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ANALYSIS OF ELECTRICITY CONSUMPTION BEHAVIOUR: CASE STUDY OF NON BUSINESS AND BUSINESS HOUSEHOLD IN MALANG CITY

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Abstract

This study aimed to (1) analyze the characteristic of the households affecting energy consumption of household electricity, that was conducted in city of Malang by analyzing the probability of each factors affecting like income, location, price of electricity (tariff), size of houses, size members household, voltages, home appliances, type of business, the bill of payment of consumption demand electricity of non-business household and business household (2) analyze the differences characteristic in consumption of non-business household than business household in Malang. (3) analyze the most effected or dominant factor to influence consumption electricity of non-business household and business household in Malang City. The results show that in Malang, according to the simultan determine income, location, size of houses, size members household, voltages, home appliances, type of business, ability to pay of demand had a significant and positive affect on the consumption electricity of non-business household and business household. But according to partial determine the effected significant factors of electricity consumption of non-business household are members, voltage and the pay of payment and according to partial determine the effected significant factors of electricity consumption of private household are price of electricity (tariff), voltage and the bill of payment and type of business household industries. The characteristic consumption patterns electricity of non-business household is contrastly different from business household. The most effected or dominant factor to influence consumption electricity of non-business household and business household in Malang City is the ability to pay the bill electricity of household of month.

Keywords: Consumption behaviour, Members of household, Voltages, The bill of payment, Type of business, Electricity, Household

1. INTRODUCTION

1.1. Research Background

Electricity has attained a very important place in every household on this earth. The demand for electricity in household are derived from the electricity consuming kind of determinants used by the household. Against this backdrop, the present paper makes an analysis about the pattern of electricity consumption in the household sector of Malang City. The aim of this research are to prove the relationship electricity demand to variables which are included in this research, then to determine the level of utility that households get in electrical energy consumption. Based on a demographic variables into the estimation, it can support the idea of Anderson (1973) and Matsukawa (2000) on Nababan's research (2015) which states the demand of energy by a household not only

reflect the revenue and cost (price), but also reflect the demographic characteristics and social characteristics, such in where the household is located, as this may affect the function of household utilities. This times at Malang City, that affect variables of demand for household electricity consumption can be developed more widely and varied. These variables may develop because of changes in the neighborhood, the house building forms, and mainly because of changes in technology, etc. The model equation of demand in this papers can used in analysis because, the changing of variables can explaining the changing of utility in electricity usage, then comparing with a household function. Including to non-business household or business household in Malang City.

1.2. Research Purposes

1. Analyze the pattern of households affecting energy consumption of household electricity, the study was conducted in city of Malang, analyze the probability of each factors affecting like income, location, price of electricity (tariff), size of houses, size members household, voltages, home appliances, type of business, ability to pay of demand consumption electricity of non-business household and business household.
2. Analyze the differences pattern in consumption of non-business household than business household in Malang.
3. Analyze the most effected or dominant factor to influence consumption electricity of private household and business household in Malang City.

2. LITERATURE REVIEW

2.1. Demands

Nicholson (2000), The demand function is a representation stating that quantity demanded depends on price, income and preferences. Tati Suhartati dan Joesron Fathurrozi (2002), Lincolin Arsyad (1991) a curve that visualize from the relationship between all of the number of items a consumer goods kind of demand at various price levels, it is a demand. Simple demand function forms can be written as follows as :

$$Q_{dx} = f(P_x) \dots \dots \dots (1)$$

Explanation:

Q_{dx} = Quantity of goods x

P_x = Price of goods x

The function above, can be explained that the quantity of the requested amount of goods X will depend goods themselves, (assuming *ceteris paribus*).

The modern ways from theory of demand, there are many factors that influence the demand for goods, such as the price of the goods, the price of other goods, income, tastes, income distribution, population, affluence of consumers, credit availability, government policies, the level of demand in the past, and the level of previous earnings. Therefore, in theory demand especially in the analysis is the relationship between the number of requests an item with the price of the goods (Sukirno, 2008).

Nuraini (2006) in practice, something considered fixed or *ceteris paribus* are having important influence on the quantity demanded.

Therefore, we can write the expansion of the demand function becomes:

$$Q_{dx} = f(P_x, P_y, I, T, A, N, P, R) \dots \dots \dots (2)$$

Explanation:

Q_{dx} = Quantity demand of the X goods

P_x = Price of the X goods

P_y = Price others good

I = Income

T = Taste

A = Advertisement

P = Population

R = Forcase

2.2. Consumption Theory

Mankiw (2006), define consumption as the purchase of goods and services by households. Goods include household spending is durable goods, vehicles, equipment and durable goods such as food and clothing. Services include intangible goods of concrete, including education. Market for the demand curve is derived from individual requests (individual consumer demand), then individual requests derived from the theory of consumption. Approach in microeconomic theory of consumption, there are two ways that the utility function (utility) and the indifference curve (indifference curve), (Suciani, 2006).

