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IS THERE CAUSALITY RELATIONSHIP BETWEEN ECONOMIC GROWTH AND INCOME INEQUALITY?: PANEL DATA EVIDENCE FROM INDONESIA

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Abstract

Our study aims to determine the causality relationship between economic growth and income inequality. Using panel data set of 26 provinces from Indonesia for a period of 2005 to 2015, Pedroni's co-integration test, Panel Vector Error Correction Model, and Granger Causality Test were employed to analyze the relationship between the variables. Accordingly, the first main finding of the research is that there is a negative and significant relationship between the economic growth and income inequality in the long-run. Secondly, in the short run, the economic growth is positively and insignificantly related to income inequality. In addition, there is a unidirectional causality running from income inequality to economic growth.

Keywords: Economic Growth, Income Inequality, Panel VECM and Granger Causality Test

JEL Classification: O47, D63

1. Introduction

High economic growth is an indicator of development success in developing countries. In the absence of economic growth, the development process is considered failed to improve the welfare of the community. Therefore, the implementation of economic development activities is expected to be oriented to increase economic growth. Economic growth also serves as an important indicator of community welfare. However, high economic growth may not necessarily improve the distribution of income in the community.

A number of studies provide different conclusions about the relationship between economic growth and income distribution. So, the relationship between the two variables is still difficult to understand and empirically still being controversial (Yang and Greaney, 2017). Such as the empirical study conducted by Wroblowsk and Yin (2016) found out that the relationship between income inequality and economic growth is very ambiguous. The direction of the relationship can be negative, positive and non-linear (Charles-Coll, 2013; Amri, 2017).

Ideally, high economic growth is in line with income distribution in the community. So, the increase in production in an economy does not increase the gap between rich and poor. However,

the government's efforts to encourage the growth of output through the process of economic development may not necessarily reduce the income inequality. As with the case of Indonesia, development policies are directed at enhancing regional economic growth. Implementation of special autonomy in the country provides greater authority for local governments to promote economic growth. Over the last five years, the rate of regional economic growth in Indonesia is relatively different from each other. On the one hand, there are areas with relatively high economic growth rates and on the other hand, there are also areas with relatively low economic growth rates. Along with the difference in economic growth, income inequality in each province is also relatively different. The difference is indicated by the difference of Gini ratio in each province.

These conditions indicate an important issue that must be observed by the local government in connection with efforts to encourage high economic growth. Because ideally, economic development by the government not only can increase the output of the economy but also can reduce inequality of income in the community. Study on the linkage between economic growth and income inequality in regions in Indonesia has not been much disclosed by previous researchers. In such a study, it is important to evaluate the extent to which the two variables are interrelated so, the local government's economic development policy oriented to reduce the income inequality.

As explained earlier, a study of the linkages between economic growth and income inequality had been widely practiced by economic researchers. But, they have not found out the same conclusions about the direction of the relationship between the two variables. The study conducted by Ucal *et al.* (2016) for the case of Turki economy found that economic growth increases income inequality in the short-run. Previously, Lundbergand Squire's (2003) study revealed that economic growth increases income inequality. In contrast to these findings, Nissim (2007) proved that economic growth significantly reduces income inequality. Binatli (2012) concluded that economic growth was negatively and insignificantly associated with income inequality. Other empirical findings concluded that income inequality was associated with low growth rates (Pede *et al*. 2009; Davis, 2007;Castello-Climent, 2010).

Previous studies focused on the direction of the relationship between economic growth and income inequality, without examining the causal relationship between the two variables completely. In contrast to the studies, my research examined the long-term relationship and causality direction between economic growth and income inequality in local economies in Indonesia. So, the research findings will be useful not only for future researchers but also for policymakers, especially local governments in planning regional development.

The paper is divided into five sections, following this introduction is section two which presents the literature review regarding economic growth and income inequality as well as the relationship between this two variables. Section three consists of model specification, measurement of variables, data issues, and estimation techniques. The results are presented and discussed in section four, while section five highlights the conclusions of this paper.

2. Literature Review

Inequality of income refers to the inequality of income distribution, i.e. the gap between rich and poor in a country (Shin, 2012). The relationship between income distribution and economic growth has long been the subject of economic research. Many studies in economic theory are concerned with the relationship between the two variables. However, until now there has been no consensus on the nature of the relationship. In other words, the form of the relationship between economic growth and income inequality remains controversial and becomes an open question (Muinelo-Gallo and Roca-Sagales, 2013). There is mixed evidence in the literature of a clear relationship between income inequality and economic growth (Fawaz *et al.* 2014).

