Regional Economic Convergence in Sumatera Island: An Analysis by Industrial Sector

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Abstract—This study aims to analyze the economic convergence of industrial sector between regions in Sumatra and analyze the factors that influence the industrial sector growth. The scope of this study is limited to the problems associated with the convergence of economic, industrial sector investment and industrial growth provinces in Sumatra Island. Variables used in the model is the GDP percapita convergence by Province in Sumatra, industrial sector investment by provinces in Sumatra Island from 2000 to 2017. By using estimation result of Regression Convergence Absolut in Sumatra Island, there is statistically influence GDP percapita a year earlier industrial sector significantly affect to GDP percapita industrial sector. The regression coefficient indicates a positive direction, it is mean that the previous industrial sector GDP rise caused by increasing in GDP percapita of industrial sector. Additional variable has a positive effect on the variable investment and labor income percapita, but the industrial sector had a negative effect. The magnitude of the effect of some economic variables that have the effect of low and statistically insignificant, thus the extra few economic variables have no impact on GDP percapita climbed down the overall industrial sector. In general, labor and investment have a significant negative impact toward the GDP percapita of industrial sectors. As for the percapita income is positive but not significant effect on percapita income of the industrial sector.

Keywords: *convergence, industry, GDP, Sumatera Island, economic growth*

I. INTRODUCTION

Economic growth is closely related to economic development. Economic development will drive economic growth, and with the economic growth will accelerate the development process. One interesting issue concerning economic growth is related to the potential convergence of views on the GDP percapita from year to year. Economic convergence is one indicator of success in development. Parameters used in the economic convergence among others, is the percapita income province early against the percapita income of the provincial average.

Convergence occurs when areas with low income (poor areas) are able to grow more rapidly than regions with high income (rich regions), so that the level of prosperity will tend to converge and in turn the prosperity gap is getting smaller [7]. The main challenges faced by local governments is how to build the area with the available resources. Given the limitations of its budget, local governments should be able to attract private investment to develop the regions with well according to the potential and human resources they have in order to provide a stimulus to economic growth, given the economic conditions in Indonesia area when viewed from the GDP.

TABLE I. GDRP PROVINCES IN SUMATRA ISLAND YEAR 2015-2017 (MILLION)

Field Effort	2015	2016	2017
Aceh	25808.45	26941.91	28227.06
North Sumatra	41019.54	44557.76	47963.99
West Sumatra	34630.86	37349.92	40324.28
Riau	102,887.81	104,952.09	105,990.99
Jambi	45580.04	49626.44	54366.37
South Sumatra	41201.28	43444.60	46420.64
Bengkulu	26845.61	29081.41	31368.79
Lampung	31153.72	34142.16	37209.50
Bangka Belitung	44425.08	46436.17	48902.75
Riau Islands	101,148.53	106,781.37	110,310.55

a. *Source: Central Bureau of Statistics, 2013-2017*

Based on Table 1. it can be seen that over the years 2013 to 2017 the GDP in Riau Islands province experienced a significant increase. GDP is the highest occurred in 2017 amounting to 110 billion rupiah. According to BPS [3] the increase is due to the creation of economic conditions both by households, private and regulation / policy of the Government especially the local government can reduce the negative effects of the global economy to the regional economy.

The financial condition of the region is one of the important factors in determining the region's ability to carry out the implementation of development to achieve high economic growth and stable. Local finance has an important role in the implementation of local government.

The importance of the role of the industrial sector on the economy in Sumatra Island is also marked by an increase in business units, as well as labor. Despite the imbalance in the industrial sector between provinces in

Sumatera Island but when viewed from the contribution of the industrial sector of each province, it turns out that the industrial sector in the province of South Sumatra has a chance to lead to a convergence in which areas the role of the industrial sector in the GDP lower able to pursue areas has the role of the industrial sector is high on the magnitude of the GDP in Sumatra.

Looking at these trends, then this study will be analyzed regarding economic convergence between regions in the industrial sector provinces in Sumatra Island and some of the factors thought to have considerable influence on the growth of the industrial sector in the provinces in Sumatra Island, namely GDP percapita, industrial investment industrial sector, and the amount of labor in the industrial sector.

