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DYNAMIC PANEL APPROACH OF MANUFACTURE LABOR PRODUCTIVITY CONVERGENCE IN ECONOMIC CORRIDOR OF SUMATERA AND JAVA: CAPITAL-INTENSIVE AND LABOR-INTENSIVE

ALFAN BAHAR AND AISYAH FITRI YUNIASIH*

Abstract. Industrialization is one of the government's focuses in these several years, through the MP3EI Economic Corridor (EC.) Program and industrial zone. As the largest industrial sector contributor, Sumatera and Java EC. is the most important corridor groups in terms of labor productivity. Convergence of labor productivity is expected to occur in the provinces within those ECs, arising from the accumulation process of an efficient and effective learning process. Otherwise, divergence may cause internal migration which affects social-economic problems, radicalization in rural areas, and regional unemployment rate disparities. However, several empirical studies found that there were differences on labor productivity growth by industry characteristics, namely capital-intensive and labor-intensive groups. Then, labor productivity, esp. Large and Medium Scale Industries, are estimated by the dynamic panel approach Sys-GMM which is related to the development of physical capital, human capital, wages, and bank credit structure in 2010-2015. The dynamic panel approach is used to overcome the endogeneity problem which may arise due to the existence of dependent variable lag. The result of the study shows that labor-intensive groups achieve convergence faster than capital-intensive. Meanwhile, variables that affect productivity of the model in Sumatera and Java EC., capital-intensive, and labor-intensive, have different effects. In general, all variables significantly affect labor productivity in Sumatra and Java EC.; physical capital, wages, and bank credit structure in labor-intensive group. While, human capital affects labor productivity in capital-intensive group.

Keywords and Phrases: Convergence, Capital-intensive, Labor-intensive, Manufacture labor productivity, Sys-GMM

1. INTRODUCTION

Industrialization is one of the main government programs at the end of this decade. The Master Plan for the Acceleration of Indonesian Economic Development Expansion (MP3EI) at President Susilo Bambang Yudhoyono's government was formed through a Presidential Regulation Number 32 of 2011 [1]. The program establishes six Economic Corridors (ECs), such as Sumatra, Java, Kalimantan, Sulawesi, Bali – Nusa Tenggara, and Maluku – Papua. Then, the program was developed by the Nawacita program on President Joko Widodo’s government. Article 14 No. 3 2014 concerning about manufacture states that the government and / or regional government is accelerating the equitable distribution of manufacturing development throughout territory of the Republic of Indonesia by industrial zoning. One tangible manifestation of the regional zoning is development of Priority Industrial Zones (KIP) and Special Economic Zones (KEK).

Table 1. Labor productivity of Large and Medium Industries (million rupiah per labor) based on the highest, lowest, Maximum-to-minimum Ratio (MMR) value, and average according to the Sumatera and Java EC., KBI, and KTI in 2015

Economic Corridors/ Zone	Highest Productivity	Lowest Productivity	MMR	Average Productivity
(1)	(2)	(3)	(4)	(5)
Sumatera	3.285,47	831,27	3,96	1.687,50
Java	1.157,30	264,19	4,38	687,27
KBI	3.285,47	264,19	12,47	1.312,41
KTI	2.138,06	193,53	11,05	914,34

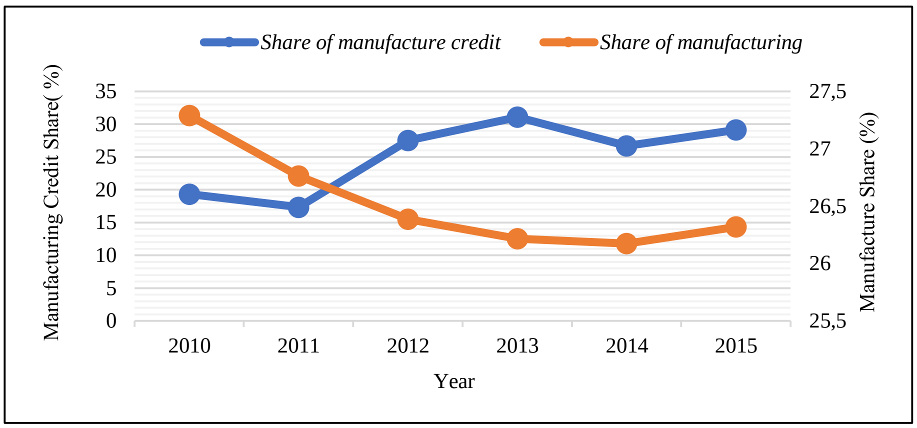
Source: IBS Survey 2015, data processing