The paradoxical relationship between economic growth and income inequality is evidenced by Shin (2012) that in East Asian and South American countries, there is a negative relationship between income inequality and economic growth**.** Whereas, in developed countries such as America and France, the relationship between the two variables is positive. Sameti and Rafie (2010) also provided empirical evidence that income inequality was positively associated with economic growth. Previous studies also tended to support a positive relationship between

the two variables (Garcia-Penalosa and Turnovsky, 2007). The existence of a positive relationship between income inequality and economic growth were also consistent with the economic theory of development which emphasizes that high inequality promotes growth (Woo, 2011).

Other empirical research findings related to the causality relationship between economic growth and income inequality also have not provided the same conclusions. Fawaz *et al.* (2014) found out that there was a strong evidence of a negative relationship between income inequality and economic growth in LIDC to be in stark contrast with a positive inequality-growth relationship for high-income and low-income developing countries (HIDC and LIDC).In terms of growth, the impact of inequality is negative and more obvious in less developed countries than rich countries (Neves *et al.,* 2016).

Sabir *et al.* (2015) found that economic growth had a negative and significant impact on income inequality. Unlike the findings, Amri (2017) found out an extreme relationship between economic growth and income inequality. However, the result of Granger causality test finds unidirectional causality from income inequality to economic growth.

Kuznets (1955) examined the relationship between economic growth and income inequality. As a result, there was a relationship between economic growth and income inequality, which is then known as the reversed U curve hypothesis (Inverted U-curve Hypothesis) as sawn in Figure 1 below.

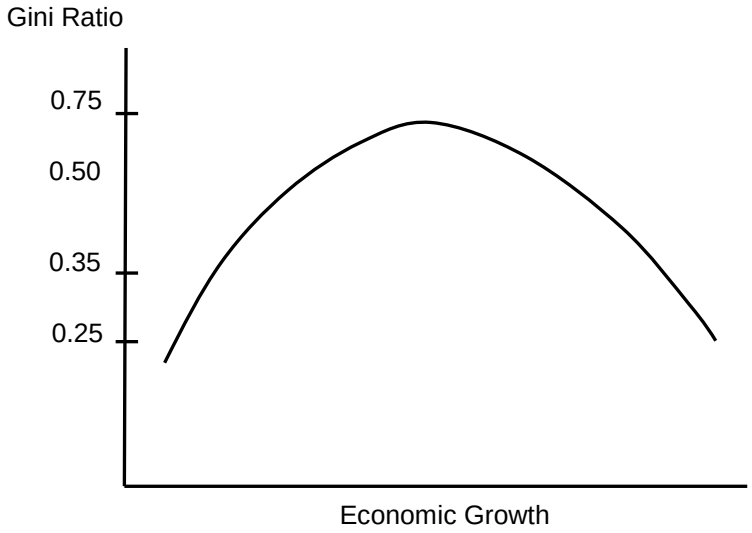

Figure 1. Inverted U curve hypothesis by Kuznets

Based on the Kuznets's (1955) hypothesis, income inequality within a country would increase in the early stages of economic growth. After reaching a certain point, the increase in economic growth tends to reduce the income inequality. The large inequality of income in the early phase of economic growth was due to the process of change that occurred in a country's economy from the agricultural society to industrial society. Kuznets also emphasized the structural changes that occurred in economic development. As the role of the industrial sector grew, there would be a shift from the agricultural sector to the modern industrial sector including the manufacturing and service industries. In this economic transition, labor productivity in the modern industrial sector would be higher than productivity in the agricultural sector. The existence of a non-linear relationship between inequality and growth was also proved by Kolev and Niehues (2016). These findings showed evidence for a nonlinear relationship between inequality and growth when the samples between developed and developing countries were combined.

Research conducted by Nuruddeen and Ibrahim (2014) in Nigeria shows that there is a unidirectional causal relationship running from economic growth to income inequality. Furthermore, Huang *et al.* (2015), using the annual state-level panel data of United States, also proves that growth volatility is positively and significantly associated with higher income inequality.

