Robust Least Squares Estimation Model for Fighting Poverty in Indonesia Case

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Abstract

Lack of electricity and high dropout rates create conditions of poverty everywhere in Indonesia. Poverty becomes a very complex problem that has broad impacts. Poverty destroys purchasing power, decreases human quality, and decreases economic welfare. Lately, efforts to fulfill electricity and basic education have become crucial because electricity can be used in a variety of activities and education will open views to improve the situation individually and socially. Therefore, the econometrics model in this study is the effect of electricity and basic education on poverty in the Indonesian Territory. This study uses secondary data cross section as many as 501 districts and cities in Indonesia. The analytical method in this study is Robust Least Squared Model. The results of the analysis of this study conclude that an increase in electricity and the level of participation in primary school education can significantly reduce poverty. Every 1% increase in household access to electricity will reduce the poverty gap index by 0.058, then each increase in participation primary school education will reduce the poverty gap index by 0.067. This study suggests that the policy of fulfilling electricity and basic education is crucial to combating poverty in regions in Indonesia.

Keywords: electricity, elementary school enrolment, poverty gap index

1. Introduction

Increased poverty gap shows more and more individuals who are met their needs under conditions below the poverty line. The problem of poverty has become interesting lately. Since the great depression of the 1930s, the focus has been on economic growth rather than poverty and economic stability. Since the world economic crisis occurred in 2008, the problem of poverty has become very interesting because the conditions of poverty and income inequality have triggered the beginning of a serious economic crisis in this modern era (Smeeding, 2005). Poverty and income inequality have damaged aggregate purchasing power of the society (Budiono & Purba, 2020). The quantity of goods and services that can be purchased becomes less, so that the production of goods and services becomes less as well (Rajagukguk, et al 2020). As is the market system that supply must be the same as aggregate demand (Budiono, 2012).

Economically, the inability of individuals to generate income makes these individuals poor. The causes of this high poverty gap include mastery of knowledge, ownership and control of productive assets, and market forces and political & legal forces. Educational systems and knowledge mastery is very important both individually and in

groups, knowledge is the basis for people to work in a more efficient and productive way and impacting to economic growth (Rajagukguk & Purba, 2012; Purba, 2014, Nadeak & Purba, 2014). In addition, science helps find new economic and technological resources in the production process to grow new economic business resources based on sustainable innovation technology (Purba & Panday, 2015, Purba, et al, (2020), Aileen, et al, 2019). Ownership and control over productive assets greatly affect the poverty gap, individuals who do not own and do not control productive assets or own and control unproductive assets will get low income or no income at all (Budiono, 2009). In decreasing the poverty in his country, the economy in Indonesia is largely supported by SMEs, such as family businesses because they provide employment and contribute 57.8 percent of gross domestic product (Tan, et al, 2019; Purba & Tan 2018). Then, as argued by Budiono, the market and political systems that are formed greatly affect the occurrence of poverty gap. Market systems and forms make a difference in the behavior of economic agents in the ability to access income. The political and legal system creates regulations that regulate every economic agent carrying out its activities; of course, the existence of regulations makes the difference economic agents' access income. Therefore, the regulatory and market system not only determines income for each economic agent but also determines revenue growth and equity (Budiono, 2011, Kim, et al, 2019). Below is the following figure 1 poverty gap index in 501 districts and cities in Indonesia in 2018 which were observed.