II. THEORETICAL FRAMEWORK

A. Theory of Structural Change

Theory of structural changes concentrate on the mechanisms transfrormasi economy experienced by developing countries, which had more subsistent and focused on the agricultural sector leading to economic structure that is more modern and is dominated by industrial and service sector [4], Two main theories that approach the structural changes that development theory proposed by Arthur Lewis with Hollis Chenery migration theory and the theory of structural transformation.

- *Arthur Lewis Development Theory*

Arthur Lewis development theory basically discuss the development process that occurs between urban and rural areas, which include the process of urbanization taking place in between both places. This theory also discusses investment patterns that occur in the modern sector and also the prevailing wage determination system in the modern sector, which in turn will have a big impact on the existing urbanization.

Lewis assumes that the economy of a country will essentially be divided into two;

1) Traditional Economy; In theory, Lewis assumed that in rural areas, with the traditional economy had a surplus of labor. The surplus is closely related to the main base of the economy which is assumed to be of the traditional economy where the level of living in a state subsistence subsistence economic consequences as well.

2) Economy Industry;It is located in the urban economy, where a sector that is important is the industrial sector. The hallmark of this economy is the high level of productivity of the inputs used, including labor. This implies that the value of the marginal product of labor especially, is positive. Thus, the urban economy will be a destination for workers from the countryside, because the value of the marginal product of labor that is positive indicates that the production function is not at the optimum level that may be achieved.

- *Chenery Pattern of Development Theory*

Analysis of Pattern of Development theory focuses on structural changes in the stages of the process of changes in economic, industrial and institutional structure of the country's economy is growing, which is undergoing a transformation from traditional agriculture to switch to the industrial sector as the main engine of economic growth. Hollis Chenery research conducted on the transformation of the production structure shows that in line with the increase in percapita income, the country's economy will shift from the original rely on the agricultural sector to the industrial sector

In general, countries that have a high population level and basically describes the level of potential demand is high, tend to set up industries that are of import substitution. That is, they produce their own goods that were once imported to and sold in the domestic market. Conversely, countries with a relatively small number of people who are likely to develop industry oriented to the international market

B. Neoclassical Growth Theory

According to the Solow-Swan theory is that economic growth depends on the availability of production factors (population, labor, and capital accumulation) and the rate of technological progress.

Furthermore, according to this theory, the capital-output ratio (capital-output ratio) may vary. In other words, to produce a certain output, it can be used a combination of capital and labor is different. If more capital is used, manpower needed less and vice versa.

Neoclassical growth theory can also be presented in the form of Cobb-Douglass production function, where output is a function of labor and capital. While the rate of technological progress is exogenous. The assumptions used in the model Solow-Swan are returns to scale constant (constan returns to scale), substitution between capital (K) and labor (L) is perfect, and the marginal productivity declining (diminishing marginal productivity) of each input , Then Cobb-Douglass (Arsyad, 2010) are:

$$Yt = Tt. A\ kt.\ Lt\ \beta \dots\dots\dots\dots\dots\dots (1)$$

Where; Yt = production level in t; Tt = level of technology in t; K_t = The amount of capital stock in year t; L_t = The amount of labor in year t; α = increase output created by the increase of one unit of capital

β = the increase of the output created by the increase of one unit of labor

To facilitate the completion of the Cobb-Douglas production function in the regression analysis between the levels of production (Y = Q) by a factor of production capital (K) and labor (L), then the three variables must be expressed in logarithm (Log). So that the Cobb-Douglas production function above can be converted into a multiple linear regression equation between variable Y with variable log loglog K and L:

Multiple Linear Regression equations:

Log Yt = log Tt + α. Log Kt + β. LogLt .... (2)

Then the multiple linear regression equation for each variable log. diderivatifkan to the time period / year (derivatives with dynamic analysis / not static), can be obtained again from the neoclassical economic growth equation Abrahamovit and RM Solow [5].

Neoclassical economic growth equation:

$$\underline{d \log Yt} = \underline{d \log Tt} + α. \underline{d \log Kt} + β. \underline{d \log Lt}$$

$$\quad dt \qquad dt \qquad\qquad dt \qquad\qquad dt$$

ry = rt + α.rK + β .rL ....(3)

Where: ry = national production growth rate; rt = rate of technological growth; rK = level of capital growth; rL = rate of growth of labor; α = role in creating the growth of the capital stock of national production; β = the role of labor in creating a national production growth.