In measuring inequality, Shankar and Shah [2] formulated the maximum-to-minimum ratio (MMR). A region has low inequality if the ratio value close to 1. Based on Table 1, Sumatera and Java EC. are the most disperse in labor productivity as they are within KBI (Western Indonesia Zone), which has the highest dispersion compared to KTI (Eastern Indonesia Zone). Even so, the average of labor productivity in Sumatera and Java EC. are the highest among other Economic Corridors, around 1.31 billion rupiah per labor. In addition, the contribution of the manufacturing sector in Sumatera and Java EC. was 89.65 percent of the total contribution in manufacturing sector throughout Indonesia by 2015. It shows that the national economic growth depends on the manufacturing sector in Sumatera and Java EC.. As manufacturing potential in Sumatera and Java, it is needed for labor productivity convergence between provinces. It is intended that all provinces within Economic Corridors benefit from development effects of the manufacturing sector.

The significant inequality and disparity in labor productivity between regions has several impacts. Theoretically, Huber [3] who supported a wage curve in the regional labor market model by Moretti [4] showed that inequality in productivity and amenities would cause imbalances in regional unemployment in a country. In addition, Medve-Balint [5] states that high or continually widening development gaps cause concern for policy makers and academics. That is because, in the long run, regional economic imbalances can cause political unrest and trigger radicalization of citizens living in disadvantaged areas. In fact, regional income imbalances lead to internal migration which creates socio-economic problems [6]. As a result, regional inequality has become an important issue in the growth of a country's labor productivity, which makes labor convergence an idea in reducing such inequality.

Convergence can be interpreted as a condition where underdeveloped regions have a tendency to catch up the backwardness of developed regions. A convergent economy is an economy that is not progressing can reduce the gap income with developed regions each year [7]. Convergence divided into sigma and beta. Sigma convergence is a reduction in cross-sectional dispersion, in per capita income over time [8]. It is usually measured by certain dispersion sizes, such as coefficient of variation. Meanwhile, beta convergence is divided into two, namely absolute and conditional beta. Absolute convergence is related to regression cross-section of revenue growth against initial per capita income, which relies on the assumption that the only cross-economic difference is the initial level of their per capita income. Conditional convergence assumes that differences are mentioned earlier is also related to differences in other factors such as technology, infrastructure, propensity to save, mix industry, and so on.

Companies operating in different industries have different characteristics in terms of size, risk, transparency of information and demand for financial services by the real economy systemically different in different regions at different stages of development [9]. On the supply side, various financial institutions have their strengths and weaknesses to provide financial services to the real economy. Labor-intensive industries are consistent with the comparative advantages determined by its endowment structure. Since labor-intensive businesses are usually smaller, they are more informationally opaque and require less amount of external finance than firms in capital-intensive industries.



Source : Statistics Indonesia dan Financial Services Authority, data processing.
Fig 1. Line graph of manufacture share and share of credit given to manufacture in Sumatera and Java EC. 2010-2015

On the regional side, there are differences in the tendency of the share of manufacturing sector and the shar*e* of bank credit to the manufacturing sector during 2010-2015. Contribution of the manufacturing sector in Sumatera and Jawa EC. tended to decrease, from 27.29 percent in 2010 to 26.32 percent in 2015. Meanwhile, the share of bank credit to the manufacturing sector tended to fluctuate and increase. The increase of credit in manufacturing sector was 9.79 percent, from 19.33 percent in 2010 to 29.12 percent in 2015. In addition, the values of the two indicators which are opposite, and the differences in both values are also likely significant.