Previously, Risso and Carrera (2012) in their research in China concluded there is unidirectional causality from inequality to growth in the early stages of economic growth. In line with Risso and Carrera's (2012) findings, Ncube *et al.* (2013) with the case of the Middle East and North Africa (MENA) concluded that income inequality reduces economic growth and poverty in the region.

3. Research Methods

The data used in this study are provided by Indonesian central bureau of statistics. Income inequality was measured by Gini ratio (GR). Hence, the measurement of economic growth is based on regional per capita income at 2000 constant market prices. The study is using panel data set of 26 provinces from Indonesia over the period of 2005-2015. The provinces consist of Aceh Province, Sumatera Utara, Sumatera Barat, Riau, Jambi, Sumatera Selatan, Bengkulu, Lampung, Bangka Belitung, Kepulauan Riau, DKI, Jawa Barat, Jawa Tengah, Yogyakarta, Jawa Timur, Banten, Bali, Nusatenggara Barat, Nusatenggara Timur, Kalimantan Barat, Kalimantan Selatan, Sulawesi Utara, Sulawesi Tengah, Sulawesi Tenggara, Maluku and Papua Province.

The first stage in our empirical study is represented by the analysis of stationarity. We used Levin, Lin & Chu (LLC) method (Levine *et al.* 2002); I'm & Shin (IPS) method (Im *et al.* 2003); ADF-Fisher Chi-square and ADF-Choi Z-stat method (Choi, 2001); PP-Fisher Chi-square and PP-Choi Z-stat method (Phillips and Sul, 2003) to check the order of integration. The analysis is intended to see whether the data used in this study has reached the stationary or not. After analysis of the stationarity of the data, the second stage is to conduct cointegration test. This test is very important to know the existence of a long-term relationship between the variables analyzed (Engle and Granger, 1987). In order to test the existence of long-run relationship between economic growth and income inequality, we used cointegration test.

In the three-stage, the causality analysis between the two variables is performed by means of a panel vector error correction model (VECM). The panel data VECM methodology combines the traditional VAR approach, which treats all thevariables in the system as endogenous, with the panel-data approach, which allows for unobserved individual heterogeneity. The optimal of lag length is evaluated by means of the Schwarz information criterion. VECM model employed to examine the causality relationship between economic growth and income inequality is formulated as follow:

$$\Delta LEG_{it} = \propto_0 + \sum_{j=1}^{n} \beta_{1j} \Delta LEG_{i,t-j} + \sum_{j=1}^{n} \beta_{2j} \Delta LGR_{i,t-j} + \gamma e_{i,t-1} + \mu_{it} \quad (1)$$

$$\Delta LGR_{it} = \propto_0 + \sum_{j=1}^{n} \beta_{1j} \Delta LGR_{i,t-j} + \sum_{j=1}^{n} \beta_{2j} \Delta LEG_{i,t-j} + \gamma e_{i,t-1} + \varepsilon_{it} \quad (2)$$

Where ΔLEG_{it} is the first difference of the natural logarithm of regional per capita income (as the measurement of economic growth) for the province of i, and year of t. ΔLGR_{it}denotes the first difference of the natural logarithm of Gini ratio (a measurement of income inequality) for the province of i, and year of t. and, α and β are constants to be estimated, as well as μ and εdenotes a stochastic error term.

Furthermore, to test the causality relationship between variables, Granger causality VAR method is used.The method will be able to identify which of the more earlier variables appear. That is, whether income inequality leads to economic growth or otherwise economic growth causes income inequality. The Granger causality test is based on the optimum lag known in the previous stage.

4. Result and Discussion

4.1. Unit root test

The first stage of the data processing is to test the stationarity of the data. As explained earlier, for the test, we use a number of methods comprised of Levin, Lin & Chu (LLC) method (Levine, *et al.* 2002); I'm & Shin (IPS) method (Im *et al.* 2003); ADF-Fisher Chi-square and ADF-Choi Z-stat method (Choi, 2001); PP-Fisher Chi-square and PP-Choi Z-stat method (Phillips and Sul, 2003). The data achieve stationary if it has p-value < 0.05. The data achieve stationary if it has

p-value < 0.05.The result of the stationarity test of the income inequality variable at the level data shows the p-value for LLC of 0,000, IPS of 1,000, ADF-Fisher Chi-square of 0.999, ADF-Choi Zstat 1,000, PP-Fisher of 0.405, and PP-Choi of 1,000, respectively. This indicates that the data has not reached stationary at the data level. Furthermore, the stationarity test of economic growth at the level shows p-value for PP-Fisher of 0.9184, and PP-Choi of 1,000, respectively. That indicates that the data is also not stationarity at level. Then the test continued on the first difference. The result of stationarity test is shown in Table 1.