Meanwhile, the neoclassical models also argued about the mobility of factors of production, both capital and labor, in the beginning was substandard. As a result, at the time of capital and skilled manpower tend to be concentrated in the more advanced so that the development gaps tend to widen (divergence). However, if the development process continues, with improvements in the infrastructure and communication facilities, the mobility of capital and labor will be more smoothly. Thus, later after the country concerned has advanced, the development gaps will be reduced (convergence). This estimate is known as the neoclassical hypothesis [10].

In connection with the growth and convergence, Abrahamovits [11] argues that countries with low productivity level has great potential to achieve a high growth rate. Nevertheless, the potential for growth will be weaker if productivity levels are approaching the level of productivity the country that became the benchmark. It shows the process of catch-up.

C. Cumulative causation theory and the concept of Convergence

In 1955, Myrdal named three important conclusions, namely:

1) The world is populated by a handful of countries that are very rich and a large number of countries that are very poor.
2) rich countries implement a continuous economic development, while poor countries progressing very slowly and there is even stagnates.
3) economic inequality chasm between rich countries and poor countries increasingly large.

Based on the principle of cumulative circular causation, unexplained occurrence of economic inequality (international, national and regional). If the circular causation process allowed to work on their own, it will cause the vines expansionary influence on the one hand

(spread effects) and the effects of depletion (backwash effect). Strategy desired government interference is taking actions that undermine policies backwash effects and strengthen the spread effects that cumulative circular causation process leading to the top. Thus further reduce inequality.

III. LITERATURE REVIEW

Research conducted by Lusiawaty Ahmad entitled *Spatial Linkage Analysis of Convergence and Economic Growth Regency / City in Central Sulawesi*. The method used in this research is quantitative using pooled Least Squared method. The results in this study is the first, there is no convergence of economic growth in the districts / cities in Central Sulawesi during the period. These results indicated by standard deviation and coefficient of variation of the GDP percapita is increasing. Secondly, there is a convergence β conducted by absolute convergence and conditional convergence in economic growth in all districts / cities in Central Sulawesi. Third, life expectancy, the average years of schooling and the road has a significant impact on economic growth in the district / city in Central Sulawesi.

Fourth,Research conducted by Anna Yulianita [11] under the title *Human Capital and Economic Convergence in Indonesia: An Empirical Analysis,*Using quantitative research methods. The results showed that all of the provinces in Indonesia is still experiencing divergences. GDP percapita is the beginning of significant and positive impact on conditional convergence (β), an increase in government spending will increase conditional convergence (β). Domestic investment has a positive effect but not significant, significant inflation and negative towards conditional convergence (β), the number of high school graduates is negative and significant conditional convergence (β). The decline in the number of secondary school graduates increases the value of conditional convergence (β).

D. Framework

Based on the theoretical framework and literature reviewapat prepared a simple framework of the factors affecting the growth of the industrial sector is labor, investment, percapita income, population, import substitution. The description can be described schematically in Figure 1
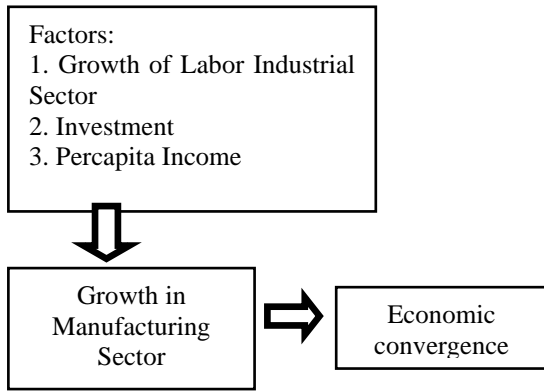
fig. 1. Convergence Analysis Framework Model Industrial Sector Inter-Province in Sumatera

IV. METHODOLOGY

The scope of this study is limited to the problems associated with the convergence of economic, industrial sector investment and industrial growth provinces in Sumatra Island. Variables used in the model is the GDP percapita convergence by Province in Sumatra, industrial sector investment by provinces in Sumatra Island.

The period of observation of economic convergence between regions in the industrial sector of the provinces in Sumatra Island is the period from 2000 to 2017.

