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Analysis of Provincial Convergence in Indonesia in 2001-2017

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Abstract:
This study aims to analyze whether regional/provincial convergence occurred in Indonesia during the 2001-2017 period and how social indicators (HDI), spatial indicators (*density*) and economic indicators (foreign investment and economic openness) affect the level of convergence between regions in Indonesia during period 2001-2017.Research data is secondary data from the Central Statistics Agency. The calculation of sigma convergence uses the standard deviation of the PDRB log per capita between provinces, while the calculation of beta convergence uses panel data regression analysis with an approach *fixed-effect model*. The results showed that sigma convergence and beta convergence between provinces in Indonesia in 2001-2017. Based on the estimation results it is known that all foreign investment (PMA), HDI, density, and export variables have significant and significant effects on the growthofthe economy.Variable density is a spatial indicator, measured by area divided by population, has a negative and significant effect on economic growth.

Keywords:*convergence; human development index; density; foreign investment; economic openness*

I. INTRODUCTION

Development is a dynamic process to achieve community welfare at a higher and more prosperous level. National development including economic development will place regional elements as important and interesting sub-national elements in development planning so that regions have a clear and very decisive role. Therefore, in the study of development economics, the regional dimension receives serious attention. This is generally related to issues of *regional equality* and *spatial distribution of resources.* In Indonesia, as in other major 3rd world countries, regions always receive special attention. No country has as diverse as Indonesia in ecology, demography, economy, ethnicity, culture. Likewise in the regional aspect, no country is equal to Indonesia in terms of the unique geography that places Indonesia as the largest archipelago in the world.

The regional dimension of economic development in Indonesia is important for several reasons. First, political reasons, with such diverse ethnicities, there are no more sensitive issues in Indonesia than regional issues. Secondly, regional income disparity originates from the natural resource income *highly uneven distribution of.* No wonder the disappointment from areas rich in natural resources such as Aceh and Irian is very large. Third, regions play an important role in government policies related to spatial dynamics, such as population distribution, for example. Related to this spatial dynamics appears the fourth, namely, how is the relationship between the center and the regions arranged? How much decentralization must be given to the regions so that it remains consistent to maintain national unity and unity (Wibisono, 2001)

Regional development is an integral part of

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national development. The development carried out by the region in addition to aiming to increase income per capita and the welfare of the people of the region, the purpose of the region to do economic development is to catch up and align with the regions that are already advanced, both in terms of income, productivity, wages and various economic indicators the other. So that the *gap* (gap) between regions will be reduced, In this case, known as "*Convergencebetween regions*" (Saldanha, 2003). Moreover, since the enactment of Law No.25 / 1999 which was revised to Law No.32 / 2004 concerning Regional Autonomy, which means that in the case of regional development it is left to each local government, the central government is only a supervisor/controller, then inevitably each region must make every effort to determine its policies and development in order to increase economic growth and catch up with the respective regions.

Convergence between regions is one indicator of success in regional development. Bucul (2012) states that convergence will occur if poor countries or regions with low incomes will grow faster than rich countries or regions with high incomes so that in the long run all countries will achieve the same level of convergence. There are two concepts of calculating convergence namely sigma convergence (*sigma convergence*) and beta convergence (*beta convergence*). Sigma convergence is measured by the level of dispersion of the log income per capita in each region. Inequality between provinces decreases or sigma convergence occurs if income dispersion decreases over time (Barro and Sala-I-Martin, 1992).

Indonesia has 34 provinces with different and abundant natural resources. One of the differences in natural resources is reflected in differences in per capita income and economic growth in the provinces in Indonesia. The Central Statistics Agency (BPS) recorded Indonesia's gross domestic product (GDP) per capita in 2017 of IDR 51.9 million, an increase from IDR 47.9 million in 2016. Of the 34 provinces, DKI Jakarta is the province with the highest income per capita namely IDR 149.8 million in 2016 rose to IDR 157.6 million in 2017, while the lowest was East Nusa Tenggara with per capita income of IDR 11.5 million in 2016 rising to IDR 11.9 million in 2017 Although DKI Jakarta is the province with the highest per capita income in the last two years, when viewed from economic growth, North Maluku is the province with the highest economic growth in 2017 of 7.92 percent while West Nusa Tenggara is the only province that has experienced a decline in economic growth of 4.56 percent in 2017 (BPS, 2018).

