The convergence analysis in Central Java Province (an approach for unconditional and conditional)

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Abstract. The aims of this paper wants to analyse the development convergence between regions in Central Java Province. We used the annual data from 2010 until 2016. The regression result show that the absolute convergence have negative sign, it indicate that the poor region could grow faster that the rich region. In other words, there is a possibility of convergence between regions in Central Java Province. From our results, we calculate the speed of convergence among this period, the value amount of 0.007 and 1.053 percent per year, with the implication of the half of life convergence is 66 - 95 years. We suggest that the provincial government of Central Java can prioritize the development programs with focusing on the under-developed regency. This program hoped to reduce income disparities then it will be one of the efforts to reach convergence amongst cities / regencies in Central Java Province.

1. Introduction
Related to growth theory, we started from the perspective of Neo-Classical growth theory argues that the low income per capita regions have possibility to accrue at higher rate than the high income regions [1]. Recently, some studies have focused on how the speeds of convergence happen between countries. This study provides several reasons why study of convergence becomes important. First of all, by learning the convergence speed, academics have the opportunity to validate the theory of the capital formation in the economic growth theory. Second, through the availability of the data right now, researchers have the opportunity to proof the convergence between countries across the region, and determine the speed of the convergence [2,3].

Furthermore, the differences in regional growth are prominent issues that happen in every single nation in the world, particularly in under-developed countries and developing countries where the investment and industrial activity are much lower than the developed countries. Regional disparities, from the context of convergence, has caused by many different reasons. At regional level, convergence can be created only by reducing income disparities in each region. The more disparities in each region the more chance divergence could happen. At this point, incentives to invest and the investment itself, which provide by government, in less developed countries is important to narrowing the gap [2,3].

In Indonesia, the study about convergence started since 1975 until now, in which the study adopts two approachments. First, the regional convergence analysis derived from the main research topic in
international level. This analysis, generally, uses cross-section regression between growth rate and initial income per capita. The second approaches, the regional disparities learned independently from the growth theory. Recent studies try to combine these two approaches [4,5]. In addition, several studies have often found two concept of convergence used in regional inequality analysis, namely beta convergence and sigma convergence [2,5,6]. However, some studies have an interest in studying convergence at the provincial level and the island level. For example in East Java and Sumatera Island [7,8], Java and outside Java [9], and also testing the convergence at the corporate governance level [10].

From previous research, the same studies about convergence tends to have relatively small differences in characteristics between regions in terms of technology, natural resources, human resources, and other inputs. Here also tends to have strong interrelatedness of economic activity between regions [5,11]. Some literature states that the study of convergence has two concepts, first known as sigma convergence, this occurs if the dispersion of the level of real per capita income tends to decline. The second concept, with beta convergence, this concept of convergence develops becomes absolute beta convergence and conditional beta convergence. Absolute beta convergence occurs by assuming other factors that condition it are constant so that less developed economies can grow faster than more advanced economies. Conditional beta convergence occurs by assuming other factors that condition it are not constant [12].

In addition, the convergence studies are always interesting, because convergence does not always mean that per capita income will be exactly the same for all regions, but theoretically there is a chance that the intensity of dispersion of income per capita across regions will decrease. The existence of this convergence hypothesis is still a debate between Neo Classical views and Endogenous Growth Theory. On the one hand, the Neo Classical view proposing the proposition of convergence will happen automatically without government policy. On the other hand, the understanding of the Endogenous Growth Theory states that convergence does not always occur so that government policy is still needed to achieve it [1,4,6].

Based on the description above, we want to study with the convergence in Province of Central Java because it included the category of provinces with large population and relatively distributed economic condition between regions. So, the paper aims to know whether there is convergence of inter-regional development in Central Java Province. If it happens, the process of convergence of regional development is expected to reduce the level of inequality between regions, so the development between regions becomes more evenly distributed.

2. Research Methods

2.1. Data
We have collected the data from Central Java in Figures from 2010 until 2016. The Central Bureau of Statistics was published it. The unit analysis included cities/regencies in Central Java Province. The data consist of growth domestic regional brutto based on current price and constant price for each cities/regencies, economically active population / working age population for each cities/regencies, employed population for each cities or regencies, the number of population for each cities/regencies, the number of investment for each cities/regencies, and the number of population at secondary school for each cities/regencies.

2.2. Method
The standard convergence approach often refers to the Solow-Swan growth model. We adopt the basic Solow model assumed that the saving rate, the growth of population, and the progress of technology were exogenous while the primary input in the production process was capital and labor, where both of input factors are paid at their marginal product level. With the diminishing returns to capital assumption, the model made some implication of the existence of the traditional model dynamics. This transition denotes how the rate of economic growth declines as it approaches the steady state condition.
of capital per labor; the economy of established regencies be predicted to grow slower than the economies of poor regencies.