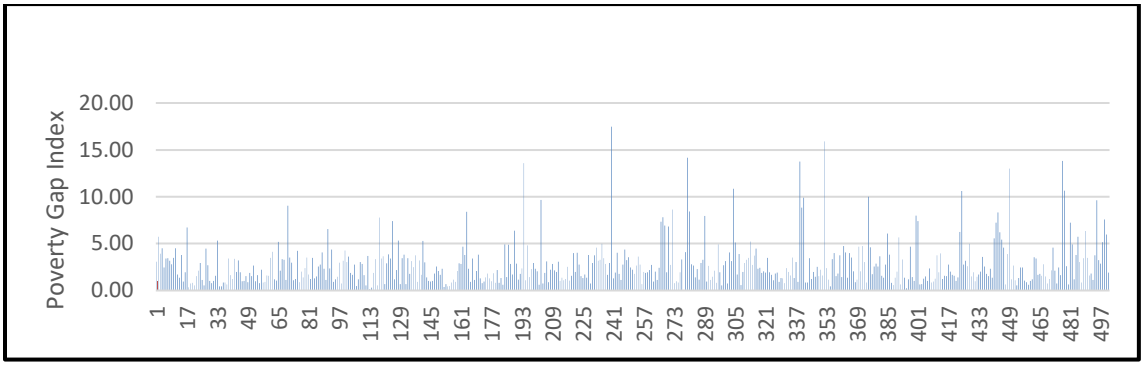

Figure **1.** Poverty Gap Index districts and cities in Indonesia, 2018

Based on Figure 1 above, from 501 regencies and cities in Indonesia, the majority of the poverty gap index for regencies and cities throughout Indonesia is in the range below 4.0. In order to improve the income structure of most regencies and cities in the future, this is why the study was made.

The impact of a high poverty gap results in a decrease in purchasing power both in total and followed by changes in economic structure. Of course, the difficult poverty gap above will always bring recession in a periodic economic cycle. Based on the description of the dynamics of poverty gap, in this study the authors want to prove that the availability of electricity and basic education to reduce poverty gap in every district and city throughout Indonesia.

2. Role of Electricity and Elementary School Enrolment

There are five main reasons electricity is fundamental to improving the quality of life and supporting social development (Niu, et al, 2013), Purba and Budiono, 2019a)). First, electricity-powered refrigerator can protect food and medicines for a long time and keep their healthy properties. Second, electric lighting increases the level of adult literacy. The application of computers, TV, and the internet has been proven to improve people 's ability to provide information & knowledge, albeit with dependency of the modern society on communication technology and information networks. Third, electricity has various applications in household activities (Purba, Hery, Lestari, 2019; Radnan & Purba, 2018). It is environmentally friendly for heating, air conditioning, air circulation, sanitation, entertainment, and engineering equipment. These are evidence that electricity improves the quality of life. Fourth, electrical energy can replace biomass and firewood, reduce air pollution in the home, and improve the environmental quality. Fifth, the use of electricity can assist people in heavy work and save a lot of time. Especially for villagers, electricity can provide employment opportunities, and potential for progress (Budiono & Purba, 2019, 2020). Therefore, electricity consumption improves the quality of human life, and so is the case with Indonesia as home to many islands along with the residents, all the way to remote areas which have limited infrastructure (Budiono, 2011). As people in remote areas in Indonesia still use firewood as a source of energy for domestic use.

Not only water is a basic need, but now electricity also become a second basic need. The basic need for humans is the availability of electricity for various modern activities (Budiono & Purba, 2019). In this modern era there have been drastic changes that have been driven by technological progress. Electricity is used for various purposes including lighting, turning on television, computers, water heaters, fans, kitchen equipment and so on. Because all equipment is related to activities, all activities depend on the presence and availability of electricity. All family members depend at least on the lighting generated from electricity (Purba et.al., 2020). School children will learn independently at home must be with electric energy lighting (Tso & Yau, 2007).

The existence of electricity has also increased income because modern production equipment is driven by electrical energy to be very fast and inexpensive (Adirinekso et.al, 2020). Likewise, electricity is used by all kinds of useful entertainment with no pollution. Electrical energy is environmentally friendly and can be stored for a certain amount of time. Electrical energy can be produced in large quantities from natural sources such as hydropower, wind power and geothermal energy.

Access to quality fuel resources enhanced the opportunities of income generation as reflected in the opportunity cost. Access to the quality fuel helped the additional income generation by the women and allowed children to go to school. This effect improved the gender equality and women's empowerment and also fulfilled the requirement of MDGs (Ray, Ghosh, Bardhan, & Bhattacharyya, 2016). Adoption of quality energy resources increased income and education level at the household level. Supply of clean fuel generated initiatives in setting up business in the rural areas involving the rural people. This will improve the village economy and reduce migration to the urban areas. Adoption of quality energy resources reduces SPM exposure resulting in the improvement of socio-economic aspects in the rural areas of developing countries (Ahmad, Mathai, & Parayil, 2014).