2.3. Energy Consumption

The research (Nababan, 2015), wrote the research conducted Halvorsen (1976) that the utility function of household electricity demand comes as a direct request. Wild and Willenborg (1975) explains that household electricity demand is a derived from demand because it depends on the main demand of electricity stock (equipment, electrical services and other electrical devices). The purpose of the Halvorsen and Willenborg's research is when the power company to raise the rate of 2%, when the shortterm effect of rising electricity prices is very small. This implies that electricity consumers reduce the use of appliance that use electricity are considered not so necessary, but the total demand of the demand for electricity, relying heavily on appliance owned electricity consumers and the type of equipment used in the home industry business or non the business, is not affected by the large number of appliance. With this condition, the price will risen by the amount requested but not too significant, so that total revenue will rise. In other words, at short

term the demand for electric power is inelastic. At the longer term, the increase in the electricity tariff has considerable influence. Because an increase in the tariff, consumers reduced purchases of air conditioners, refrigerators and other electronic equipment, then replace them with energy-saving appliances or move to areas where electricity rates are cheaper. Therefore the final effect of these price increases are in demand for the bigger power electrical energy. The elasticity at the longterm is greater than at shortterm, it can occur in all of the factors that ultimately determine of demand. The demand function of some items usually include one of the independent variables of the function of the demand for other products. This relationship indicates that the quantity of items purchased derived from the demand for other goods, therefore we use the term derived demand to show a relationship like this. Number of housing or car loans does not directly be determined, because the amount is derived from the demand for home or car. So even though the demand for consumer goods (product - the final product) may or may not constitute a derived demand, but the demand for all productive goods (products that are used for the processing industry until the end) is a derived from demand. (Lincoln, 2002).

3. RESEARCH METHOD

This research was conducted in Malang by analyzing the population of the household sector electricity customers in Malang, both business and non business sector. In this concept, the demand for electricity (kWh) for non-business household (Y1) and demand business household kWh (Y2) is a variable Y, which is called as the dependent variable or the dependent variable. Incomes (X1), the location (X2), Size of household (X3), members of household(X4), Voltages (X5), tariffs (X6), quantity appliance (X7), type of business (X8) , ability to pay (X9) is a factor that affects the electricity demand of the household sector in Malang. The variables (X1, X2, X3, X4, X5, X6, X7, X8, X9) are independent. Multiple linear regression model, to discern the patterns, and determine the best pattern using the classic assumption test, chow test, analysis of observation, survey and primary data collection by questionnaire, the consumption of electricity last three months in December 2015, January and February 2016, with the method sampling is purposive sampling, then processed using SPSS, to produce a model

of household electricity consumption demand non-business to business in the city of Malang. The original data are transformed into natural logarithms, which have economics meaning and are approximate to view growth rate the elasticities.

a. Non Business Household

$$\begin{aligned} \text{Ln}(Y)_2 &= \beta_0 + \beta_1 \text{Ln}(X1)_t + \beta_2 D1(X2)_t \\ &+ \beta_3 \text{Ln}(X3)_t + \beta_4 \text{Ln}(X4)_t + \beta_5 \text{Ln}(X5)_t \\ &+ \beta_6 D2(X6)_t + \beta_7 \text{Ln}(X7)_t + \beta_9 \text{Ln}(X9)_t \\ &+ \mu \dots \dots \dots (3) \end{aligned}$$

b. Business Household

$$\begin{aligned} \text{Ln}(Y)_1 &= \beta_0 + \beta_1 \text{Ln}(X1)_t + \beta_2 D1(X2)_t + \beta_3 (X3)_t \\ &+ \beta_4 \text{Ln}(X4)_t + \beta_5 \text{Ln}(X5)_t + \beta_6 D2 \text{Ln}(X6)_t \\ &+ \beta_7 \text{Ln}(X7)_t + \beta_8 D3(X8)_t + \beta_9 \text{Ln}(X9)_t \\ &+ \mu \dots \dots \dots (4) \end{aligned}$$

Y 1: Demand of the private household, average monthly consumption (**KWh/Monthly**),

Y 2: Demand of a board household, average monthly consumption (**KWh/Monthly**),

X1 : Monthly average income the household (in Rupiah).