Following Mankiw, Romer, and Weil from their paper, the linear estimation on transitional dynamic can write as follows

\[ y = -\lambda(y - y^*) \]  

(1)

where

\[ \lambda = (1 - \alpha)(n + g + \delta) \]  

(2)

The expanded MRW by incorporating the quality of human capital results in an additional parameter \( \beta \), it results the output elasticity to the quality of human capital, and the degree of convergence defined as

\[ \lambda = (1 - \alpha - \beta)(n + g + \delta) \]  

(3)

In the empirical level, \( \lambda \) reflects the velocity of the convergence, take for example, if \( \alpha = \beta = \frac{1}{3} \) and \( n + g + \delta = 0.06 \) then a convergence rate is obtained by 0.02. The rate of convergence, \( \lambda \), is derived from the derivation that starts from the capital accumulation equation as follows

\[ \frac{dk}{dt} = sf(k) - (n + g + \delta)k \]  

(4)

Where \( k = K/AL \); \( s \) is a constant part from output that have invested; \( n \) and \( g \) are the rate of growth of labor and technology; and \( \delta \) is the depreciation rate.

By performing a first-order Taylor expansion from the right-hand side of the equation around the steady-state capital stock, \( k^* \), it will give

\[ \frac{dk}{dt} = [sf'(k^*) - (n + g + \delta)](k - k^*) \]  

(5)

Using the steady state condition \( sf(k^*) - (n + g + \delta)k^* \), to substitute \( s \), it will give us

\[ \frac{dk}{dt} = \left[ \frac{f'(k^*)k^*}{f(k^*)} - 1 \right] (n + g + \delta)(k - k^*) \]  

(6)

If capital have marginal product, so \( \frac{f(k^*)k^*}{f(k^*)} \) is the capital in steady state condition, it will imply

\[ \frac{dk}{dt} = -\lambda (k - k^*) \]  

(7)

where \( \lambda = (1 - \alpha) (n + g + \delta) \)

To show that the income will converge to the steady state level at the same capital level, note that \( y = f(k) \). Because the following first-order approximation will be fulfilled:

\[ \frac{dy}{dt} = \frac{f(k^*)dk^*}{dt} \]  

(8)

\[ y - y^* = f(k^*) (k - k^*) \]  

(9)

with substitution method, we get
\[
\frac{dy}{dt} = -\lambda (y - y^*) \tag{10}
\]

The solution from the differential equation in (1) or (10) are

\[
\ln(y_t) = (1 - e^{\lambda t}) \ln(y^*) + e^{\lambda t} \ln(y_0) \tag{11}
\]

Where \(y_0\) is the income per effective worker at a given start time. By subtracting \(\ln(y_0)\) from both sides, we will get

\[
\ln(y_t) - \ln(y_0) = (1 - e^{\lambda t}) \ln(y^*) - (1 - e^{\lambda t}) \ln(y_0) \tag{12}
\]

Next, we substitute \(y^*\) into equation (12), we get

\[
\ln(y_t) - \ln(y_0) = (1 - \lambda t) \frac{\alpha}{1-a-\beta} \ln(sk) + (1 - e^{\lambda t}) \frac{\beta}{1-a-\beta} \ln(sh) - (1 - e^{\lambda t}) \frac{\alpha + \beta}{1-a-\beta} \ln(n + g + \delta) - (1 - \lambda t) \ln(y_0) \tag{13}
\]

We employed the equation where it’s estimated by the regression approach, in the Solow model, we can say that the income growth defined by the steady state determinant function and the income initial level. This equation estimates with multiple regression techniques where \(\beta\) parameter estimated by the least squares method [13]. Some variables description involved in this paper, as follows:

| Variable                                      | Description                                                                 |
|-----------------------------------------------|----------------------------------------------------------------------------|
| Difference GDRP per Working Age Person 2010–2016 | The difference in gross regional domestic product each region in Central Java Province between 2010 and 2016. |
| GDRP10 WorkingAge                             | The initial gross regional domestic product each region in Central Java Province for year 2010. |
| I/GDRP                                        | The total investment divided by gross regional domestic product in each region. |
| \((n + g + \delta)\)                          | The sum for the number of labor, the rate of technology, and the depreciation rate. Where the rate of technology and the depreciation rate assumed by 0.05 or 5%. |