In general, convergence is reducing the income gap between regions so that it can be understood as a process of underdevelopment of low-income regions to high-income regions. The income gap can be reduced by using a convergence process that is calculated based on real income per capita. The convergence of economic growth in Indonesia will be achieved if there is a convergence process of economic growth in the provinces in Indonesia, namely through increasing per capita income growth (Barro et al, 1992). This study tries to examine whether there has been a convergence of economic growth in Indonesia in 2001-2017 as an indicator of the success of development because with the convergence, this shows that the government has been able to determine the right policies for each region.

Based on the background of the problems above, the authors formulated the main issues as follows 1) whether there was regional/provincial convergence in Indonesia during the 2001-2017 period; 2) how big is the rate of convergence that occurred between regions/provinces in Indonesia during the period 2001 - 2017; 3) whether social indicators (HDI), spatial indicators (*density*) and economic indicators (foreign investment and economic openness) affect the level of convergence between regions in Indonesia during

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the 2001-2017 period.

The research objectives of the analysis of Convergence between regions in Indonesia are 1) analyzing whether there is convergence between regions in Indonesia during the period 2001-2017; 2) analyze the level of convergence rate that occurred between regions/provinces in Indonesia during the period 2001-2017; 3) analyze the factors that influence the level of convergence between regions in Indonesia during the period 2001-2017, namely social indicators (HDI), spatial indicators (*density*) and economic indicators (foreign investment and economic openness).

II. LITERATURE REVIEW

Convergence is a process of economic growth in the countries or regions that differ such that reducing the *gap* (ravine) revenue, productivity, wages, and various other economic indicators. This could mean reduced differences in GDP per capita, and productivity (Abramovitz, 1986), reduced wage differentials, or the tendency of poor countries to catch up with the rich countries because of their amazing economic growth (Barro, 1992).

Convergence, at the core of the growth theory of the 1990s, is based on at least two different hypotheses that are interrelated. First, the *catch-up hypothesis* (Abramovitz (1986) which suggests that countries with low productivity levels have great potential to achieve high growth rates. Even so, the potential for growth will weaken if the level of productivity approaches the level of productivity of the country that it supplies. This indicates the process of catching up. Besides, the process of catching up also occurs if the relative variance around the average productivity decreases over time due to faster growth in previously lagging countries. Abramovitz (1986) also argues that if the relative dispersion of productivity decreases over time, convergence will also occur.

Second, Baro and Sala-I-Martin (1992) using the neoclassical growth model (Solow, 1956) in a closed economy predict that the growth rate per capita tends to be inversely related to the level of output or initial per capita income. Assuming that the same preferences and technology apply from one economy to another, poor countries tend to grow faster than rich countries.

The concept of convergence

The main concepts of convergence according to previous researchers (see for example Barro and Martin, 1995; Garcia and Soeltianingsih, 1998; Lall and Yilmaz, 2000) are twofold. The two concepts are *sigma* (σ) *convergence* dan *beta* (β) *convergence*. The purpose of *sigma convergence* is to measure the level of dispersion of output growth. While the use of beta *convergence* is to determine the effect of factors estimated to determine the degree of convergence.

The procedure for testing *beta convergence* is to first find out whether there is *unconditional convergence or absolute convergence*, and then test the convergence that can be explained (*explained convergence*) or conditional convergence. Absolute convergence is done by estimating an econometric model where the dependent variable initial conditional only explanatory variable. This concept states that convergence depends on the structure or characteristics of each region and this structural difference results in differences in the stable per capita income of each region. While conditional convergence is done by including some explanatory variables in the test other than the dependent variable at the beginning of the period. By testing conditional convergence it can be seen whether poor regions can grow faster than rich regions if other variables are considered constant.