Apart from the side of the bank's credit structure, there are differences in characteristics between the two classifications in the productivity and response of each industry group. Manjappa and Mahesha [10] found that the average productivity growth is getting more increased in the capital-intensive industry group, while the labor-intensive industry group the opposite applies. In addition, Leonardi [11] found that wage payments were higher applies to the capital-intensive industry group. Moene and Wallerstein [12] as well stated that reducing salary differences between industries and companies can improve efficiency by accelerating the movement of labor and capital from activities which is less productive towards highly productive activities. On the other hand, labor productivity improvement is the result of investment in physical and fixed capital the formation of physical capital stock [13]. Investment in physical capital stock, related with the adoption of new technology, Che and Zhang [14] argued that human capital stock plays a very important role to increase productivity and economic growth. Some important research objectives to be examined as follows. (1) Describe labor productivity; (2) analyze the effect of wages, physical capital stock, human capital stock, and the structure of bank credit to labor productivity; and (3) analyzing whether sigma convergence and beta labor productivity occur, both at Sumatera and Java EC., labor-intensive group from the manufacturing sector, as well as capital-intensive group. Other than that, one study of labor productivity has been examined by Yuniasih *et al.* [15], which found that physical capital stock, human capital stock, total trade, and real wages found to have a positive influence. Then Lin *et al.* [9] found in the study, empirically, more labor-intensive industries are growing faster than industries capital-intensive in provinces with smaller banks that are more active, compared to provinces with branches of the four largest banks in China being more dominant.

2. METHODOLOGY

Convergence is described by Mankiw [16] as a poor economy will catch up with the developed economy. If convergence is not achieved, countries that were originally poor will remain forever poor. The Solow model predicted when convergence occurs depends on the difference when they start. First, if two an economy with the same steady state as determined by savings rates, population growth rates, and labor efficiency, due historical mistakes so start with a different capital stock. Second, if two the economy has different established conditions, different levels of savings, so there is no need to expect convergence. That is, every economy will approach the steady state itself. Sala-i-Martin [17] defined the convergence of sigma and beta in his research. The negative relationship between productivity growth rates and initial productivity levels will be shows the existence of beta convergence. In other words, convergence occurs if an underdeveloped economy tends to grow faster than a developed one. Convergence sigma says that productivity dispersion across economic groups tends to decrease over time.

2.1 Data

Type of data used in this study is panel data which is a combination of time-series data and cross-section data. The time-series data in this study cover the period 2010-2015, while the cross-section data used are the provinces in the MP3EI Economic Corridors. The provinces in question include DI. Aceh, Sumatera Utara, Sumatera Barat, Riau, Jambi, Sumatera Selatan, Bengkulu, Lampung, Kepulauan Bangka Belitung, Kepulauan Riau, DKI Jakarta, Jawa Barat, Jawa Tengah, DI. Yogyakarta, Jawa Timur, and Banten.

The data used are secondary data in the form of annual publication data of the Large and Medium Industry Survey (IBS) and micro data of the National Labor Force Survey (Sakernas) in 2010-2015 sourced from the Statistics Indonesia (BPS). Other supporting data used include the Provinces in Figures and dynamic tables obtained through the BPS website of each research province and the publication of the Indonesian Banking Statistics (SPI) obtained from the

Financial Services Authority. The following is the data used in the study.

2.2 Operational Definition of Variables

Based on the data collected, several operational definitions of variables are used in this study are as follows:

2.2.1 Labor Productivity

Labor productivity is calculated through real IBS output divided by total labor. Real IBS output data is obtained through total IBS output per province divided by manufacturing deflators. The manufacturing deflator approach uses GRDP of the manufacturing sector at current price divided by GRDP of the manufacturing sector at constant price on 2010 base year. The unit of productivity is output in thousand rupiahs per labor.

2.2.2 Human Capital

Human capital is obtained through the proportion of labor status (laborers/ employees and non-agricultural freelance workers) in the manufacturing sector which graduated from senior high school (SMA) and above. Due to limitations of IBS data, then the data approach is carried out through Sakernas micro data. The depreciation rate is calculated in this variable. The depreciation rate formula is $(n_{it} + g_{it} + \delta_{it})$, where n is the growth rate of labor, g is the growth rate of technological progress, and δ capital depreciation rate. Refers to the assumed value $(g_{it} + \delta_{it})$ of 0.05 by Firdaus and Yusop [18], Yuniasih *et al.* [15] uses these values to be variable divider of physical capital and human capital. Therefore, the variable human capital is in this study, was also restricted to the results with a depreciation rate of 0.05. The value is the unit of human capital stock in decimal fractions as a value proportion.