3. Results and Discussions

In this section, we will conduct the empirical testing of the existence of convergence in Central Java Province. We employ the Solow Model for our empirical testing. We report the regression of the change in the log of GDRP per working age over among regencies/cities in Central Java Province over the period 2010–2016, on the log of GDRP per working age in 2010, without controlling for another variable. In this part (Table 2), our regression called unconditional convergence regression. Table 2, the log of GDRP per working-age 2010 (GDRP10perWorkingAge) appears as the independent variable. The table we present wants to show the presence or not about the convergence in Central Java Province. The unconditional convergence model has the \(R^2\) of the regression is 0.255, it means that this model can explain the absolute beta convergence equal to 25.5 percent with the other things being constant (ceteris paribus). The regression parameter of the log of GDRP per working age is negative and significant, then it indicates the tendency that poor regencies/cities grow faster on average than its rich counterparts. The speed of convergence amount of 0.011 then it implies that the time to cover the half of initial gap is equal to 66 years.
This result confirms that the existing of convergence will have the consequences that an accelerating the distribution of development due to the increase in income of the region. This is expected to reduce the level of inequality of inter-regional development, so that the process of equality of inter-regional development can be achieved. In addition, the important role of income variable per capita becomes one of the significant factors to the growth of the region then the development in the region can be done in accordance with the advantages or potentials in the region concerned [2,5]. Some researchers argue that there are allegations that region (districts or cities) with low real per capita income tend to grow higher compared to districts or cities with higher real per capita income. However, the process of convergence still requires time because of differences in income between regions that are categorized as rich and not. In addition, it was suspected that the initial low level of per capita income in the region was categorized as not wealthy so it has implications for the limited availability of capital, one of which is used to increase the carrying capacity of the regional economy [2,3,9].

**Table 2. Regression Output for The Unconditional Approach**

| Variable                        | Coef.  | Std.Err | Sign |
|---------------------------------|--------|---------|------|
| CONSTANT                        | 1.529  | 0.315   | ***  |
| Log(GDRP10perWorkingAge)        | -0.061 | 0.018   | ***  |
| R-Squared                       | 0.255  |         |      |
| Adj R-Squared                   | 0.232  |         |      |
| F-Stat                          | 11.295 |         |      |
| Prob F-Stat                     | 0.002  |         |      |
| Speed of Convergence (%)        | 1.053  |         |      |
| Half Time of Convergence        | 66     |         |      |

Sign : α = 1% (***) ; α = 5% (**) ; α = 10% (*) | assume : g + δ = 5%

Table 3, we want to show the convergence was exist or not. In this section, our regression called conditional convergence regression. From this table, we wants to see the existence of convergence by involving control variables. Our regression called conditional convergence regression by splitting the model into two namely the regression model of restricted conditional convergence and the regression model of unrestricted conditional convergence.

These findings support previous studies that there is the existence of convergence in Central Java, in addition to the findings being a proof of validity between the neoclassical model and the endogenous growth model. Convergence can be a consideration for policy makers related to one of the critical issues in the form of characteristic regional development patterns in Central Java. Because the nature of convergence arises, poorer regions have the potential base to 'catch up' richer regions in increasing the relative level of income per capita so that the tendency for differences in economic growth between regions is not permanent [12]. One literature suggests that economic growth can continue due to technological change. A business unit or region can enjoy an increased scale of returns obtained from investment returns including investment in human resources. The spillovers of knowledge between producers and the external benefits of human capital do not result in a decrease in yield. Thus, business units or regions capable of mastering more advanced and efficient technology will be able to grow faster [14]. The implications in the form of policies that can be derived from convergence in the context of regional economic growth are that regional income convergence is a special case or conditional in nature. This means that income convergence between regions can or may not be achieved. Convergence of income between regions can occur in view of endogenous growth theory if the mechanism of overflow effects works from one region to another [15]. The form of policy
can be in the form of efforts to distribute income across cities and regencies, requiring strong links with other regions. In line with regional autonomy, the coordination function should be played by the provincial government in synchronizing development programs between regional governments under its subordination [1,7].

Table 3. Regression Output for The Conditional Approach

| Variable                          | Coef.  | Std.Err | Sign | Coef.  | Std.Err | Sign |
|-----------------------------------|--------|---------|------|--------|---------|------|
| CONSTANT                          | 1.114  | 0.651   | *    | -0.433 | 1.029   |      |
| Log(GDRP10perWorkingAge)          | -0.043 | 0.022   | *    | -0.0002| 0.0307  |      |
| Log(I/GDRP)                       | -0.023 | 0.014   |      | -0.0730| 0.0298  | **   |
| Log (n + g + δ)                   | -0.032 | 0.156   |      | 0.0456 | 0.1556  |      |
| Log(School)                       |        |         |      | 0.0902 | 0.0476  | *    |

R-Squared 0.314  Adj R-Squared 0.247  F-Stat 4.726  Prob F-Stat 0.008  Speed of Convergence (%) 0.007  0.00004  Half Time of Convergence 95  19802