Gross convergence or sigma (σ) is measured using a dispersion measure which in this case is the coefficient of variation and standard deviation of the logarithm of the dependent variable.

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Whereas to calculateβ convergence (Barro and Martin, 1995) are :

A. $\left(1-e^{-\beta T}\right)/T$

(1)

where β nothing else is the coefficient of the variable *initial level of percapita income*and T is the length of the period.Sigma convergence measures the level of dispersion of income. If the income dispersion has decreased, it can be said that inequality between regions tends to decrease or income convergence has occurred. To determine whether sigma convergence occurs, it can be calculated by the spread of GDP per capita measured as coefficient of variation or standard deviation. Sigma convergence occurs if the coefficient of variation in a particular year is smaller than the coefficient value of the previous year, so it can be said that sigma convergence has occurred.

Empirical Review

Studies from Barro and Sala-I Martin (1995) found a positive correlation between GDP growth rates with the following variables: initial GDP per capita, *education attainment, life expectancy, public spending on education, changes in the terms of trade, the investment ratio*, and *the rule of law*. They also found a negative relationship between growth rates and government consumption, market distortion (reflected *premium black market* in thein the forex market), political instability, *fertility rates*, and population growth. They estimated 24 regression equations and found that convergence rates varied between 1.4% and 2.8%, but the highest frequency varied between 2.5% and 2.7%.

Sodik (2006) in his research shows that the convergence of sigma (σ) using a dispersion measure (coefficient of variation) of the logarithm value per capita PDRB proves that real GDP per capita in Indonesia has fluctuated from year to year in the observation period, so it can be said that growth Real GDP per capita is unstable between provinces in Indonesia, in other words, there has been an inequality in the growth of real GDP per capita between provinces in Indonesia. From the estimated results of the initial real per capita GRDP coefficient can be seen the value of *(β)* convergence (convergent speed) which is equal to 8.28% for the period 1993-2003.

Prasasti, D (2006), in his research, based on the results of the estimation of beta *(β)* or absolute convergence shows the *catch-up*, ie poor provinces, measured by per capita GRDP, shows a faster per capita GRDP growth rate than rich provinces with GRDP higher. The rate of absolute convergence during the 1993-2003 period was -0.6507 percent. Indonesia's GDP per capita is experiencing convergence. This can be seen in the sigma convergence test *(σ)* which uses a dispersion measure (coefficient of variation) of the logarithm value per capita PDRB shows enough evidence that there has been a decrease in the gap of GDP per capita between provinces and shows the direction of convergence.

Research from Ayu Savitri Gama (2007) shows the results that convergence did not occur in Bali Province in the 1993-2006 period. By seeing the beta convergence coefficient = 0.049 is positive, it confirms that there has been a divergence rather than convergence in per capita PDRB disparities between districts/cities in Bali Province.

The results of research from Masrukhin (2009) show that absolute convergence occurred in West Java during the 2000-2007 study period amounting to -0.66859 so that the income level tendency is increasingly converging. Conditional convergence during 2000-2007 shows a convergent tendency of -0.933> 0 which indicates that the tendency for per capita income levels between regencies/cities is more uniform (converging) with the condition that an increase in the number of population aged 10 and over who work also occurs in each district/city.

Research conducted by Krismanti T (2011) shows the results that regional income

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convergence in regencies/cities in Java does not occur (divergent), as well as East Java. The highest level of convergence occurred in West Java because of the contribution of the manufacturing sector. Meanwhile, convergence with the household expenditure approach is very high in each province and throughout Java.

Study Setyorini. G (2011) this research found that the convergence in gross domestic regional product happened in every period of the presidential leadership in Indonesia. We also found that regional economic growth in Indonesia is determined by gross domestic regional product per capita, oil and gas resources, general allocation funds and revenue sharing funds.

