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Article

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Does Energy Infrastructure Reduce Inequality Inter-regional in Riau Province, Indonesia?

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ABSTRACT

This research aims to determine the effect of energy infrastructure on the dynamics of development inequality that occurs between regions in Riau Province by adding economic growth and balanced funds as control variables. The analysis used dynamic panel data modeling with Generalized Method of Moment (GMM) approach and datasets from 12 regions in 7 years starting from 2011 to 2017. The results of the model show that the inequality of the previous period and economic growth can significantly increase inequality. Whereas balance funds and electricity infrastructure have a negative and significant influence, or can reduce inequality significantly. These results provide evidence that energy infrastructure can reduce inequality.

Keywords: Inequality, Energy Infrastructure, Generalized Method of Moment, Riau
JEL Classifications: C33, D63, Q43

1. INTRODUCTION

Sustainable development promoted by UNDP with the deadline of 2030 is a new development agreement that encourages changes that shift towards sustainable development based on human rights and equality to encourage social, economic and environmental development. SDGs are applied with universal principles, integration and inclusive with the spirit of "No-one Left Behind." The SDGs consist of 17 goals in order to continue the efforts and achievements of the Millennium Development Goals (MDGs) which ended in 2015.

This research is related to the effort to achieve the SDGs goals which are found in the 7th goal "Affordable and Clean Energy" and the 10th "Reduced Inequalities." Indonesia has created a framework for achieving SDGs, including those related to the 7th goal is ensuring universal access to affordable, reliable and modern energy services. Further, related to the 10th goal, which is to reduce intra-and inter-regional inequality.

Riau Province is one of Indonesia's oil-producing regions for both fossil oil and palm oil. This region is also used as the center of western Indonesia trade and the area included in the main corridor in the Master Plan for the Acceleration of Indonesian Economic Development (MP3EI) Sumatra region, as well as some coastal areas directly facing the Malacca Strait. In the process of regional development, it is necessary to identify the potential and problems of the area. By paying attention to this, at least the existing problems can be anticipated and use the existing potential optimally.

The macroeconomic condition of Riau Province over the past seven years with the use of GRDP data has fluctuated with an average economic growth of 2.80%. The rate of growth in 2011 of 5.57% continued to decline until 2015-0.22%, then again increased in 2016 and 2017 by 2.18% and 2.68%. Meanwhile, the regional income distribution of Riau Province based on the Gini Index data for 2011-2017 shows that in general there is a fluctuating change in Riau Province with an average of 0.357 and this value indicates the imbalance between individuals at the middle level.

This gives a signal that the economic growth that occurs is accompanied by an increase in income inequality. Ideally, economic development will produce economic growth that will produce high economic growth while increasing prosperity and reducing inequality. Economic development is related to economic growth and is accompanied by changes in output distribution and economic structure (Nafziger, 2012).

According to Sjafrizal (2012) there are several key factors that caused the inequality of development between regions: (1) the difference in the content of natural resources, (2) the differences in demographic conditions, (3) the lack of goods and services mobility, (4) the concentration of economic region activities, (5) the development funds allocation among regions.

The success of development should not be enough if only measured by the success of development in the economic sector, but also in the field of human development and infrastructure. The occurrence of inequalities between regions in Riau Province generally can be seen from the quality or quantity of infrastructure including electrical energy infrastructure because the existence of infrastructure is one of the supporting factors in accelerating development.

This research aims to reveal the effect of energy infrastructure on the dynamics of development inequality that occurs between regions in Riau Province. This research is organized as follows: the next section briefly reviews the research conducted on the subject. Then, the following section explains data and methodology, while section 4 presents and explains empirical results. The final section presents conclusions and policy implications.

2. LITERATURE REVIEW

The relationship between economic growth and inequality is theoretically known as the Kuznets and neo-classical hypothesis which states that the beginning of development will be accompanied by an increase in inequality to a certain point, and then development will reduce inequality. Over time, research on this subject continues to grow. Research outside Indonesia was carried out by Barro (2000); Benjamin et al. (2017); Frank (2009); Halter et al. (2014) and domestically by Bakri et al. (2016); Dewi and Ida (2014); Hidayat et al. (2018); Hidayat and Rahayu (2018) findings indicate that the long-term relationship between inequality and growth is positive naturally proven neo-classical hypotheses and driven mainly by concentration at each income level.