Tabel 1. Panel Unit Root Test

No	Variable	Method	Individual Intercept				Intercept & Trend			
			Level		First Difference		Level		First Difference	
			T-stat	P-value	T-stat	P-value	T-stat	P-value	T-stat	P-value
1	*l*EG	Levin, Lin & Chu	-3.654	0.000	-3.065	0.001	-2.808	0.0025	-9.068	0.000
		Im, Pesaran & Shin	4.028	1.000	-0.810	0.209	0.930	0.8238	0.388	0.651
		ADF - Fisher X^2	25.941	0.999	57.822	0.269	40.469	0.8770	47.509	0.651
		ADF - Choi Z-stat	4.727	1.000	-1.225	0.110	1.411	0.9208	0.829	0.797
		PP – Fisher	53.817	0.405	82.138	0.005	31.888	0.9874	76.498	0.015
		PP – Choi	5.789	1.000	-2.796	0.003	4.659	1.0000	-1.059	0.145
2	*IGR*	Levin, Lin & Chu	-3.813	0.000	-5.771	0.000	-2.898	0.0019	-4.672	0.000
		Im, Pesaran & Shin	0.309	0.622	-2.092	0.018	0.705	0.7595	0.488	0.687
		ADF - Fisher X^2	40.790	0.869	74.064	0.024	36.876	0.9441	42.368	0.827
		ADF - Choi Z-stat	0.340	0.633	-3.027	0.001	0.792	0.7859	0.370	0.644
		PP – Fisher	43.597	0.790	133.716	0.000	32.048	0.9867	126.262	0.000
		PP – Choi	-0.021	0.492	-6.502	0.000	2.341	0.9904	-4.529	0.000

4.2. Co-integration Test

Pedroni (1999) suggests seven statistical tests to determine the presence of panel cointegration. The statistical methods are divided into two group. The first group consists of panel v-statistic, panel rho-statistic, panel PP-statistic and panel ADF-statistics. All the statistical testsare termed "within-dimension" (Panel test). The second group of the test consists of group rho-statistic, group PP-statistic and group ADF-statistic, is termed "between-dimension" (group test). The null hypothesis proposed in the co-integration test is that there is no cointegration between income inequality and economic growth, while the alternative hypothesis is that the two variables are cointegrated. The acceptance of these hypothesis refers to the p-value generated by the output E-views with the provision that if p-value <0.05, the alternative hypothesis is accepted. Conversely, if p-value> 0.05, then the null hypothesis is accepted. The result Pedroni's cointegration test can be seen in Table 2.

The results of Pedroni (1999)'s panel cointegration tests that some p-values> 0.05, especially for the rho-panel and group-rho statistic. However, p-value for Panel PP, ADF Panel, Group PP and Group ADF-Statistic < 0.05, respectively. Thus, it can be interpreted the existence of long-run cointegration relationships between the two variables.

Table 2. The Result of Pedroni's residual-based cointegration test

Panel Cointegration Statistics (Within-Dimension)		
Test Statistics	Statistical Values	
	Intercept	Intercept and Trend
Panel v-Statistic	2.442 (0.007)***	-1.809 (0.965)
Panel rho-Statistic	-1.090 (0.138)	2.556 (0.995)
Panel PP-Statistic	-2.347 (0.009)***	-0.953 (0.170)
Panel ADF-Statistic	-3.851 (0.000)***	-3.619 (0.000)*
Group Mean Panel Cointegration Statistics (Between-Dimension)		
Test Statistics	Statistical Values	
	Intercept	Intercept and Trend
Group rho-Statistic	1.315 (0.906)	4.183 (1.000)
Group PP-Statistic	-1.737 (0.041)*	-1.303 (0.096)*
Group ADF-Statistic	-2.928 (0.002)***	-2.632 (0.004)***

Note: The values in parentheses give the probabilities values. Ho: no cointegration; * and ** indicate the rejection of null hypothesis at 1% significant level.