Study Emalia (2012) shows that during the research period there was no absolute convergence between regencies / cities in Lampung province. This indicates that the increase in GRDP per capita in lagging districts / cities is not growing faster than in the more developed districts / cities. The speed of absolute convergence is 11.14 percent per year. In addition conditional convergence is not found, so it can be concluded that regions with low per capita income are unable to catch up from regions with higher per capita income. The speed of conditional convergence is 11.71 percent per year and the time required to close half of the initial gap (the half-life convergence) is 5.86 years.

Study Bayu Kharisma dan Saleh (2013) based on the estimation results across 26 provinces over the period 1984-2008 provides a strong indication of the existence of absolute and conditional convergence in Indonesia during the study period, both based on estimates of OLS, fixed effects, random effects and first differenced GMM and system GMM. Dynamic panel data estimation with system GMM produces an efficient and consistent estimator to handle issue regarding problems of instrument validity. Thirdly, based on the system GMM estimation, it is found that the provinces in Java have faster speed of convergence comparatively to those outside Java.

Yuniasih, M. Firdaus, and I. Fahmi (2013) studies show that the regional convergence of aggregate labor productivity during the 1987-2011 period occurred in Indonesia with a convergence speed of 0.06518 and the time needed to close the gap around 11 years. Determinants of aggregate labor productivity in Indonesia during the 1987–2011 period included physical capital stock, human capital stock, total trade, and real wages, all of which had a positive effect.

Study Nurhamidaha and Suhartinia (2014). The result with FD GMM show the existence income convergence and require 22 years to decrease half inequality by involving human capital and physic capital, that show slow process the convergence. Long road with small contribution to GDP per capita, causing slow income convergence. Hence, human capital and physic capital that existing especially long road should be optimized to accelerate income convergence between regions in South Sumatra province.

Andrian Syah Malik (2014) examined the convergence between provinces in Indonesia after the implementation of regional autonomy in 2001-2012, the results of his study stated that there has been a sigma convergence (*sigma convergence*) between provinces throughout Indonesia as indicated by a decrease in per capita GRDP dispersion and also occurred convergence beta*(beta convergence)*after the implementation of regional autonomy. The speed of convergence in Indonesia after the implementation of regional autonomy in 2001-2012 is 6.3% per year.

Study from Rizky. S (2018) shows that there is a tendency for economic convergence in North Sumatra Province. This indicates that districts / cities that are relatively underdeveloped will be able to catch up with districts / cities that are relatively more advanced. The variables that influence in increasing income per capita in order to encourage economic convergence are capital expenditure, human development index (HDI) and

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the level of open unemployment (TPT).

III. RESEARCH METHODS

Types and Sources of Data

This study uses a quantitative approach that serves to describe data in the form of numbers or percentages and econometric analysis in the form of panel data regression *(pool data)*. Panel data is a combination of data *cross-section* that is 33provinces in Indonesia and data *time series* 2001-2017. The number of provinces in Indonesia is 34, but North Kalimantan Province is combined with East Kalimantan Province due to limited data. The data needed in this study is the Human Development Index (HDI) data, Population Density, Foreign Investment (PMA), Exports, Gross Regional Domestic Product based on constant Prices and Applicable Prices and Per Capita Revenues of the Province sourced from the Central Statistics Agency.

Estimation Model

research refers to the Barro and Sala-I-Martin (1995) model. Their model uses an equation that links the growth rate of per capita income between two-time points to the initial level of per capita income. If we assume that we have observations at two-time points 0 and T, then the model can be written as follows:

$$(1/T).\log(y_{iT}/y_{i0}) = a - \left[\left(1-e^{-\phi T}\right)/T\right].\log(y_{i0}) + U_{i0,T} \quad (2)$$

where i denotes region, a is an intercept, $(y_{iT/yi0})$ is the growth rate of real GDP per capita, y_{iT} and y_{i0} successively is the *final dan initial level of percapita income*, and $U_{i0.T}$ is the *average error term*. The *initian income coefficient* is $\left(1-e^{-\beta T}\right)/T$, are likely to decline over the lenght of the time interval T.