The relationship between electricity use and economic development for over one hundred countries constituting over 99% of the global economy. The general conclusions are that: Wealthy countries have a stronger correlation between electricity use and wealth creation than do poor countries. For the global economy, there is a stronger correlation between electricity use and wealth creation than there is between total energy use and wealth. In wealthy countries, the increase in wealth over time correlates with an increase in the proportion of energy that is used in the form of electricity. (Ferguson, Wilkinson, & Hill, 2000)

The basic needs approach recognizes education as a basic need. Education is itself a basic need and equality of access to educational services, particularly in rural areas. Education is therefore an important ingredient of a basic needs strategy (Purba, Rajagukguk, & Meranga, 2016). At the same time, closely akin to the human capital theory, the basic needs strategy also recognizes education as a basic need that helps in the fulfilment of other basic needs, and helps in improving the quality of life (Tilak, 2002). The indirect effect of education on poverty through its fulfilment of basic needs such as better utilization of health facilities, shelter, water and sanitation, and its effects on the behaviour of men on decisions relating to health, and so on. The fulfilment of other basic needs, in turn, enhances the productivity of the people and yields higher wages.

The relationship between poverty and education is further strengthened, as education and other basic needs reinforce each other. Fulfilment of any one of the basic needs (nutrition, safe drinking water, health, shelter and education) can be beneficial to the fulfilment of each of the others and, conversely, lack of any one has adverse effect on the satisfaction of other basic needs. Therefore, education was accorded a higher place among the several basic needs. Education forms a critically important factor in the basic needs framework, as it is fundamental to the satisfaction of all basic needs (Budiono, (2001), Tilak (2002), Wedgwood (2007)).

Poverty is defined as the individual life in a household with an expenditure of no more than US $ 1 per day per person which is valued at international prices. Poverty Gap Index (PGI) is an average measure of the expenditure gap of each poor population against the poverty line. The higher the index value, the further the average population expenditure is from the poverty line (Ziliak, 2005). The general PGI formula is as follows (Alkire & Santos (2014), Thon (1979) (Alkire & Santos, 2014) (Thon, 1979):

$$\mathrm{PGI} = \sum_{i=1}^{q} \left[\frac{z - y_i}{z}\right]^{\alpha}$$

α : the degree of aversion to poverty such that as α increases there is increasing weight given to the poorest households 1.

z: poverty line

q: several poor families
y_i: average monthly expenditure per capita of the population below the poverty line, where the form of the mathematical equation is;,
a person is poor if $y_i < z$.
n: total population

As describe above, the concept of poverty is a multidimensional concept in social life. Income is not sufficient to be a good enough indicator to measure poverty. To measure poverty, income may need to be supplemented with attributes such as health condition attributes, and education achievements. Multidimensional analogues with the composition of growth and equity are solved (Purba & Budiono (2019b), Tsui (1996)).

3. Methodological Approach

Based on the problems and possible causal relationships between electricity with PGI and elementary school enrolment with PGI, then we compile an economic model as outlined in the following figure.

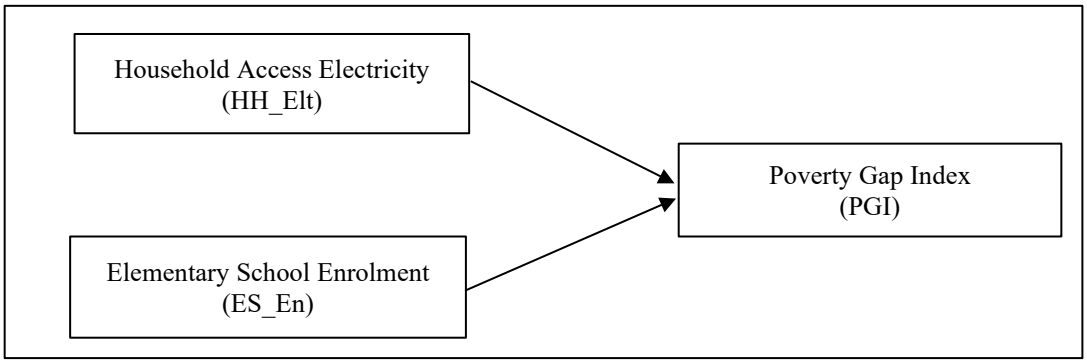

Figure 2. Economic Model

The following is an explanation of the Household Access Electricity, Elementary School Enrolment, and PGI variables used in the model.

Table 1 Variables Description, Indicator, and Label

Variable	Indicator	Description	Label
Electricity	Household Access Electricity	The number of households that can access electricity in regencies and cities	HH_Elt
Elementary School Enrolment	Elementary School Enrolment	Elementary school enrolment in districts and cities	ES_En
PGI	PGI	Poverty gap index in districts & municipalities	PGI

Source: Selection of research variables

The Household Access Electricity data is the number of household customers in public companies in electricity. The Household Access Electricity in Indonesia means were managed by state companies that located those areas of regions. Elementary school enrolment in all districts and cities throughout Indonesia (Budiono et.al., 2020). They plays a role not only in teaching but also provides important advice in the area of his social environment (Budiono & Purba, 2020).