Furthermore, the acceptance or rejection of the hypothesis for Kao's Residual Panel Cointegration Test also refers to the p-value with the provision as follows: the p-value < 0.05 indicates that there is cointegration between the income inequality and economic growth. Conversely, the p-value > 0.05 indicates that there is no cointegration between the variables. The result of Kao's residual panel cointegration test in Table 3**.**

Table 3.The Result of Kao's Residual Panel Cointegration Test

Null Hypothesis	T-Statistic	P-value
No cointegration	-5.1659***	0.000
Residual Variance	0.004	
HAC variance	0.004	

Note: *** indicates the rejection of null hypothesis at 1% level of significant.

Table 3 above provides the results of Kao (1999) panel cointegration test. The p-value of 0.000 less than 0.05 so the null hypothesis is rejected. This indicates that the long-run relationship exists between regional economic growth and income inequality. Based on Pedroni's and Kao's residual cointegration test can be concluded that there is strong evidence pointing out all variables co-integrated in the long-term.

4.3 The result of the lag length criteria test

This test is intended to determine the optimal lag length for the time series data model. There are basically a number of criteria that can be used to detect the optimal lag length in the VAR model. The criteria include the Akaike information criterion (AIC), Hannan-Quinn (HQ), and Schwarz information criterion (SC). The results of data processing show that each of these criteria produces the different optimal lag lengths. AIC and HQ indicate the optimal lag length of 8, while SC indicates the optimal lag length of 5, as shown in Table 4.

Table 4. Result of Lag Length Criteria Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7.366289	NA	0.002789	-0.206396	-0.131348	-0.177624
1	219.1154	399.0655	9.45e-07	-8.196744	-7.971601	-8.110430
2	224.5048	9.742522	8.97e-07	-8.250186	-7.874947	-8.106328
3	225.0693	0.976909	1.03e-06	-8.118049	-7.592714	-7.916648
4	226.4820	2.336408	1.14e-06	-8.018538	-7.343107	-7.759594
5	255.1084	45.14163	4.44e-07	-8.965707	-8.140181*	-8.649220
6	257.4814	3.559484	4.76e-07	-8.903130	-7.927508	-8.529099
7	262.7032	7.431010	4.60e-07	-8.950122	-7.824404	-8.518548
8	275.0460	16.61531*	3.39e-07*	-9.270999*	-7.995185	-8.781882*

Notes:* indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion

Since the variable achieved stationarity after first differencing and Schwarz information criterion shows an optimal lag length of 8, use the lag length in applicating panel vector error correction model as means of data analysis technique. The result of the econometrics method comprises of two parts covering short-term and long-term effects between the variables as described in the following sections.

4.4. The result of panel vector error correction model

The result of PVECM divided into two parts. The first part is related to the co-integration equation and error correction pointing out the long-run and short-run relations between income inequality and economic growth. The second part represents the short run equation between the variables. The result of PVECM describing co-integration equation and error correction pointed in Table 5.

Table 5. The Long-Run and Short Run Relations

Cointegrating Eq:	CointEq1	
∆LGr(-1)	1.000000	
∆LEG(-1)	0.539287	
	(0.23449)	
	[2.29987]	
C	-3.890078	
Error Correction:	∆(∆LGr)	∆(∆LEG)
CointEq1	0.044132	0.010997
	(0.05951)	(0.00550)
	[0.74162]	[2.00112]

Note: Standard errors in ( ) & t-statistics in [ ].

Refer to the result of PVECM above, the co-integration equation of the variables is estimated as:

$\Delta LGR - 3.890 + 0.5393\Delta LEG_{t-1} = 0$, then the equation can be written as:

$$\Delta LGR = 3.890 - 0.5393\Delta LEG_{t-1} \quad (3)$$

The equation 3 above provides the empirical evidence deal with the long run relationship between income inequality and economic growth. In the long run, there is a negative relationship between the two variables, where economic growth can reduce income inequality. In other words, increasing output in the local economy in Indonesia, in the long run, encourages the distribution of income in the community. The existence of a negative relationship between the two variables can be explained as follows. Increased output is a logical consequence of an increase in economic activity in the community which then affects the absorption of labor. In addition, the increase in regional economic growth is also in line with the government's efforts to build better

infrastructure in rural areas, thereby increasing economic activity and the income of the poor who mostly work in the agricultural sector. This is what causes the fact that, in the long run, there is a negative relationship between economic growth and income inequality.