X2 : The place of residence *Dummy variable (D1) which is equal to 1 if the household located in strategies centre of City and 0 if otherwise*

X3 : Size of the household (m2).

X4 : Size of the family (peoples).

X5 : The Voltage (VA)

X6 : Tariff *Dummy Variabel.(D2)*

X 7: Size of the electrical appliances

X8 : Type of business household *Dummy Variabel.(D3)*

X9 : Monthly average ability to pay bil of electricity (Rp/Month).

β0 : Constanta

e : Exponential

4. RESULT AND IMPLIED RESEARCH

4.1. The Model of Non Business Household

$$\begin{aligned} \Delta Y1 &= -0,436 + 0,004 \ln X1 - 0,018 \ln X2 D1 \\ t \ 2.00 &= (-1.254) \quad (0,049) \quad (-0.811) \\ &- 0,010 \ln X3 + 0,0417 \ln X4 - 0,0556 \ln X5 \\ &\quad (-0,159) \quad (5,364) \quad (-5,069) \\ &- 0,010 \ln X6 D2 + 0,163 \ln X7 + 0,750 \ln X8..(5) \\ &\quad (-0,417) \quad (1,415) \quad (16,030) \end{aligned}$$

$$R^2=0,936 \quad DW=1,779 \quad F_{test}=2.02 \ (121.477)$$

1. The First Hypotheses of Non-Business Household:

- a) The income does not give significant effect to the consumption of demand for non-business household electricity consumption in Malang. The significant value of 0.961 directing that the error rate in stating that there is influence between the incomes of the electricity consumption is 96.1%. In the non-business household electricity in Malang, did not make the size of the income earned as a main income, but rather give priority to the lifestyle such as tastes, trends, culture. The result showed that, it can be seen the value of the income elasticity of energy demand for household electricity is 0.004%, it means that demand for household consumption, including inelasticity demand.
- b) The location does not give significant effect to the consumption of demand for non-business household electricity consumption in Malang. The significant value of 0.420 directing that the error rate in stating that there is influence between the locations of the electricity consumption is 42%. They used electricity for normal activity. Especially for light system, they feel comfortable because around their crowded houses location, the electricity shining brightly. The result showed that, it can be seen the value of the location elasticity of energy demand for household electricity is 0.018%, it means that demand for household consumption, including inelasticity demand.
- c) The size of building does not give significant effect to the consumption of demand for non-business household electricity consumption in Malang. The significant value of 0.875 directing that the error rate in stating that there is influence between the location of the electricity consumption is 87,5%. Housing Units with more one floor tended to consume less electricity, it is possible reason that an increasing number of high – rise buildings with modern structure were built and equipped with energy efficient facilities. The result showed that, it can be seen the value of the size of building elasticity of energy demand for household electricity is 0.01 %, it means that demand for household consumption, including inelasticity demand.
- d) The family members' size are positive and give significant effect to demand electricity consumption non business household in Malang. The significant value of 0.000 directing that the error rate in stating that there is influence between the power of the electric energy demand is 0 % .One-person households had the most substantial increase in household electricity. As household size decreased, the increase of percapita electricity demand driven by the change of household size should be an important issue to be considered. The result showed that, it can be seen the value of the members of household elasticity of energy demand for household electricity is 0.0147%, it means that demand for household consumption, including inelasticity demand.
- e) The Voltage is negative and does not give significant effect to demand electricity consumption non business household in Malang. The significant value of 0.000 directing that the error rate in stating that there is influence between the power of the electric energy demand is 0 %. The result showed that, it can be seen the value of the voltage of household elasticity of energy demand for household electricity is 0.055%, it means that demand for household consumption, including inelasticity demand.
- f) Tariff does not give significant effect to the consumption of demand for non-business household electricity

consumption in Malang. The significant value of 0.678 directing that the error rate in stating that there is influence between tariffs on electric energy demand is 67.8%. The result showed that, it can be seen that the value of the tariff of household elasticity of energy demand for household electricity is 0.010%. It means that demand for household consumption, including inelasticity demand. They are willing to pay no matter at what cost. In other words electricity has been identified as something they cannot live without.