The data used in this research is secondary data obtained from various institutions / agencies involved in the issues to be studied are the Central Bureau of Statistics South Sumatra, Bank Indonesia and the results of research and writing as well as other sources that are considered relevant in supporting this research.

Data collection methods used in this study is a literature study and documentation methods. Book study method is derived from the literature in the form of literature, scientific papers, and articles. Documentation method is data collected from agencies or institutions concerned with the issues to be studied.

It contains technical analysis techniques and how that will be done for the measurement and assessment is needed in this analysis. Analytical techniques used are:

To analyze the convergence tendency of the industrial sector in the province of South Sumatra used two measures of convergence used [11]. The first convergence-α or convergence absolute or unconditional convergence (unconditional convergence) is measured by the coefficient of the initial level of the GDP percapita. Convergence-α equation written more simply as follows

$$\log (Y_i, 0 / Y_i, T) / T = a - b \log (Y_i, 0) \ldots\ldots\ldots\ldots (4)$$

Where:

(Yi, 0 / Yi, T) / T	= The GDPpercapita of the regional industrial sector i in the initial sample until the year t divided by period (GDP percapita average)
Yi, 0	= The GDP percapita of the regional industrial sector i in the initial sample
Yi	= The GDP percapita regional industrial sector i in year t
T	= period of time
a	= *intercept*
b	= *Slope coefficient*

Both convergence-β is the coefficient of the initial level of GDRP percapita industrial sector if the rate of growth year GDRP percapita industrial sector regressed against the initial level of the GDP percapita of the industrial sector by combining the control variables that condition the early growth of labor industrial sector, investment sector, the GDP capita industrial sector. B-convergence equation can be written as follows:

$$\log (Y_i, 0 / Y_i, T) / T = a - b \log (Y_i, 0) + c \log (I_i, o) + \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where Ii, o shows the initial condition of the initial conditions in the industrial sector investment in the region i T. A series of dots indicate other variable or variables that are considered also affect the growth rate of the industrial sector in the long term, such as the growth of industrial sector workforce, and the GDP percapita. Equation (4) and (5) regressed by the method of ordinary least squares (OLS) tested at a 99 percent confidence level.

A. Factors Affecting Growth in Industrial Sector in Sumatera

Analysis of factors affecting the growth of the industrial sector provinces in Sumatra Island is done to address the problem and test the second hypothesis regarding the influence of factors related to the industrial sector growth provinces in Sumatra Island.

In this study, analysis of data using multiple regression model with Ordinary Least Square (OLS) derived from linear production function Neoclassical growth model that is Q = f (K, L). Where Q is output, K is the amount of capital and L is labor. Furthermore, by adding other variables that influence the output of formed a complete analysis model, namely:

$$Q = \alpha o + \beta 1\ \beta 2\ K + L + \beta 3 Y + e \ldots\ldots\ldots\ldots (6)$$

Where:

Q	= Real output
K	= investment
L	= Industrial sector workforce
Y	= Percapita Income
α	= constant
β	= coefficient
e	= Error term

B. Stochastic Convergence

developed using Fourier unit root test consists of three steps. For the first step, we estimate the following model:

$$y_{iT} = \alpha_0 + \sum_{k=1}^{G} \alpha_{1\,sin}^{k}\left(\frac{2\pi kt}{t}\right) + \sum_{k=1}^{G} \alpha_{2\,cos}^{k}\left(\frac{2\pi kt}{t}\right) + e_{iT}$$

Here, k indicates the number of frequency, t is a term trend, T is the size until, 3.1416, and $\pi = v_t \sim N(0, \sigma)$ showed that a single frequency in Equation 1 is enough to estimate the Fourier expansion, so Equation 1 can be rewritten as follows:

$$y_{iT} = \alpha_0 + \alpha_1 sin\left(\frac{2\pi kt}{t}\right) + \alpha_2 cos\left(\frac{2\pi kt}{t}\right) + e_{iT}$$

Because the value of k, representing the corresponding frequencies, generally tidakm known as a top priority, Equation 2 should be estimated using all the frequencies in the interval [0,1,0,2,0,3, ..., 4,8,4,9 , 5] and selecting k which gives the minimum value= k of Bayesian information criterion.