The least-squares method is generally used for estimation purposes in the multiple-regression model. Once regression coefficients are obtained, a prediction equation can then be used to predict the value of a continuous output (target) as a linear function of one or more independent inputs. Regression models may be attributed to the interpretability of model parameters and ease of use. However, the major conceptual limitation of all regression techniques is that one can only ascertain relationship but can never be sure about underlying causal mechanism (Tso & Yau, 2007).

Next, the analysis tools used are the econometrics and statistics methods to test the models and their respective parameters. Based on the problems and possible causal relationships between electricity and PGI and elementary school enrolment with PGI, we are compiling an economic model. Next, the analysis tools used are the

econometrics and statistical methods to test the model and their respective parameters (Greene, 2018). The unknown parameters of the stochastic relation $y_i = x_i'\beta + \varepsilon_i$ are the objects of estimation. It is necessary to distinguish between population quantities, such as β and ε_i, and sample estimates of them, denoted b and e_i. the population regression is $E[y_i|x_i] = x_i'\beta$, whereas authors estimates of $E[y_i|x_i]$ denoted

$$\hat{y}_i = x_i'\beta \tag{1}$$

The disturbance associated with the *i*-th data point is

$$\varepsilon_i = y_i - x_i'\beta \tag{2}$$

For any value of b, we shall estimates ε_i with the residual

$$e_i = y_i - x_i'\beta \tag{3}$$

From the definitions, so The basic framework for analyzing cross section data is a regression model of the form (Greene, 2018)

$$y_i = x_i'\beta + \varepsilon_i = x_i'\beta + e_i \tag{4}$$

This study uses cross section data that includes in 501 districts & cities in Indonesia Territory. The purpose of this study is to analyze impact of availability of Household Access Electricity (HH_Elt) and elementary school enrolment (ES_En) towards PGI.

A multiple regression model with more than one explanatory variable may be written as the applied regression model for this study is

$$PGI = \beta_0 + \beta_1\, HH\_Elt + \beta_2\, ES\_En \tag{5}$$

Subsequently a calculation is made by estimating the suitability of the econometric model that is the magnitude of the R-squared and F-test with a significance level of 5%.

Based on the theoretical estimates for each parameter to achieve the desired model conditions in mathematical equations are as follows;

$$\beta_1 = \frac{\partial PGI}{\partial HH\_Elt} < 0 \quad \text{and} \quad \beta_2 = \frac{\partial PGI}{\partial ES\_En} < 0 \tag{6}$$

Based on the calculus equation, the partial test of each independent variable is one way. Household Access Electricity affects PGI in the inverse direction, and Elementary School Enrolment also affect PGI in the inverse direction. Thus, the value of each parameter β is expected to be negative.

While the partial testing of each independent variable on the dependent variable is carried out by t-test with a significance level in this study amounting to 5%.

By using the null hypothesis (H_0) and alternative hypothesis (H_1) for partial testing on the β_1 parameter as follows:

$H_0 : \beta_1 = 0$, Household Access Electricity does not affect PGI.

$H_1 : \beta_1 < 0$, Household Access Electricity affects PGI in the inverse direction.

The null hypothesis (H_0) and the alternative hypothesis (H_1) for partial testing on the β_2 parameter are as follows

$H_0 : \beta_2 = 0$, Elementary School Enrolment does not affect PGI.

$H_1 : \beta_2 > 0$, Elementary School Enrolment influences PGI in the inverse direction.

Thus it is clear, in practical econometrics there is always outlier data which means the data do not follow general patterns. This problem becomes very serious and complex. A model is considered robust if it meets the requirements of basic assumptions. In regression analysis, a method for estimating parameters is needed to meet the best linear unbiased estimator (BLUE). One popular method used is Ordinary Least Square (OLS). The classic assumption that must be fulfilled in OLS so that the estimation results are robust is homoscedasticity. Violation of the assumption of homoscedasticity is called heteroscedasticity, which means that the error is not constant. The consequence of heteroscedasticity can result in the OLS estimator obtained still meets the requirements of unbiased but the resulting variant becomes inefficient which means the variant tends to enlarge so that it is no longer the smallest variant. Therefore, the best traits will not be fulfilled (Greene, 2018).