2.2.3 Physical Capital

Physical capital is approximated by the estimated value of fixed capital goods of machinery and equipment divided by the number of production workers. The real value is obtained by dividing by manufacturing deflator. In addition, physical capital is restricted using the same approach as human capital, which is divided by the degree of depreciation. The unit of physical capital stock is thousand rupiah per production labor.

2.2.4 Real Wages

Real wages are calculated using the basic wage divided by the CPI for each province. The unit is namely thousand rupiah per labor.

2.2.5 Bank Credit Structure

The bank credit structure is approached by multiplying two indicators, namely the bank credit structure and labor intensity. This approach refers to research conducted by Lin *et al*. [9]. Due to limitations and differences in the characteristics of different studies, then modifications were made to the indicator. Bank structure indicators are approached through ratios credit value of commercial banks to non-bank third parties in the processing industry sector by province with total loans disbursed by commercial banks to all business fields per province. Meanwhile, labor intensity is the ratio of total labor to fixed capital. The fixed capital uses the estimated value of all fixed capital goods.

2.3 Descriptive Analysis

Each variable will be described both through the diagram being analyzed in cross-section and time-series as well as comparisons between groups of results regional grouping. To see productivity disparities in Sumatrea and Java EC., this study uses sigma convergence analysis. The sigma convergence is illustrated based on the weighted variation coefficient values observed throughout line diagram. The sigma convergence is illustrated through the weighted variation coefficient. As for the coefficient of variation is modified by weighing the amount of labor as already developed by Akita and Kataoka [19] and used in research Yuniasih *et al.* [15]. The weighted variation coefficient formula is stated as follows.

$$CV = \frac{1}{\bar{\bar{Y}}}\sqrt{\frac{Li}{L}\sum_{i=1}^{n}(Yi-\bar{Y})^2} \quad (1)$$

Where Li is the number of workers of the i province. is the total provincial workforce in the economic group. Yi is the i province's labor productivity. Then, $\bar{Y}$ is the provincial average productivity in the economic group.

2.4 Inference Analysis

According to Baltagi [20], many economic relationships are dynamic and one of the advantages of panel data is that it allows researchers to better understand the dynamics of adjustment. For example, Arellano and Bond [21] on a dynamic work model, Blundell *et al*. [22] about the dynamic corporate investment model, Islam [23] about the dynamic model for growth convergence. This dynamic relationship is characterized by the presence of the dependent variable lagging among the regressors, as follows.

$$y_{it} = \delta y_{i,t-1} + x_{it}'\beta + u_{it} \quad i = 1, \dots, N; t = 1, \dots, T \quad (2)$$

Where δ is a scalar, x_{it}' is $1 \times K$ and β is $K \times 1$. It is assumed that u_{it} follows the one-way error component model as follows.

$$u_{it} = \mu_i + v_{it} \quad (3)$$

Where $\mu_i \sim IID\left(0, \sigma_\mu^2\right)$ and $v_{it} \sim IID(0, \sigma_v^2)$ are mutually independent of each other and within the individual components themselves.

Because lag variables become regressors in the model, Ordinary Least Square (OLS) estimators result biases and inconsistencies in parameter estimation [24]. An alternative approach is to use Generalized Methods of Monents (GMM) to overcome the problem of endogeneity. There are two types of estimates that can be used through the GMM method, namely:

2.4.1 First Difference GMM (FD-GMM)

A dynamic panel data model without independent variables other than a mathematical lag is shown in the following equation:

$$y_{it} = \delta y_{i,t-1} + u_{it} \quad (4)$$

To get consistent estimates of δ with N → ∞ and fixed T, Baltagi [20] used first difference to eliminate individual effects.

$$y_{it} - y_{i,t-1} = \delta\left(y_{i,t-1} - y_{i,t-2}\right) + \left[(u_i + v_{it}) - \left(u_i + v_{i,t-1}\right)\right] \qquad (5)$$

$$y_{it} - y_{i,t-1} = \delta\left(y_{i,t-1} - y_{i,t-2}\right) + (u_i - u_i + v_{it} - v_{i,t-1}) \qquad (6)$$

$$y_{it} - y_{i,t-1} = \delta\left(y_{i,t-1} - y_{i,t-2}\right) + (v_{it} - v_{i,t-1}) \qquad (7)$$