Linkage of income and environmental conditions are very popular with the Environmental Kuznets Curve (EKC) which adopts the Kuznets hypothesis related to per capita income and income inequality, which at the beginning of an increase in income will result in environmental decay to a certain point, then enter the environmental improvement phase (Tasri and Karimi, 2014; Yandle et al., 2002).

Njoke et al. (2019) research on the relationship of electricity consumption, carbon emissions and economic growth in Cameroon. Results from autoregressive distributed lag bounds test, confirms a positive and significant short-run as well as a long-run relationship between CO_2 emissions and economic growth. Prior to the application of Toda and Yamamoto Granger causality test, the results reveal a unidirectional causality running from CO_2 emissions to economic growth. Furthermore, the EKC hypothesis shows the existence of an inverted U-shaped curve relating carbon emissions rise to the continuous economic evolvement in Cameroon. However, electricity consumption has no effect on economic growth.

Nayan et al. (2013) this research shows evidence of unidirectional causality between energy consumption and GDP. In energy consumption model, the GDP is found to significantly determine energy consumption. Whereas in the GDP model, energy consumption has, however, the less significant effect on GDP. Energy price and investment are the other important determinants of energy consumption and income, respectively.

Furthermore, the results of research from Sultan and Alkhateeb (2019) revealed that in the short term there is a direct relationship between energy consumption and economic growth, and in the long run found a two-way relationship between energy and economic prosperity in India.

Amrullah (2006) research on the effect of infrastructure development on economic growth in Indonesia for the islands of Java-Bali and Outside Java found that each type of infrastructure has a significant effect on economic growth except clean water infrastructure. Furthermore, the results of research from Radiansyah (2012) related to the relationship between infrastructure and GRDP per capita produce that road, electricity, and telephone infrastructure have positive and significant effects.

Theoretically and with many research findings, infrastructure development can encourage economic growth, but uneven development will result in income inequality and facility coverage. Next, some research results related to physical infrastructure and infrastructure budget towards inequality.

Research done by Calderon and Chong (2004) about the influence of infrastructure on inequality, points out that infrastructure is represented by roads, railways, telecommunications, and energy measures. It found that the quantity and quality of infrastructure are negatively related to inequality. Furthermore, research by Prasetyo et al. (2013) shows that economic infrastructure and social infrastructure will indirectly affect inequality. Likewise, with the results of research from Seneviratne and Sun (2013), it finds that better infrastructure, both quality, and quantity, promotes income equality, while the link between investment and income distribution is weak.

However, research done by Schlesewsky and Winter (2018) employs three different inequality metrics – the Gini coefficient, the Theil Index and the Atkinson index – all of which unambiguously indicate regressive effects of network charges. The three metrics show an increase in economic inequality of at least 0.67% when accounting for network charges. This finding is due to (1) the relative inferiority of electricity, (2) the regressive impact of a fixed component of network charges, (3) considerable regional disparities, and (4) the higher prevalence of prosumers within high-income households.

Hidayat (2014) research with the use of multiple regression states that government expenditure on infrastructure is a source of inequality and HDI can reduce inequality. Furthermore, the results of Hidayat et al. (2018) use panel data regression that government expenditure and HDI can reduce development disparities between regions.

3. METHODOLOGY

3.1. Measurement of Regional Inequality Development

3.1.1. Bonet index

This index is a measurement made by Bonet (2006) to measure inequality between regions in Colombia. Bonet Index in the province for period t ($IB_{i,t}$)

$$IB_{i,t} = \left| \frac{PDRB\ PC_{i,t}}{PDRB\ PC_{Prov,t}} - 1 \right|$$

Note: $IB_{i,t}$ = Inequality of the district/city; $PDRB\ PC_{i,t}$ $PDRBPC_{i,t}$ = GRDP per capita district/city; $PDRB\ PC_{Riau,t}$ = GRDP per capita Province.

The formula states that perfect equality occurs when the per capita GDP per capita region is equal to the province per capita GRDP. Bonet Index value approaching 0 (zero) can mean that the per capita GDP disparity is lower. If the value is higher, it can be interpreted that the per capita GDP per capita among high-rise regions or regional economic growth happens unevenly.