Equation Barro and Sala-I-Martin modified in this study to be more simple. In general, the Barro and Sala-i-Martin equations can be written as follows:

$$\log(y_{it}/y_{it-1}) = a + b\log(y_{it-1}) \quad (3)$$

where t and i successively indicate year and region, y_{it} and y_{it-1} each shows the *final* and *initial level of income* (indicated by per capita GRDP).

It is assumed we have two observations at two-time points namely 0 and T. Then equation (2) implies that the average growth rate over time intervals from 0 to T can be written as follows:

$$\log(y_{iT}/y_{i0})/T = a + b\log(y_{i0}) \quad (4)$$

where log is a logarithm, T is a time interval, and b is the coefficient of *initial income*. Equation (3) is what will be used to test the convergent absolute hypothesis. Whereas to test the convergent conditional hypothesis we will use equation (4) which is modified to

$$\log(y_{it}/y_{i0})/T = a + b_1\log(y_{i0}) + b_2 IPM_{it} + b_3 DEN$$
$$b_5 OPENNESS_{it} + u_{it}$$

where :

t = time (2001-2017)

i = province area

a = constant

b_1= convergence coefficient

y = growth rate of GRDP

IPM_{it}= Human Development Index (HDI) as a Social Indicator

$Density_{it}$= Population Density (DENSITY) as a Spatial Indicator of

PMA_{it} Foreign Investment (PMA) as an Economic Indicator

$OPENNESS_{it}$= Economic Openness as an Economic Indicator

μis an*error term*

Analytical methods carried out using panel data, i.e. combined time data for *series* from 2001-2017 period and *cross-sections of* Provinces in Indonesia (34 provinces). Theoretically, there are several benefits gained by using the combined data. First, the increasing number of observations

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held for the sake of estimating population parameters has a positive effect by increasing the *degree of freedom* and reducing the possibility of collinearity between independent variables. Second, it is possible to estimate each individual characteristic as well as time separately. Thus, the analysis of estimation results will be more comprehensive and include things that are closer to reality.

In the *classical linear regression model*, the*error terms are* always stated to be *homoscedastic* and *serially uncorrelated*. That way, the use of method *ordinary least square* will produce the estimator *best linear unbiased*. However, the assumption regarding the disturbance cannot be applied to panel data. Panel data composed of several individuals for several periods brings new problems like the disorder. The problem is *disturbances* or *error term* that there are now three types of, namely *time-series related disturbances*, *cross-section disturbances* and interruptions originating from both. (Gujarati, 2003).

If all the distractions of individuals (μ_i), disruption time (λ_t) and *random noise* are combined into one and follow the rest of the initial assumptions *random noise* that is distributed normally-free-identical, then the use of the method *of generalized least squares* will produce estimators that meets nature *best unbiased linear*. This method, in other words, states that all disturbances that occur follow a normal distribution, with the un*expected value* of zero, as is the assumption held in the classical linear regression equation model. This method is known as the *Random Effect Model*, or also called the *Error Components Model*.

However, if the assumption that all disturbances cannot be stated follows all assumptions *random noise* as in the classical linear regression equation model, then the use of *ordinary least square* or *generalized least square* will not produce results that meet the nature *best linear unbiased*. In this way, the interrupt components of time and interpersonal components will be incorporated in the constant interceptmodel. This method is known as the *Fixed Effect Model* or also called the *Dummy Variable Model*. This estimation method to get an efficient estimator by applying the estimation process of the data deviation*(deviation)*from the average over time, the average according to the individual, and the average in both. To choose between using *dummy variablesmodel* or *error components model*, this study will use Hausman statistics (Sitanggang and Nachrowi, 2004).