For example $y_{it} - y_{i,t-1} = \Delta y_{it}$; $y_{i,t-1} - y_{i,t-2} = \Delta y_{i,t-1}$; dan $v_{it} - v_{i,t-1} = \Delta v_{it}$. Therefore, these equations can be simplified into:

$$\Delta y_{it} = \delta \Delta y_{i,t-1} + \Delta v_{it} \qquad (8)$$

With the OLS method, the estimation produced on Equation 8 will be inconsistent with the parameter δ. That is because the relationship $y_{i,t-1}$ and $v_{i,t-1}$, even when T → ∞ [25]. Then, Baltagi [20] gave an example with the case t = 3 by including instrument variables that have a strong relationship with $\Delta y_{i,t-1}$, but do not relate to an error whose number depends on t.

$$y_{i3} - y_{i,2} = \delta\left(y_{i,2} - y_{i,1}\right) + (v_{i3} - v_{i,2}) \qquad (9)$$

For t = 4, the equation is stated as follows:

$$y_{i4} - y_{i,3} = \delta\left(y_{i,3} - y_{i,2}\right) + (v_{i4} - v_{i,3}) \qquad (10)$$

Until t = T, the set of valid instrument variables is $\{y_{i,1}, y_{i,2}, \dots, y_{i,T-2}\}$ with the following error matrix.

$$\Delta v_i = \begin{bmatrix} v_{i3} - v_{i,2} \\ \vdots \\ v_{iT} - v_{i,T-1} \end{bmatrix} \qquad (11)$$

With the covariance error matrix as follows.

$$E(\Delta v_i \Delta v_i') = \sigma_v^2 (I_N \otimes G) \qquad (12)$$

For matrix G sized (T-2) × (T-2), expressed as follows.

$$G = \begin{bmatrix} 2 & -1 & 0 & \cdots & 0 & 0 & 0 \\ -1 & 2 & -1 & \cdots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & -1 & 2 & -1 \\ 0 & 0 & 0 & \cdots & 0 & -1 & 2 \end{bmatrix} \qquad (13)$$

Based on a predetermined time period, the matrix diagonally containing valid instrument variables can be expressed by the W_i matrix [20]

$$W_i = \begin{bmatrix} [y_{i1}] & 0 & \cdots & 0 \\ 0 & [y_{i1}, y_{i2}] & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & [y_{i1}, \dots, y_{i,T-2}] \end{bmatrix} \qquad (14)$$

The moment equation for W_i matrix is:

$$(W_i{}' \Delta v_i) = 0 \qquad (15)$$

The one-step consistent estimator by Arellano and Bond [21] is:

$$\widehat{\delta_1} = [(\Delta y_{-1})' W (W'(I_N \otimes G) W)^{-1} W' (\Delta y_{-1})]^{-1} \times$$

$$[(\Delta y_{-1})' W (W'(I_N \otimes G) W)^{-1} W'(\Delta y)] \quad (16)$$

Hansen [26] argued that the optimal estimator for δ_1 ($N \to \infty$ and fixed T) is the moment of restriction, with the optimal weighing matrix as follows.

$$W'(I_N \otimes G) W = \sum_{i=1}^{N} W_i' G W_i \quad (17)$$

For the two-step efficient estimator estimation, the optimal weighing matrix is used as follows.

$$V_N = \sum_{i=1}^{N} W_i' (\Delta v_i)(\Delta v_i) W_i \quad (18)$$

Substitution Δv_i with difference residuals derived from one step consistent estimator obtained two step efficient estimator.

$$\widehat{\delta_2} = [(\Delta y_{-1})' W \hat{V}_N^{-1} W'(\Delta y_{-1})]^{-1} \times [(\Delta y_{-1})' W \hat{V}_N^{-1} W'(\Delta y)] \quad (19)$$

Verbeek [25] developed the estimator used by adding independent variables in addition to the lag of the dependent variable through the following equation.