This finding is consistent with Woo's (2011) study using cross-country data set of 93 countries which concludes that there is a negative relationship between income inequality and long-term growth. Nissim (2007) and Binatli (2012) also provide the same conclusion that there is a negative relationship between the two variables. However, this finding is not in line with the study conducted by Li *et al.*(2016) for the case of Chinese economy proving the empirical evidence that there exists a robust positive long-run relationship between income inequality and growth in post-reform China.

Error correction part as shown in Table 5 above represents the short-run relationship between variables. In the short run, when income inequality lies above long-term balance, then economic growth will increase in the next period. A positive relationship between income inequality and economic growth in the short term indicates that the distribution of income within a community group is inequal along with the increase in output in the economy. As described earlier, in the long run, there is a negative relationship between economic growth and income inequality. Instead, in the short term, the relationship between the two variables is positive. This finding is consistent with the findings of Charles-Coll (2013) research which concludes that the relationship between economic growth and inequality income can be negative or positive.

The result of PVECM also shows that economic growth is positively affected by itself in the two, four and six-years horizon. This indicates that enhancing of the aggregate output in the period of year t, caused by increasing of aggregate output at the two, four and six-years before. Income inequality is negatively affected by itself in the one and two-years horizon and is positively in the three, four and five-year horizon. Increasing in income inequality in the period of year t has a negative and significant effect on income inequality at the two years later. but, the effect has changed to be a positive and insignificant effect on the variables at three and four years later.

Table 6. The Summary of The Panel Vector Error Correction Model (PVECM) Result

Exogenous Variable	**Endogenous Variable**					
	∆LGr			∆LEG		
	Coefficient	Standar Error	t-statistics	Coefficient	Standar Error	t-statistics
∆LGr(-1)	**-0.9445**	**0.5467**	**-1.7277**	-0.1374	0.0505	-2.7222
∆LGr(-2)	-0.2272	0.3988	-0.5698	-0.0682	0.0368	-1.8524
∆LGr(-3)	**0.0053**	**0.2695**	**0.0196**	**0.0258**	**0.0249**	**1.0377**
∆LGr(-4)	**0.2359**	**0.2840**	**0.8306**	**0.0191**	**0.0262**	**0.7273**
∆LGr(-5)	**0.0869**	**0.3095**	**0.2809**	**-0.0682**	0.0286	-2.3877
∆LGr(-6)	-0.1740	0.3901	-0.4460	-0.0397	0.0360	-1.1007
∆LGr(-7)	-0.6755	0.4639	-1.4560	-0.0562	0.0428	-1.3109
∆LGr(-8)	**0.7570**	**0.7287**	**1.0389**	-0.0006	0.0673	-0.0090
∆LEG(-1)	1.1604	2.1067	0.5508	-0.0619	0.1946	-0.3185
∆LEG(-2)	1.8533	3.5503	0.5220	**0.6241**	**0.3279**	**1.9034**
∆LEG(-3)	-4.7601	4.0761	-1.1678	-0.6812	0.3764	-1.8097
∆LEG(-4)	**3.4750**	**1.6120**	**2.1557**	**0.5683**	**0.1489**	**3.8174**
∆LEG(-5)	-3.2215	2.1087	-1.5277	-0.1073	0.1947	-0.5509
∆LEG(-6)	-0.8317	1.5109	-0.5505	0.2328	0.1395	1.6681
∆LEG(-7)	1.5788	2.2537	0.7006	-0.3817	0.2081	-1.8339
∆LEG(-8)	-0.7153	1.0755	-0.6651	-0.0807	0.0993	-0.8122
C	-0.0048	0.0749	-0.0636	0.0322	0.0069	4.6471
	R-squared : 0.6877 Sum sq. resids : 0.0210 S.E. equation : 0.0513 F-statistic : 1.0363 Akaike AIC : -2.8976 Schwarz SC : -2.0266			R-squared : 0.9497 Sum sq. resids : 0.0002 S.E. equation : 0.0047 F-statistic : 8.9151 Akaike AIC : -7.6619 Schwarz SC : -6.7909		

Note: Number in ( ) is regression coefficient of the variables. A number in [ ] is t statistics.