Panel Data Model Estimation

Analisis data yang dilakukan dengan estimasi regresi, yang mana menurut Widarjono estimations using panel data, 3 models can be performed, namely:

a. Method *Common Effect* is a panel data estimation that only combines data *time series* and *cross-section* using the method *Ordinary Least Square (OLS)*. This approach does not pay attention to individual dimensions or time. In this model, there is an assumption that the intercept and regression coefficient value is fixed for each object of study and time.
b. The *Fixed Effect* method in this estimation method assumes that each object has a different intercept but has the same coefficient. To differentiate between one object and another, *dummy* or pseudo-variables are used, so this method is also called *Least Square Dummy Variables (LSDV).*
c. The model *Random Effect* in this method does not use variables *dummy* like those used in *fixed effects*. This method uses residuals that are thought to have intertemporal and inter-object relationships. The model *random effect* assumes that each variable has a different intercept but that intercept is random or stochastic.

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Hausman Test Specifications

The main assumption in the regression model is that the component error $E(u_{it}/X_{it})=0$. This is important because disturbance factors (disturbance) contain individual invariant effects (μ_i) that are unobserved and may be correlated with X_{it}. For example, in an equation that μ_i might be denoted as unobservable individually and might correlate with some variables on the right side of the equation. In this case, $E(u_{it}/X_{it})\neq 0$ the GLS estimator $(\hat{\beta}_{GLS})$ will be biassed and inconsistent β. However, by doing the transformation μ_i and ignoring it, the within estimator $(\hat{\beta}_{Within})$ will be unbiased and consistent with β. Hausman (1978) suggests comparing $\hat{\beta}_{GLS}$ with $\hat{\beta}_{Within}$, where both are consistent with the null hypothesis $H_o: E(u_{it}/X_{it})=0$, but certainly with differences in probability limits. In reality, it $\hat{\beta}_{Within}$ will be consistent even when it is H_o true or not true, whereas it $\hat{\beta}_{GLS}$ will be BLUE, consistent and asymptotic on H_o, but it will be inconsistent when it H_o is incorrect. Statistical tests will base on $\tilde{q}_1=\hat{\beta}_{GLS}-\tilde{\beta}_{Within}$, with H_o, $p\lim \tilde{q}_1=0$ and $\text{cov}(\hat{q}_1,\hat{\beta}_{GLS})=0$.

By using the fact that $\hat{\beta}_{GLS}-\beta=(X'\Omega^{-1}X)^{-1}X'\Omega^{-1}u$ and $\tilde{\beta}_{Within}-\beta=(X'QX)^{-1}X'Qu$, will be obtained $E(\hat{q}_1)=0$, and

$$\text{cov}(\hat{\beta}_{GLS},\hat{q}_1)=\text{var}(\hat{\beta}_{GLS})-\text{cov}(\hat{\beta}_{GLS},\tilde{\beta}_{Within})$$

$$=(X'\Omega^{-1}X)^{-1}-(X'\Omega^{-1}X)^{-1}X\Omega^{-1}E(uu')QX(X'QX)^{-1}$$

$$=(X'\Omega^{-1}X)^{-1}-(X'\Omega^{-1}X)^{-1}=0 \quad \text{.....(5)}$$

Furthermore jika $\tilde{\beta}_{Within}=\hat{\beta}_{GLS}-\hat{q}_1$, will be obtained

$$\text{var}(\tilde{\beta}_{Within})=\text{var}(\hat{\beta}_{GLS})+\text{var}(\hat{q}_1)$$

Since $\text{cov}(\hat{\beta}_{GLS},\hat{q}_1)=0$, then;

$$\text{var}(\hat{q}1)=\text{var}(\tilde{\beta}_{Within})-\text{var}(\hat{\beta}_{GLS})=\sigma_v^2(X'QX)^{-1}-(X'\Omega^{-1}X$$

.....(6)

Thus the Hausman statistical test is as follows:

$$m_1=\hat{q}_1'\left[\text{var}(\hat{q}_1\right]^{-1}\hat{q}_1$$

.....(7)

where H_o asymptotic is distributed as χ^2_K where K is the dimension of the slope vector β. Furthermore, to meet operational technical aspects, it Ω will be replaced by an estimator consistency $\hat{\Omega}$, so GLS will be possible. The rejection of the Hausman statistic means the rejection of the *fixed effect model* or *dummy variable model*. So the greater the Hausman statistical value, the more leads to the acceptance of the alleged *error components model* (Baltagi, 2003).