$$\begin{pmatrix} \hat{\delta} \\ \hat{\beta} \end{pmatrix} = \left([\Delta y_{-1} \Delta X]' W \hat{V}_N^{-1} W' [\Delta y_{-1} \Delta X]\right)^{-1} \times \left([\Delta y_{-1} \Delta X]' W \hat{V}_N^{-1} W' \Delta y\right) \quad (20)$$

The instrument matrix used is:

$$W_i = \begin{bmatrix} [y_{i1} \Delta x'_{12}] & 0 & \cdots & 0 \\ 0 & [y_{i1}, y_{i2}, \Delta x'_{13}] & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & [y_{i1}, \dots, y_{i,T-2}, \Delta x'_{1T}] \end{bmatrix} \quad (21)$$

2.4.2 System GMM (Sys-GMM)

Because FD-GMM is a biased and weak estimator of precision when the number of samples is small, Blundell and Bond [24] developed the GMM System. The reason for this is the instrument used in the weak first-difference equation. Baltagi [20] suggested the Sys-GMM method to be an alternative when FD-GMM does not meet the assumptions.

Sys-GMM is a combination of appropriate first-difference and level dependent equations as instruments, with additional lagged first-differences as instruments. The methods for determining the matrix of instrument variables both Sys-GMM and FD-GMM are the same. The Sys-GMM model equation is as follows.

$$\begin{pmatrix} \Delta y_i \\ y_i \end{pmatrix} = \delta \begin{pmatrix} \Delta y_{i,t-1} \\ y_{i,t-1} \end{pmatrix} + \begin{pmatrix} \Delta v_i \\ v_i \end{pmatrix} \quad (22)$$

Where i: 1, 2, …, N

With instrument matrix variable as follows.

$$Z_{Sys} = \begin{bmatrix} Z_{diff} & 0 \\ 0 & Z_{level} \end{bmatrix} \quad (23)$$

$$Z_{Sys} = \begin{bmatrix} Z_{diff} & 0 & \cdots & 0 \\ 0 & \Delta y_{i,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \Delta y_{i,T-1} \end{bmatrix} \tag{24}$$

2.5 Test Specifications for Dynamic Panel Models

2.5.1 Arellano-Bond Test

This test consists of two hypotheses that test Arellano-Bond components m1 and m2. Arellano-Bond m1 expresses the relationship between first order and error, while Arellano-Bond m1 expresses the relationship between second order and error in each equation. The two of them tested the hypothesis that there is no relationship between error with first order and second order. Baltagi [20] formulated his hypothesis mathematically, namely:

$H_0: E\left(\Delta v_{it} \Delta v_{i(t-j)}\right) = 0$
$H_1: E\left(\Delta v_{it} \Delta v_{i(t-j)}\right) \neq 0$

Where $j = 1,2$

The statistics proposed by Arellano (2009) are as follows.

$$m_j = \frac{\hat{r}_j}{s.e.(\hat{r}_j)} \sim N(0,1) \tag{25}$$

$$r_j = \frac{1}{T-3-j} \sum_{t=4+j}^{T} r_{tj} \tag{26}$$

$$r_{tj} = E\left(\Delta v_{it} \Delta v_{i(t-j)}\right) \tag{27}$$

The critical region rejects H_0 from the calculated statistic, namely when $m_j < -Z_{\frac{\alpha}{2}}$ or $m_j > Z_{\alpha/2}$, when $p - value < \alpha$. The consistency of the model with the GMM method is said to be consistent if the null hypothesis on Arellano-Bond m1 is rejected, while the null hypothesis on Arellano-Bond m2 fails to be rejected.

2.5.2 Sargan Test

The validity of the instrument was tested through the Sargan test [20]. The hypothesis that is tested statistically can be stated mathematically as follows.

$H_0: E(W' \Delta v_i) = 0$
$H_1: E(W' \Delta v_i) \neq 0$

Statistics that used in Sargan test as follows.

$$S = \Delta v' W \left(\sum_{i=1}^{N} W_i' \Delta v_i \Delta v_i' W_i\right)^{-1} W' \Delta v \sim \chi^2_{(g-k)} \tag{28}$$

Where g is the number of instruments and k is the number of parameters. The critical region of reject H_0 from the calculated statistics is when $S > \chi^2_\alpha$ or $p - value < \alpha$. A dynamic panel model with a valid GMM method when there is no relationship between the instrument variable with error or H_0 fails to be rejected.

