a positive and insignificant effect on electricity consumption. The same research was carried out by Alawin et al. (2016) and Veromita (2019), who said that GRDP per capita had a positive and insignificant effect on electricity consumption. According to him, the insignificant effect of GDP per capita on energy consumption is due to the substitution factor between energy and input with existing technology, one of which is renewable energy as a substitute for fuel and as a driver for power generation and bio-energy development in Indonesia.

The Effect of Population Variables on Electricity Consumption in Indonesia 2015 – 2019

Based on the test results in this study produce a regression equation that shows that the value of the regression coefficient on the population variable (X2) is 0.435872, which means that every increase or increase in the number of people (millions of people) will increase electricity consumption in Indonesia in 2015 - 2019 by 0.435872 percent. Judging from the results of the t-test that the t-count value of 0.742668 is lower than the t-table value of 1.69913, the population variable has no significant effect on electricity consumption. So it can be concluded that the population variable had a positive and insignificant effect on the electricity consumption variable in Indonesia from 2015 to 2019.

The results of this study are from research conducted by Al-Bajjali and Shamayleh (2018), which says that the population positively influences electricity consumption. When the population increases, the community's basic needs will also increase. Given that electrical energy is one of the basic needs of society that must be met, along with the increase in population, the public consumption of electrical energy will also increase.

The Effect of Installed Power Capacity Variables on Electricity Consumption in Indonesia 2015 – 2019

Based on the test results in this study produces a regression equation that shows that the regression coefficient value for the installed power capacity variable (X3) is 0.456393, which means that any increase or increase in installed power capacity (MVA) will increase electricity consumption in Indonesia in 2015 - 2019 by 0.456393 percent. Judging from the results of the t-test that the t-count value of 8.665744 is greater than the t-table value of 1.69913, the installed power capacity variable has a significant effect on electricity consumption. So it can be concluded that the installed power capacity variable had a positive and significant effect on the electricity consumption variable in Indonesia from 2015 to 2019.

The results of this study are in line with research conducted by Assagaf (2010), Aminuddin (2011), and Veromita (2019), which states that the installed power capacity variable has a positive and significant effect on increasing electricity consumption. The increase in installed power capacity indicates a high demand from the public to install a larger electric power capacity. The greater the capacity, the more excellent the opportunity to use a more considerable amount of electricity, encouraging a more significant increase in electricity consumption.

The Effect of Electricity Tariff Variables on Electricity Consumption in Indonesia 2015 – 2019

Based on the test results in this study, a regression equation shows that the value of the regression coefficient on the electricity tariff variable (X4) is -0.002374, which means that every increase or increase in electricity tariffs (thousands/kWh) will reduce electricity consumption in Indonesia in 2015 – 2019 by 0.002374 percent. Judging from the results of the t-test that the t-count value of 0.040093 is lower than the t-table value of 1.69913, the electricity tariff variable has no significant effect on electricity consumption. So it can be concluded that the electricity tariff variable had a negative and insignificant effect on the electricity consumption variable in Indonesia from 2015 to 2019.

Based on the assumption of the law of demand, when the price of goods increases, the quantity demanded will decrease. This is similar to an increase in electricity rates which can reduce the amount of demand or consumption of electricity consumption. In this study, electricity tariffs have a negative and insignificant effect on electricity consumption; this can happen when the government increases electricity rates, which will affect electricity consumption. This study aligns with Jamil & Ahmad (2010), which examined the relationship between consumption of electricity, price of electricity, and GDP in Pakistan. The results show no significant effect between electricity prices and electricity consumption. In addition, this research is also supported by research conducted by Rosyadi & Amar (2019), which states that electricity prices have a negative and insignificant effect on electricity consumption in Indonesia.

Conclusion

Based on the results of data analysis and discussion of electricity consumption in Indonesia during the 2015 - 2019 period, it can be concluded that the research conclusion is that GRDP per capita and population have a positive and insignificant effect on electricity consumption. The installed power capacity has a positive and significant effect on electricity consumption. Meanwhile, electricity tariffs have a negative and insignificant effect on electricity consumption. Suggestions that can be given to further researchers are expected to be able to increase the number of variables and the time used to obtain a better model. In addition,

it is also hoped that the scope of research can be expanded not only on the demand side but also by estimating the supply side of electricity.

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