IV. RESULTS AND DISCUSSION

Results of Sigma Convergence Analysis (σ)

Sigma convergence (σ) is measured by the standard deviation of per capita GRDP. If the standard foreign exchange decreases from time to time, then the convergence of sigma (σ) has occurred and the implication is that the difference in per capita real GRDP between the provinces or regions has diminished. Table 1. Shows that the standard deviation of PDRB real percapita

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between province in Indonesia has down from 4871,46 in 2001 to 303770,62 in 2017.

Table 1
Result of the Sigma Convergence (σ)

Year	Sigma Convergence	Dispersion
2001	4871.46	0.92
2002	4944.07	0.88
2003	5597.21	0.88
2004	5747.13	0.89
2005	5909.99	0.86
2006	6131.52	0.86
2007	6404.92	0.87
2008	6654.45	0.87
2009	6804.01	0.86
2010	12834.88	1.22
2011	26701.98	0.85
2012	27276.69	0.82
2013	28804.86	0.83
2014	29268.54	0.82
2015	29286.91	0.79
2016	29603.12	0.78
2017	30377.62	0.77

Source : data processed

In addition, the real per capita GRDP dispersion also decreased from 0.92 in 2001 to 0.77 in 2017. The decrease in both standard and dispersion deviations indicates that GRDP growth real per capita in Indonesia fluctuates from year to year in the observation period. So that it can be said that the growth of real per capita GRDP is unstable between provinces in Indonesia in other words that there is inequality in the growth of real per capita GRDP between provinces in Indonesia. Tendency ofthe overall dispersion rate isdecreased, so it can be concluded that sigma convergence occurs. The calculationSigma convergence is calculated to explain that level of incomegenerated will be positively correlatedinitial per capita income growth.

The occurrence of sigma convergence is in accordance with previous studies that have been calculate the level of sigma convergence in Indonesia such as Wibisono (2003), Aritenang (2009), Rahman (2012) which states that there is a convergence in Indonesia. Sigma convergence also indicates that to reduce the level the gap cannot be done
quickly. But it requires a comprehensive development process in each province to improve economic growth and reduce level of inequality like development transportation, education, agriculture, health infrastructure as has been done in the United States and Japan (Shioji, 2001). After sigma convergence occurs, the calculation of beta convergence can be done.

Beta Convergence

Convergence is calculated by two analyzes, namely absolute convergence analysis and conditional convergence. Both are calculated based on econometric analysis based on panel data analysis. To calculate absolute convergence panel data regression analysis is used based on the approach *fixed effect* that is generated through the selection of models based on the calculation of the F test and the Hausman Test. Convergence between provinces in Indonesia in 2001-2017 is shown from the calculation of the value of the convergence of the bet. The following table 2 presents the results of the estimated beta convergence regression.

Results EstimatesRegression Equations
Estimates of Regression Results Absolute Convergence

Table 2
Results of regression estimation *Absolute Convergence* for Provinces in Indonesia

Independent Variabele	Dependent Variable
initial per capita real GRDP	0.600498*** (20.402462)

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Source :Data processed

*** sig at α = 0,01; ** sig at α = 0,05; * sig at α = 0,10

Based on table 2. shows the results of the regression of ***Absolute Convergence***, providing strong evidence of the existence of ***Absolute Convergence***. The estimated coefficient of the initial real per capita GRDP is very significant. From the estimation results of the initial real per capita GRDP coefficient can be seen the value of ***β convergence***(speed of convergence) which is equal to 8.28% for the period 2001-2017.