3.2. The Definition of Operational Variables

The research used is descriptive quantitative research. The study was conducted in Riau Province. The regions that became the unit of analysis were 12 regions in Riau Province consisting of 2 cities and 10 districts. The type of data used is secondary data from a number of Central Bureau of Statistics surveys including socio-economic surveys, as well as time-series data from the GRDP, Fiscal Decentralization, HDI, economic growth, and inequality from 2011-2017.

For the formulation of the model to be used, there are several variables that must be defined as follows: (1) Inequality (INEQ), calculated using the Bonet Index; (2) Economic Growth (LPE), this variable uses the data GRDP constant price 2010, the unit value used in the form of percentages; (3) Balancing Fund (PERB), this variable is a grant given by the central government for development, the source of data used is the Regional Budget (APBD), the units used are in the form of Rp billion; (4) Energy infrastructure (RE), this variable is represented by the electrification ratio, which ratio reflects the access of electricity installed to households, data sources from socio-economic surveys and regional welfare statistics by the Central Bureau of Statistics.

3.3. Model Dynamic Panel Data

Dynamic panel data analysis is used if the independent variable is a lag of the dependent variable. This is based on the fixed effect and random effect models using the residual covariance variance structure in the FGLS estimator. If there is a lag of the dependent variable as an independent variable, then there is a correlation between the dependent and the residual. The dynamic panel data regression method illustrates the relationship between economic variables that are dynamic in nature characterized by entering the lag of the dependent variable as a regressor in the regression. The general form of dynamic panel data models is as follows: (Greene, 2012; Verbeek, 2012)

$$Y_{it} = \delta Y_{i,t-1} + X_{it}^{T}\beta + u_{it} \tag{1}$$

With u_{it} it is assumed that the one-way error component is as follows:

$$u_{it} = \varepsilon_{it} + \mu_{it} \tag{2}$$

Merging equations (1) and (2) then the dynamic panel equation is obtained as follows:

$$Y_{it} = \delta Y_{i,t-1} + X_{it}^{T}\beta + \varepsilon_{it} + \mu_{it} \tag{3}$$

The dynamic panel regression model used in this study is as follows:

$$Ineq_{it} = \delta\, Ineq_{i,t-1} + \beta_{x1} LPE + \beta_{X2} PERB + \beta_{X3} RE + u_{it} + \varepsilon_{it} \tag{4}$$

Note: u_{it} = District/city specific effect; ϕ_{it} = time specific effect; ε_{it} = Error; β = estimated coefficient value.

The dynamic panel model is used by the Generalized Method of Moments (GMM). GMM has two models in the estimation, namely the first difference GMM and system GMM. System GMM method is useful for estimating the system of equations of first differences and the level at which the instrument used at the level is lag first differences from the series. To produce efficient estimators on dynamic panel data when T is small, it is important to utilize initial conditions (Baltagi, 2008).

This study uses a validity test that applies to GMM. As suggested by Arellano and Bond (1991); Arellano and Bover (1995); Blundell and Bond (1998), two specification tests are used. Firstly, Sargan/Hansen test of over-identifying restrictions which tests for overall validity of the instruments and the null hypothesis is that all instruments as a group are exogenous. The second test examines the null hypothesis that error term ε_{it} of the differenced equation is not serially correlated particularly in the second-order (AR2). One should not reject the null hypothesis of both tests. Meanwhile, for hypothesis T-test with a significant level of 95%.

4. RESULT AND DISCUSSION

The validity and reliability test of the instrument is shown by the AR (1) and AR (2) serial correlation tests and the Sargan test. Based on Table 1, the P-value of AR (1) and AR (2) of greater than 0.05 shows that there is no density of serial correlation problems in the first order and second order so that the model is feasible to be used and it can be concluded that the term error in the model does not have a serial and it can be said that the estimator used is efficient. Furthermore, for the Sargan test a Prob (J-statistic) value of greater than 0.05 so accept H_0 which means that the overidentifying restriction conditions in the use of the model are valid.

Based on the estimation results in Table 2, Lag Inequality (Ineq (−1)) has a positive and significant coefficient value with a P = 0.0000 smaller than 0.05. Thus it can be concluded that the development inequality that occurred in the previous period can affect the inequality that occurs in the current period provided that other variables contained in the model are considered constant or ceteris paribus. In reality, an inequality that occurs without a policy for equality will worsen the inequality that occurs. Therefore, the government must continue to schedule or prioritize equitable development, not just increase income.