This assumption is very important in the regression analysis because it relates to the estimated standard error of the regression coefficient. Standard error regression has a role in the formation of t-counts and F-counts will be overestimated which may subsequently produce conclusions that appear to be significant but not significant. Therefore, if the assumption of homoscedasticity is not fulfilled the results of the t-test are uncertain (Greene, 2018).

As Greene (2018) suggests the regression method is done by weighting the data with an appropriate multiplier factor. By using the Stata Software application version 15, automatically the selected weighting is the right weighting so that robustness is met the requirements. The results of the t-test and F-test will show the true

value and are significant. Data analysis was performed by following the ordinary least square (OLS) econometric model framework. The data collected for this were processed by the STATA Application Release 15 version.

4. Result and Discussion

Based on the proposed econometrics model, we conduct data processing in 501 observations (districts and cities) cross section. By using linear regression and robustness feasibility, the output of data processing is as follows.

Table 2. Result of Linear Regression for Poverty Gap Index in Districts and Municipalities.

LINEAR REGRESSION				
Number of observation: 501 F (2, 498) : 52.16 Prob > F : 0.0000 R-squared : 0.3477 Root MSE : 1.9207				
PGI	Coefficients	Robust Standard Error	t-test	P value > t
HH_Elt	- 0.0582733	0.007	- 8.29	0.000
ES_En	- 0.0672728	0.0315	- 2.14	0.030
Constant	13.98832	2.7805	5.03	0.000

Source: processing data, 2020.

Based on the running data in Poverty Gap Index are influenced by independent variables in the model. The test results for the proposed model that the results of the value of F-test = 52.16 and probability F = 0.00 smaller than the significance level of 5%, we reject the null hypothesis. The independent variable household access to electricity and elementary school enrolment simultaneously influence the poverty gap in every city and district throughout Indonesia.

The partial analysis shows that the results of the t-test on the variable household access electricity and elementary school enrollment reject the null hypothesis and the direction of the negative coefficient. The value of this negative coefficient parameters supports to the theory. Every 1% increase in households accessing electricity will reduce the poverty gap by 0.058. Every 1-year increase in elementary school enrolment will reduce the poverty gap by 0.06. Impact of electricity and educational participation on poverty show the same.

As Indonesia with a very large area and many islands (archipelago), most of the large islands the electricity supply is filled with hydroelectric power (renewable) and distributed using a transmission network with an efficient system and technology. Meanwhile, for remote areas and islands where it is difficult to reach, the household electricity supply is fulfilled by separate diesel power plants (non-renewable). The following table shows the amount of electrical energy supplied by the state electricity company and distributed to customer groups.

Table 3 Electricity Distributed to Customers (in Giga Watt hours)

Consumer Group	Years					
	2012	2013	2014	2015	2017	2018
Social	4,447.45	4,873.11	5,446.61	5,946.47	7,055.32	7,789.35
Household	72,176.80	77,869.29	84,136.25	88,742.25	93,733.71	97,930.90
Business	30,689.44	33,748.61	36,289.01	36,994.66	41,625.37	44,049.88
Industry	60,828.60	65,255.61	66,277.86	65,429.77	75,970.15	81,109.52
Public	6,199.62	6,595.80	6,878.35	7,166.83	7,629.51	8,132.39
All Customer Group	174,341.91	188,342.41	199,028.08	204,279.97	226,014.06	239,012.04

Source: https://www.bps.go.id

The table shows that during 2012 till 2018 the growth of distributed electrical energy has increased by an average of 5%.

For efforts to increase the years of schooling were carried out by adding new elementary school buildings and assigning teachers to be sent to regions throughout Indonesia for teaching. The Indonesian

government also recruits new graduates to become civil servants of teachers. Furthermore, the Indonesian government requires school-age children to attend compulsory education.

5. Conclusion

It turns out that the combination of fulfilling education and electricity can reduce poverty gap powerfully. Between electricity and education support each other and in the same direction to reduce poverty gap. The National Development Strategy of these two basic needs is the key to success for the Indonesian state. Policies that support the fulfillment of electricity and cheap education for the community are absolute. Indonesia Government is going to push electricity energy. Government had to build some electricity power station in all Indonesia region. Also government do program for placing teacher in all region. This is important because this policy strategy has a dual effect not only for reducing poverty inequality but also for social welfare across districts and cities. Thus, it has been proven that the need for education and meeting electricity does not only improve the economic conditions of the community but also reduce the poverty gap.

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