Results of Estimation of regression Conditional Convergence 2001-2017

Table 3
Regression Estimation Results with Fixed EffectMethod

Variable	2001-2017 Periods
Real GRDP per capita Initial	0.604613***
PMA	(19.12882)
	0.002472**
IPM	(0.515390)
	0.000163**
Density	(2.502150)
	-15.30459***
Ekspor	(-6.238956)
	57.85797*
	(1.725330)
R-squared	0.982761
S.E. Regression	1456175.
DW-statistic	1.419143
F-statistic	2156.765
(Prob. F-statistic)	0.000000

Source: processed data

*** sig at α = 0,01; ** sig at α = 0,05; * sig at α = 0,10

Based on table 3. above shows that the estimation results with the method *Fixed effect* for ***conditional convergence*** have coefficient values lower than *absolute convergence* that is equal to 0.604613. From the estimation results of the initial real per capita GRDP coefficient, it can be seen the value of the velocity ***conditional convergence***which is 9.07% per year. This means that the presence of explanatory variables will further increase the speed of convergence between regions in Indonesia during the observation period. The initial real per capita GRDP variable to measure the speed of convergence shows a positive and significant relationship which means that a high convergent speed will drive economic growth.

Foreign investment has a positive influence on growth.Indicate that the increase in planting foreign capital will increase economic growth in Indonesia. That matter according to Tiwari and Mutascu's research (2011) which states that investment foreign is more effectively applied in countries categorized as countries developing and poor countries.

The human development index has a positive effect on growth.

The resulting estimation coefficient shows a significant effect, which indicates that an increase in HDI will increase economic growth, meaning that the high quality of human resources can produce quality products and services, competitive and innovative so that it can become one of the keys to increasing income per capita.

While the variable *density* (density) is significant for regional economic growth and is followed by a net export variable (economic openness). The net export variable measured by the ratio of net exports to GRDP at current prices is a *proxy for* regional economic openness that has a direction that is consistent with the theory even though it is at a degree of 10% (statistically significant). So it can be said that the level of economic openness of a region plays a role in increasing regional economic growth.

By comparing the two equations we can see that the inclusion of control / explanatory variables has

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contributed to the improvement of the equation. It can be appreciated from the increasing ability of independent variable in explaining the dependent variable that is reflected by the number of R squared ($R^{2)}$that is equal to 0.982761 or by 98.27%, ie 98.27% of variation of the independent variable can explain the variation of the dependent variables while the rest is influenced by other factors not tested in the model.

V. Discussion

Initial real per capita GRDP

Estimated coefficient on initial real per capita GRDP of 0.604613. These results state that a one percent increase in GRDP per capita will increase growth by around 60.46% per year. The magnitude of this coefficient is significant and significantly confirms the existence of ***conditional convergence*** in Indonesia and implies that convergence occurs at a rate of around 60.46% per year. Convergence is said to be conditional in the sense of prediction that higher growth rates in provinces with lower income levels only apply if the other explanatory variables are held constant.

Based on the estimation results it is known that all foreign investment (PMA), HDI, density, and export variables have significant and significant effects on growthin the economy.Variable density is a spatial indicator, measured by area divided by population, has a negative and significant effect on economic growth. These results are under the previous study of Naude and Krugell (2004) that density affects economic growth.

The net export variable measured by the ratio of net exports to GRDP at current prices is a *proxy for* regional economic openness that has a direction that is consistent with the theory even though it is at a degree of 10% (statistically significant). So it can be said that the level of economic openness of a region plays a role in increasing regional economic growth.

VI. CONCLUSION

Based on the research results there has been a sigma convergence (*sigma convergence*) between provinces throughout Indonesia in 2001-2017 which is indicated by a decrease in per capita GRDP dispersion where the standard deviation of per capita real GRDP between provinces in Indonesia has decreased from 4871.46 in 2001 to 30377070, 62 in 2017 and there has also been a *beta convergence*. The speed of convergence in Indonesia is shown by the large value of ***β convergence***which is equal to 8.28% for the period 2001-2017 while the convergence speed as measured by ***conditional convergence***9.07% per year. The results of conditional convergence analysis of all provinces in Indonesia in 2001-2017 showed that foreign investment, human development index, and the ratio of exports to GRDP based on prices apply as a variable of economic openness that positively influences economic growth. Population Density (DENSITY) as a Spatial Indicator has a negative effect on the economic growth of all provinces in Indonesia.

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