Regarding with the causality relationship between the two variables, the result of PVECM reveals that on one side, economic growth has a positive and significant effect on income inequality at the four-years horizon and negative and insignificant effect at the five and six-year horizon. On the other side, the income inequality negatively and significantly affects economic growth in the one and five-years horizon. The result of the PVECM explaining the causality relationship between economic growth and income inequality can be seen in Table 6.

Table 6 above shows the determination coefficient (R^2) of 0.6877 can be interpreted that lag of income inequality and economic growth during the 8-period horizon is able to explain 68.77 percent income inequality. This means that in the time horizon of 8 periods, 31.23 percent of the variations that occur in income inequality is explained by variables other than those two variables. Furthermore, by placing economic growth as an endogenous variable, the determination coefficient of 0.9497 indicates that the lag of economic growth and income inequality can explain 94.97 percent of variations that occur in economic growth, and only 5.03 percent is explained by other variables.

4.5. Impulse Response Functions

Impulse response function (IRF) shows the response of endogenous variable to the shock that occurs in other endogenous variables in a dynamic VAR system. IRF can be used to examine the effect of one standard deviation of shock from one innovation variable on the current or future endogenous variable values. The innovation variables in the study are economic growth and income inequality when the variable is employed as an explanatory variable for either of the two.

The income inequality response to economic growth is fluctuating. In the time horizon of one and two periods, the shock of economic growth is responded positively by income inequality. An increase in economic growth led to an increase in income inequality. Until the third period, the response becomes negative and then positive in the fourth period. Furthermore, in the fifth and sixth period, the response is negative and tends to decrease. The reaction of each endogenous variable to the structural shocks occurring in the exogenous variables as shown in Figure 2 below.

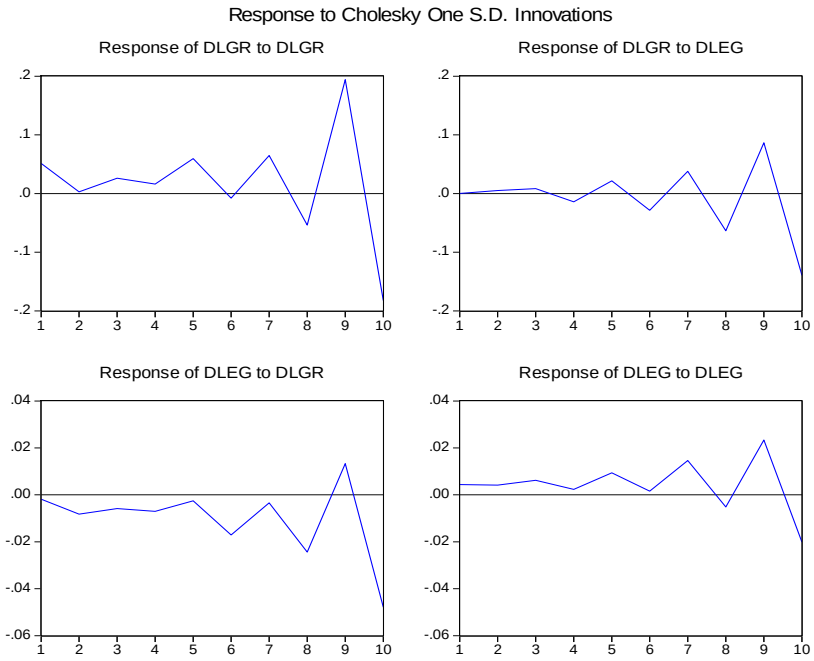

Figure 2. Impulse Response Function

The top right graph shows that the shock of income inequality by 1 standard deviation will result in a change of economic growth which has a relatively small increase up to the 3th-period.

The response decreased from the fourth period, then increased again until the fifth period. The shocks of economic growth provide a very volatile response to the 8-period horizon, and after a period of increase, the response will return negatively until the tenth period.

The shock of economic growth of 1 standard deviation will result in changes in income inequality decreased in a the-8 period horizon. The response changes move positively at the 9th-period and then negative at the 10th-period. In the first and second periods of the economic growth response to the income inequality is negative, and the response moves positively in the 3-4th period. Then, at the 5th-period and so on the economic growth response to income inequality is negative and less so to the long-term equilibrium. This is demonstrated by the top right graphic showing the movement of the IRF curve approaching the horizontal line.