Restriction Test

| Stat | Value |
|------|-------|
| F – Stat | 3.587 |
| Prob   | 0.068 |

Sign : α = 1% (***); α = 5% (**); α = 10% (*) | assume : g + δ = 5%

In line with earlier explanation, the GDRP per working age 2010 (GDRP10perWorkingAge) appears on the right-hand side with other control variables. Since the coefficient on the initial GDRP per working age is negative and significant in the restricted conditional convergence model, it indicates the ability for poor regencies/cities to accrue faster than its rich regencies/cities on average. Contrast with the unrestricted conditional convergence model, the coefficient on the initial log of GDRP per working age is negative and not significant, we can argue that there is no indication for poor regencies/cities to grow faster on average than the established regencies/cities. For the restricted conditional convergence model, the speed of convergence amount of 0.007 then it implies that the time to cover the half of initial gap is equal to 95 years. The difference findings show in the unrestricted conditional convergence model, since the sign for the initial log of GDRP per working age is not significantly negative, we get the speed of convergence amount of 0.00004, then we get the huge value for the half of initial gap is equal to 19802.

From this findings, we argue that for every region that has a certain status whether it is included in the rich region or not, this does not guarantee an increase in living standards between rich and poor regions, especially closely related to the process of economic growth. This is due to the dependence on other factors, different typologies for each region. The main thing is in the form of sustainable growth to support economic convergence. When growth rates tend to be high but potentially fragile because they are not supported by human resources, technology, infrastructure, and others; this causes the nominal convergence will not change. As a result, there is no reduction in economic inequality, one good precedent is that the convergence process tends to stagnate [16].
4. Conclusion

We have showed that regency difference in income per capita is the most appropriate method in understanding the convergence in regency in central java. We have arrived in conclusion that convergence in Central Java Province is running slowly, by using the period of observation from 2010 to 2016. Based on our findings, the convergence rate is between 0.007 and 1.053 percent per year, with the implication of the half of life convergence is 66 - 95 years. Although this paper already uses control variables, the convergence rate does not change so much.

Some of the limitations of this paper, (1) the period used is limited so that it could not catch the convergence phenomenon; (2) the specification error because the required data is unavailable and or difficult to construct; (3) the variable measurement error such as use of the average value, perhaps it can be distort the long-term relationship between the variables.

Our expectation that further research can be conducted with focusing much to derived explanation why the independent variable vary across regency to regency in Central Java. Thus, the findings will be very important to analyze the different in growth between regency. In addition, this findings will be a worthy contribution to the convergence study between regency in Central Java Province. Furthermore, as stated before, reducing income disparities will be one of the efforts to reach convergence level. That’s why, we suggest that the provincial government of Central Java will prioritize the development programs with focusing on the under-developed regency.

References

[1] Amalia S K, Santos D B, and Santoso 2018 J. Econ Policy 11(1) 151
[2] Vidyattama Y 2006 Econ. Finance Indones. 54(2) 197
[3] Yulianita A, Susetyo D, Syamsurijal A K, and Azwardi 2017 Int. J. Sci. Res. Publ. 7(7) 439
[4] Dao M Q 2012 Prog. Dev. Stud. 12(1) 77
[5] Tirtosuharto D 2013 The 23rd Pacific Conference of Regional Science Association International (RSAI) and the 4 th Indonesian Regional Science Association (IRSA) Institute (Indonesia: Bank Indonesia)
[6] Berger W, Salotti S, and Sarda J 2017 Appl. Econ. Lett. 25(8) 571
[7] Sumarsono H, Rahmawati F, Hadi Y, Putri R D, and Annisya 2018 J. Econ. Finance 9 (1) 75 - 78
[8] Budiman A, Aiman H, and Yeniwati Y 2018 J. Ecogen 1(3) 511
[9] Maryaningsih N, Hermansyah O, and Savitri M 2014 Bull. Monet. Econ. Bank. 17(1) 61
[10] Matos P V and Faustino H C 2012 Econ. Model. 29(6) 2198
[11] Gomleksiz M, Sahbaz A, and Mercan B 2017 Economies 5(27) 1
[12] Simionescu M 2014 Econ. Sociol. 7(1) 48
[13] Wooldridge J 2013 Introductory Econometrics : A Modern Approach 5th Edition (South-Western: Cengage Learning)
[14] Narayan L 2017 Int. J. Multidiscip. Res. Dev. 4 (7) 436
[15] Matkowski Z, Prochniak M, and Rapacki R 2016 Conference on Economic Tendency Surveys and Economic Policy (Copenhagen: 33rd CIRET)
[16] Haller A P 2019 Econ. Transdiscipl. Cogn. 22(1) 5