Further testing is doneTesting is done by testing the unit root test with H0: = 0 (there is a unit root). The null hypothesis is rejected if the value of the ADF test statistic has a value less (more negative) than the value of local criticism. If the null hypothesis is rejected then the data is stationary. In a regression equation to estimate the model (Nachrowi, 2006) as follows: Y

1) Models with an intercept;

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + a_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \text{.............. (9)}$$

2) Models with an intercept and time trend

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + a_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t ...(10)$$

Where, Δ is the differentiating factor; is the intercept (constant); is the trend of the time; m is the optimal lag period which makes the residual white noises; εt is residual white noise. In the selection of the lag period is also very important to make a precise estimate and the residual white noise. $\beta_1 \beta_2 t$

There are two methods used in this study to select the period (p) the optimal lag (Wang et al, 2010).

1) SBC (Scwartz Bayesian Criterion):
SBC = T ln (SSE) + k ln (T) .... (11)

2) AIC (Akaike Information Criterion):
AIC = T ln (SSE) + 2k .... (12)

Where T is the total number of samples; C is an infinite number of parameters that must be estimated; k is the total amount if the parameters to be estimated; and SSE is the sum of the squares of residuals.

C. Operational Definition of Variables
1) Growth Industry Sector is the increase in the GDP reduced industrial sector GDP the previous year

2) Economic convergence is a process of economic growth in different regions such that the imbalance of regional development will be reduced [11].
3) The GDP percapita is Gross Domestic Product divided by the population in a region and a specific period.
4) Labor is the population of working age who work or have a job but for the moment he is not working and looking for work.

V. RESULT

TABLE II. RESULTS ESTIMATION of CONVERGENCE REGRESSION ABSOLUT in SUMATRA

Variables	Sumatera island		
	Coefficient	t-statistic	Prob.
constants	0.604683	2.945846	0.0037 ***
Log the GDP percapita Preliminary Industrial Sector	0.792026	10.91186	0.0000 ***
F-statistic	178.39		
Prob.F	0000		
R-Square	0.5164		

b. Source: Processed Data, 2019

*** significant at α = 0.01,
** significant at α = 0.05

The Absolute or Convergence Convergence equation α which can be formulated as follows:

LogYt = 0.604 + 0.7920Yt-1

Overall of the equation in Table 1 above shows the positive direction according to the results estimated.

Based on Table 1 shows that the GDP percapita is statistically the influence of previous year industrial sector will significantly affect GDP percapita industrial sector. The regression coefficient indicates a positive direction, meaning that the previous industrial sector GDP rise will cause an increase in GDP percapita industrial sector. In absolute value regardless of economic convergence another variable that is equal to 0.604 percent. To see the trend of other economic variables that affect the convergence of the calculation of conditional convergence by adding a number of variables such as Employment, Investment and percapita income. The preliminary analysis is statistically the relationship of these variables to GDP percapita are shown in Table 3.

TABLE III. CORRELATIONS BETWEEN SOME ECONOMIC VARIABLES WITH THE GDP PERCAPITA OF INDUSTRIAL SECTOR

Variables	Pearson Correlation	Sig
The GDP percapita of Industrial Sector Early Years	0656	0001 **
Labor	-0107	0165
Investation	0048	0534
Percapita Income	0061	0431

c.Source: Processed Data, 2019

** significant at α = 0:01
* Significant at α = 0:05

Based on Table 4. Additional these variables have a positive effect on the variable investment and labor percapita income, but the industrial sector had a negative effect. The magnitude of the effect of some economic variables that have the effect of low and statistically insignificant, thus the extra few economic variables have no impact on GDP percapita climbed down the overall industrial sector. For more details, it can be seen from the graph residual viewed condition that occurs after the additional variables. β convergence equation or Conditional Convergence can be formulated as follows:

$$LogYt = 2.8750 + 0.7102Yt\text{-}1\text{-}0.4243L\ \text{-}0.1138I + 0.15863Ycap$$

Based on the result, the estimation indicate that the general model of employment and investment have a negative and significant effect to the GDP percapita of industrial sectors.
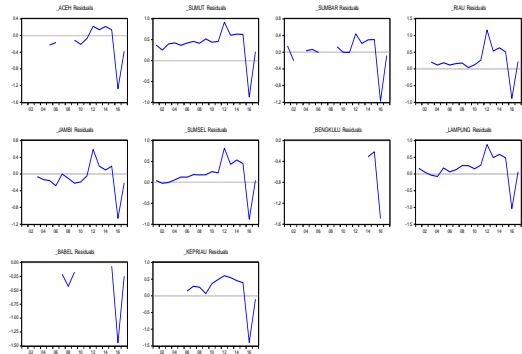
TABLE IV. ESTIMATED REGRESSION CONDITIONAL CONVERGENCE IN SUMATRA(RANDOM EFFECT MODEL)