4.6. Variance Decomposition Analysis

One way to determine how important the different exogenous shocks are explaining the dependent variables is to calculate the fractions of the forecast error variance of these variables attributable to the respective orthogonal shocks. The variance decomposition analysis to assess the dynamic interactions between the variables (economic growth and income inequality). The analysis would reveal the contribution of both economic growth and income inequality in explaining the forecast error variance of these two variables on each other. The results of the variance decomposition as shown in Table 7.

Table 7. Variance Decomposition of Variables

Period	Variance Decomposition of ΔLEG			Variance Decomposition of ΔLEG		
	S.E.	ΔLGr	ΔLEG	S.E.	ΔLGr	ΔLEG
1	0.051267	100.0000	0.000000	0.004734	15.28740	84.71260
2	0.051608	99.00026	0.999742	0.010347	66.45940	33.54060
3	0.058412	97.14941	2.850590	0.013419	58.57388	41.42612
4	0.062229	92.38072	7.619285	0.015322	65.97106	34.02894
5	0.088812	90.37574	9.624265	0.018133	49.06735	50.93265
6	0.093622	82.03172	17.96828	0.024951	72.71334	27.28666
7	0.119977	79.18250	20.81750	0.029121	54.73990	45.26010
8	0.145970	67.04529	32.95471	0.038320	72.04650	27.95350
9	0.257812	78.15189	21.84811	0.046808	56.35547	43.64453
10	0.345190	71.48947	28.51053	0.069897	72.11130	27.88870

Note:DLEG denotes the first difference of log economic growth. DLGR denotes the first difference of log Gini ratio

Based on table 7 above, interpreted that Variations in economic growth variable explain around 99 percent of its forecast error variance at the 2-year horizon, 99.7 percent at the 3-year horizon, and 92.14 percent at the 4-year horizon respectively.. This indicates that economic growth is one of the important variables in explaining the dynamic of its forecast error variance for over year. The VDA result also shows that Gini ratio contributes up to 9.62 percent of the forecast error-variance of economic growth at the 5-year horizon, indicating that Gini ratio has a smaller contribution on dynamic of economic growth at the year horizon.

4.7. The result of Granger causality test

Granger causality test is not only used to determine the causal relationship between variables. But it is also capable of analyzing which of the two variables (examined) first appear. To test the causality relationship between the two variables, we used the VAR Granger Causality / Block Exogeneity Wald Tests. The test results are shown in Table 8.

Table 8. The result of VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable	Dependent variable	
	ΔLGR	ΔLEG
ΔLEG	[28.3899] (0.0004)	-
ΔLGR	-	[11.5095] (0.1745)

Note: Number in [ ] is chi-square test. The number in parenthesis ( ) is a probability value.

According to the result of the tests listed above, it is clear that Gini ratio Granger causes economic growth. Conversely, there is no causality running from economic growth to income inequality.This finding is in line with the previous research conducted by Risso and Carrera (2012) for China economy, concluding that there is unidirectional causality from inequality to growth. Conversely, this finding is in contrast to other empirical evidence such as conducted byNuruddeen and Ibrahim (2014) in Nigeria that provides the empirical evidence the unidirectional causality from economic growth to income inequality.

5. Conclusion and Recommendation

The main objectives of our study to analyze the causality relationship between economic growth and income inequality for 26 selected provinces in Indonesia. Using cross-section panel data and employing panel vector error correction model (PVECM), at least the key conclusions of the study are as follows: firstly, there is a long-run and short-run relationship between economic growth and income inequality. In the long-run, the economic growth is negatively and significantly related to the income inequality. Conversely, in the short-run, the relationship between the two variables is positive and significant. Secondly, there is a unidirectional causality running from income inequality to economic growth. In another word, the income inequality leads to regional economic growth in Indonesia. The income inequality indicated by the dominance output by some community groups in the economy over a period of time will promote the increase in output in the next period. This is due to the increase in wealth of the rich, especially those who work as business actors reallocate their wealth to productive economic activities so that output in the economy increases.

Considering to the causality relationship between the two variables, the local government in Indonesia should be able to develop regional development planning that is not only oriented to increase economic growth in the region but also to encourage the distribution of income in the community. This can be done through the development of better public infrastructure especially in rural areas with relatively large numbers of poor people.

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