- g) Total Appliances does not give significant effect to the consumption of demand for non-business household electricity consumption in Malang. The significant value of 0.162 directing that the error rate in stating that there is influence between the amount of electronic equipment against electrical energy demand was 16.2%. The result showed that the value of the total appliances of household elasticity of energy demand for household electricity is 0,163%, it means that demand for household consumption, including inelasticity demand. The household in high density, always plug out the cable whenever in not used.
- h) The Ability to pay of electricity affect the demand for electrical energy is positive and significant effect to demand electricity consumption non-business household in Malang. The significant value of 0.000 directing that the error rate in stating that there is influence between the cost of the electric energy demand is 0%. The result showed that, it can be seen the value of the cost or tariff elasticity of energy demand for household electricity is 0.750%, it means that demand for household consumption, including inelasticity demand.

2. Second Hypotheses of Non-Business Household

The type of business is not included in this study due to non-business households are not doing business. The households have only done the function as a residence or dwelling.

3. Third Hypotheses of Non-Business Household

The patterns of consumption between non-business and business household are different, because the result of Fcount is bigger than Ftable in Chow Test. So, the third hypotheses for non business household is different and receipt sign. Df = 9 dan 132, F table 2,01, this indicates that the regression line is unstable. Based on the above hypothesis can be concluded that there are differences patterns in electricity consumption, the effects caused by revenue, size of building, members, the voltages, quantity appliances, ability to pay, locations, tarif and type of business on demand for electrical energy consumption among non business households with businesses household.

4. Fourth Hypotheses of Non-Business Household

The dominant affecting factor electriccity demand for non- business household in Malang is the ability to pay the cost of electricity that is issued by the household. So that the fourth hypothesis non-business household is refused. It can be seen from Standardized Coefficients that the value of the greatest ability to pay the cost of electricity by 0.856. is 0,750 %.

4.2. Business Household Model

$$\ln Y_2 = -0,490 - 0,026 \ln X_1 - 0,006 X_2 D_1 - 0,076 \ln X_3 \\ t_{2,00} = (-0,922) \quad (-0,0647) \quad (-0,178) \quad (-0,926) \\ -0,106 \ln X_4 - 0,354 \ln X_5 + 0,098 X_6 D_2 \\ (-0,989) \quad (-0,2891) \quad (3,041) \\ -0,068 \ln X_7 + 0,070 X_7 D_3 + 0,814 \ln X_9 \dots (6) \\ (-0,360) \quad (2,309) \quad (8,5527)$$

$$R^2 = 0,832 \quad DW = 1,412 \quad F_{test} = 2,02 \quad (35,863)$$

1. First Hypotheses of Business Household

- a. Income does not give significant effect to the consumption of demand for business household electricity consumption in

- Malang. 0520 addressing the significant value that the error rate in stating that there is influence between incomes on electricity of demand is 52%. The result showed that, the value of the income elasticity of energy demand for household electricity is 0,026 %, it means that demand for household consumption includes inelasticity demand.
- b. The location does not give significant effect to the consumption of demand for business household electricity consumption in Malang. 0859 addressing the significant value that the error rate stating that there is influence between the location of the electrical energy demand is 85.9%. The result showed that the value of the location elasticity of energy demand for household electricity is 0.006 %, it means that demand for household consumption, including inelasticity demand indicated that houses in sub strategic city areas consumes more energy than those in high density urban areas due to differences in building practices than have a relatively affluent lifestyle and climatic factor.
 - c. The size building area does not give significant effect to the consumption of demand for business household electricity consumption in Malang. 0358 addressing the significant value that the error rate in stating that there is influence between the building area of the electrical energy demand is 35.8%. The result showed that the value of the size of building elasticity of energy demand for household electricity is 0.76%, it means that demand for household consumption include in inelasticity demand. Household that have a larger housing size consumed less energy than did those with smaller housing size due to economies of scale.
 - d. Members of household does not give significant effect to the consumption of demand for business household electricity consumption in Malang. The significant value of 0.326 directing that the error rate in stating that there is influence between the number of members of the electric energy demand is 32.6%. The result showed that, it can be seen the value of the income elasticity of energy demand for household electricity is 0,106 %, it means that demand for household consumption include in inelasticity demand.
 - e. The voltages are significant and give negative effect on energy demand of electrical home appliances business in Malang. The significant value of 0.005 directing that the error rate in stating that there is influence between income on energy demand of electricity was 0.5%. It can be seen the value of the voltages elasticity of energy demand for household electricity is 0.354 %, it means that demand for household consumption include in inelasticity demand.
 - f. Tariff is positive and give significant impact on the consumption of demand for business household electricity consumption in Malang. 0003 addressing the significant value that the error rate in stating that there are significant tariff between the demand for electricity is 0.3%. It can be seen that the value of the tariff elasticity of energy demand for household electricity is 0.098%, it means that demand for household consumption include in inelasticity demand. The price, once again is suspected to be important indicator in decision making of using electrical devices. Then, the change in prices would be assessed to see the response of consumer in decision making in using electrical devices.
 - g. Total electronic device does not affect the demand for household electrical energy business in Malang. 0720 addressing the significant value that the error rate in stating that there is influence between the amount of electronic equipment against electrical energy demand is 72%. It can be seen that the value of the total appliances elasticity of energy demand for household electricity is 0.068 %, it means that

demand for household consumption includes in inelasticity demand. The amount of electronic equipment based energy saving and efficiently reduce power consumption.