Variables	Sumatera island		
	Coefficient	t-statistic	Prob.
constants	-3.543311	-2.700540	0.0078 ***
L	0.243517	1.876484	0.0628 *
I	-0.140296	-2.817743	0.0056 ***
Ypcp	1.381628	5.583337	0.0000 ***
F-statistic	11.56965		
Prob.F	0.000001		
R-Square	0.2094		

d.Source: Processed Data, 2019

*** significant at α = 0:01
** significant at α = 0:05

Generally described the changes that occur there are some areas that experienced the upward trend of GDP percapita industrial sectors that previously negative i.e. Lampung province but on the other hand this will lead to a slowdown additional positive trends in some areas of the province of Jambi and Bangka Belitung.

e.Source: Processed Data, 2019

fig. 2. Relations Industry Sector GDRP percapita GDRP Beginning with the Industrial Sector

Based on Figure 7. pointed out that the impact of the addition of these variables did not cause a positive trend in all even add to the negative trend in some areas of the island of Sumatra. From the research there have been absolute convergence in each region of the island of Sumatra. In Table 4 are shown results of estimations Convergence Conditional β or below.

TABLE V. RESULTS OF REGRESSION MODEL ESTIMATION OUTPUT IN SUMATRA *(RANDOM MODEL EFFECT)*

Variables	Sumatera island		
	Coefficient	t-statistic	Prob.
constants	-3.543311	-2.700540	0.0078 ***
Labor	0.243517	1.876484	0.0628 *
Investation	-0.140296	-2.817743	0.0056 ***
Income percapita	1.381628	5.583337	0.0000 ***
F-statistic	11.56965		
Prob.F	0.000001		
R-Square	0.2094		

f.Source: Processed Data, 2019

*** significant at α = 0:01
** significant at α = 0:05
* Significant at α = 0:10

Therefore, we will estimate a model relating the influence of other variables on the Output namely industrial sector GDP. The equation can be seen below.

$$Q = -3.5433 + 0.2435L\ \text{-}0.140296I + 1.3816Ycap$$

Based on Table 4 shows that the result is not much different from the results of conditional convergence. Statistically significant influence both labor, investment and percapita income to the output of the industrial sector. Directions coefficient of investment has a negative effect on the output of the industrial sector. This condition is caused by fluctuating domestic growth which indicates that they lack confidence and reduced secondary commodities that caused investors in the country reducing investments or to invest in the island of Sumatra. In addition, some domestic factors that cause fluctuation is the governance of infrastructure and communication between businessmen and the government still relatively intensive and need to be restyled. Infrastructure is the key factor to achieve higher economic growth. Infrastructure, especially transportation, good will reduce distribution

costs and streamline the economy. While the employment and percapita income and a significant positive effect. This condition occurs due to the positive development trend both industrial employment and the GDP in the region in Sumatra experienced a significant increase.

VI. CONCLUSION

Results Estimation of Regression Convergence Absolut in Sumatra Island was statistically influence GDP percapita a year earlier industrial sector will significantly affect GDP percapita industrial sector. The regression coefficient indicates a positive direction, meaning that the previous industrial sector GDP rise will cause an increase in GDP percapita industrial sector. Additional variable has a positive effect on the variable investment and labor income percapita, but the industrial sector had a negative effect. The magnitude of the effect of some economic variables that have the effect of low and statistically insignificant, thus the extra few economic variables have no impact on GDP percapita climbed down the overall industrial sector. In general, labor and investment have a significant negative impact toward the GDP percapita of industrial sectors. As for the percapita income is positive but not significant effect on percapita income of the industrial sector. And of Results of Regression Model Estimation Output in Sumatra that the result is not much different from the results of conditional convergence. Statistically significant influence both labor, investment and percapita income to the output of the industrial sector. Directions coefficient of investment has a negative effect on the output of the industrial sector.

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