Estimation results for economic growth variables have a positive coefficient of 0.003059, meaning that if there is an increase in the economic growth of 1% then the development imbalance will increase by 0.003059 points, assuming ceteris paribus. Furthermore, the significance value of economic growth is 0.0005 lower than 0.05 and it can be concluded that economic growth has a significant effect. These results are in line with research Frank (2009); Mukhlis et al. (2018); Risso and Carrera (2012) where economic growth that occurs in each object has a positive influence on inequality. Moreover, these results illustrate that economic growth that occurred followed by an increase in inequality, can be said to be a phase of divergence in the neo-classical hypothesis. Therefore, the government must be smart in taking policies related to future economic growth and development.

Result for balanced fund variable, the coefficient value obtained is negative of −0.0000103 stating that each increase in the balanced fund by one unit can reduce inequality by −0.0000103 with the assumption of ceteris paribus. The resulting significance value of 0.0231 is smaller than 0.05 and it can be concluded that the balancing fund is significant towards inequality. This result is in line with Sjafrizal (2012) which states that regions that receive a greater investment allocation from the government or can attract more private investors will tend to have faster regional economic growth rates. This condition will encourage the process of regional development through the provision of more jobs and higher income per capita levels. The allocation of government investment in the regions is more determined by the regional government system adopted. If the regional system adopted is centralized, then the allocation of government funds will tend to be allocated more to the central government so that inequality in development between regions will tend to be high. If the government system adopted is autonomous or federal, then government funds will be allocated more to the regions so that inequality in development between regions will tend to be lower.

Table 1: Arellano-bond serial correlation test

Arellano-bond serial correlation test				
Test order	**m-Statistic**	**rho**	**SE (rho)**	**Prob.**
AR (1)	−0.195190	−0.000871	0.004464	0.8452
AR (2)	−1.753951	−0.003243	0.001849	0.0794

Table 2: Summary of GMM results

Dependent Variable: INEQ				
Method: Panel generalized method of moments				
Transformation: First differences				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
INEQ (−1)	0.620326	0.055664	11.14407	0.0000
LPE	0.003059	0.000821	3.727474	0.0005
PERB	−1.03E-05	4.43E-06	−2.336595	0.0231
RE	−0.000373	0.000110	−3.386007	0.0013
Cross-section fixed (first differences)				
Mean dependent var	-0.008250	S.D. dependent var		0.018725
S.E. of regression	0.017150	Sum squared resid		0.016471
J-statistic	7.992619	Instrument rank		12
Prob (J-statistic)	0.434192			

Based on the results of data processing, the energy infrastructure has a negative coefficient of −0.000373 which means that any increase in value energy infrastructure can reduce inequality by −0.000373 with the assumption of ceteris paribus. Furthermore, the significance value of 0.0013 is <0.05 and it can be concluded that energy infrastructure has a significant influence on inequality. This result is similar to research Calderon and Chong (2004); Hidayat et al. (2018); Seneviratne and Sun (2013) where infrastructure can reduce inequality.

Furthermore, the energy infrastructure is represented by the electrification ratio, which ratio reflects access to electricity installed in the household. The real condition of electrification that occurs in the regency is that not all of the people have easy access to electricity, which ranges from 60-85% of households that have access to electricity, the low electrification ratio is due to the fact that there are still many rural areas that do not have access to electricity, then there are still areas with a live electricity duration of fewer than 18 hours/day, and rotating blackouts occur in some areas. Whereas the reverse condition for urban areas where access to electricity is 100% installed and enjoyed by the community but there are still rotating blackouts at certain times. The seriousness of the government in improving electricity infrastructure can be seen from the increase electrification ratio from 2011-2017 which is worth 60.99% to 82.89% in entirety Regency/City area in Riau Province.

5. CONCLUSION

Based on the results of the previous model, it can be concluded that the inequality of the previous period and economic growth can increase the inequality that occurs. Meanwhile, for balance funds and energy infrastructure, it can reduce inequality between regions in Riau Province. These results provide evidence that energy infrastructure can reduce inequality. Furthermore, the policy that must be carried out by the regional government is to remain consistent in the development of electricity infrastructure, especially rural areas and areas that are still isolated, not just data collection but also physical implementation so that the electrification ratio can reach 100% in accordance with the ideals of the State. In addition, the government should make economic growth for equitable development not merely increase income.

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