- h. The ability to pay an electricity are positive and give significant effect to the consumption of demand for business household electricity consumption in Malang. The significant value of 0.000 directing that the error rate states that there is influence between the costs of electricity to the electric energy demand is 0%. The result showed that, the bill of payment elasticity of energy demand for household electricity is 0,814 %, it means that demand for household consumption includes in inelasticity demand.

2. Second Hypotheses of Business Household

Type of business affect the demand for electricity consumption household in Malang. Based on these results, the hypothesis is accepted. The significant value of 0003 showed that the rate of error shows that there is influence between types of businesses on electricity demand of business household in Malang is 0.3%. The result showed that the type of business elasticity of energy demand for household electricity is 0,070 %, it means that demand for household consumption, including inelasticity demand.

3. Third Hypotheses of Business Household

The pattern of household consumption of non business in contrast to domestic business this case in view of the results of the F count > F table with calculations chow test. So that the third hypothesis for non-business household patterns differ by household businesses receive. Df = 9 and 132, then the F table 2.01. F count > F table, this indicates that the regression line is unstable. Based on the above hypothesis can be concluded that there are differences in electricity consumption patterns, effects caused

revenue, size of building, number of members, the power, the number of electronic, electrical costs, locations, type of business and rates on demand konsusmsi electrical energy between non business and businesses household.

4. Fourth Hypotheses of Business Household

The dominant factor affecting energy demand for household electric business in Malang is the ability to pay the cost of electricity that is issued by households and prices or tariffs of electricity. So that the fourth hypothesis for non-business household is refused. It can be seen from the Standardized Coefficients that the greatest of ability to pay for electricity is 0878 and tariff is 0192.

4.3. Chow Test.

Table 1. Result all regression non-business and business household

Model	Sum of Square s	Df	Mean Square	F	Sig.
Regress	54.215	9	6.024	103.377	.000 ^a
Residual	8.158	140	.058		
Total	62.373	149			

$$F_{count} = \frac{RSS5/K}{RSS4/(N1 + N2 - 2K)} \dots \dots \dots (7)$$

Explanation:

K = Quantity of independend variable and constanta

N1; N2 = Quantity of observation 1 and 2

$$F_{count} = \frac{\frac{1,435}{9}}{\frac{6,737}{75 + 75 - 2 \times 9}} = \frac{0,1594}{\frac{6,737}{132}} = \frac{0,1594}{0,05103} = 3,123$$

Df = 9 dan 132, F tabel 2,01

F count > F table

5. CONCLUSION

1. Simultaneously both of non-business household and business households

variables such income, location, size of building, number of members, power, tariff, the number of electronic devices, the cost of electricity, type of business significantly affected the demand electricity household sector in Malang. Partially for non-business household.

2. Variables such as income, the location, the size of building area, tariff, number of electronic devices, give no significant effect on the demand for electricity. While the variable number of members, voltages and ability to pay significantly influence the demand for non-household business electricity in Malang. Partially for household business variables such as income, the location, the size building area, the number of electronic devices, the number of members, does not give significant effect on demand of the electricity. While the variable type of business, power, tariff and electricity costs significantly influence the demand for electricity business household in Malang.
3. Type of business gives significant positive effect on the demand for energy consumption of business household electricity in Malang.
4. The characteristic pattern of household electricity consumption of non-business differs from household. The payment system for home electricity consumption plays an important role in decision making. The investigation of the effect in home displays showing electricity use on customer behavior, and proved that prepayment maturing increases awareness of electricity use. In Indonesia, there are two payment system that have been enacted, which are postpaid system and prepaid system. By using postpaid system, the customers are charged with a load fee and usage fee. The customers can see the total amount of use electricity during amount in their bill. Meanwhile, by using prepaid system, the customer is free of charge from a load fee, but to be able to use electricity the customer should purchase a voucher through ATM or specific designated stall with an amount determined by the customers themselves. The prepaid system is able to show the amount electricity consumed in real time, and the remaining of electricity that can be used by customer.

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