2.6 Significance Test of Model

2.6.1 Simultaneous Test

Simultaneous test tests the parameters of the dependent variable simultaneously related to the independent variable. Mathematically, the hypothesis can be written as follows.

$H_0: \beta_1 = \beta_2 = \cdots = \beta_k = 0$
$H_1: minimum\ one\ \beta_p = 0$

Where β is the parameter coefficient of the independent variable, k is the number of the independent variable, and p is the pth parameter; p = 1,2, ..., k. Statistics calculated through the Wald test, referring to Nurhamidah and Suhartini [7], are stated as follows.

$$W_{score} = n\widehat{\beta}'\widehat{V}_N^{-1}\widehat{\beta} \sim \chi_k^2 \quad (29)$$

The $\widehat{\beta}$ is the parameter estimation value of one-step efficient estimator or two-step efficient estimator. The critical region rejects H_0 from the calculated statistics which is when $W_{score} > \chi_\alpha^2$ or $p - value < \alpha$.

2.6.2 Partial Test

Partial test examines each parameter of the dependent variable related to the independent variable in the model. Mathematically, the hypothesis can be written as follows.

$H_0: \beta_p = 0$
$H_1: \beta_p \neq 0$

Where β is the dependent variable parameter and p is the pth parameter. The partial test statistic, referring to Nurhamidah and Suhartini [7], is stated as follows.

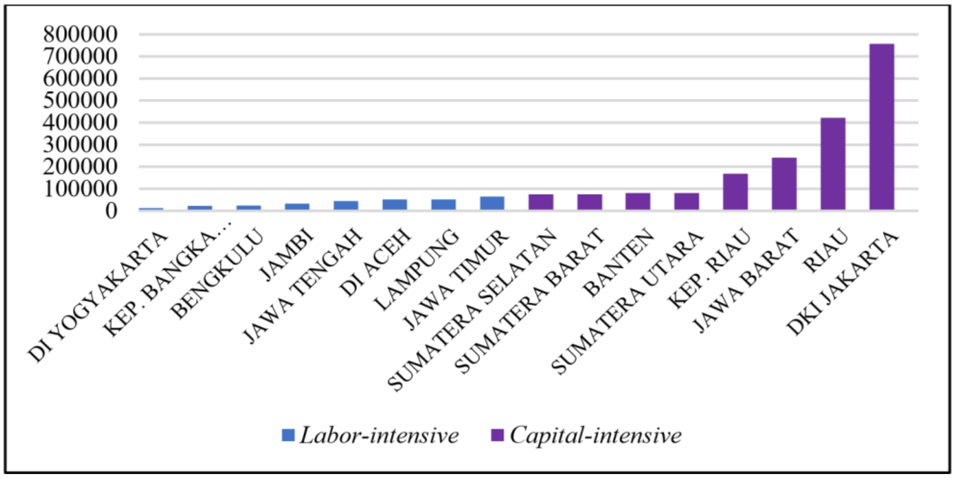
$$Z_{score} = \frac{\widehat{\beta_p}}{s.e.(\widehat{\beta_p})} \sim N(0,1) \quad (30)$$

The $\widehat{\beta}$ is the parameter estimation value of one step efficient estimator or two step efficient estimator. The critical region rejects H_0 from the calculated statistic namely when $Z_{score} < -Z_{\frac{\alpha}{2}}$ or $Z_{score} > Z_{\alpha/2}$, when $p - value < \alpha$.

3. RESULTS

3.1 Overview of the Capital-intensive and Labor-intensive Groups

By a median value of 68.508.28 (in thousand rupiahs), the provinces are divided into two groups, namely labor-intensive with a capital-labor ratio below the median and capital-intensive namely capital-labor ratio above the median. In each group, it appears that the labor-intensive group is more homogeneous in terms of the capital-labor ratio than the capital-intensive group. Among capital-intensive provinces, the capital-labor ratio tends to be higher than the average of the group, namely Kepulauan Riau, Jawa Barat, Riau, and DKI Jakarta.



Source: IBS Survey 2010, data processing

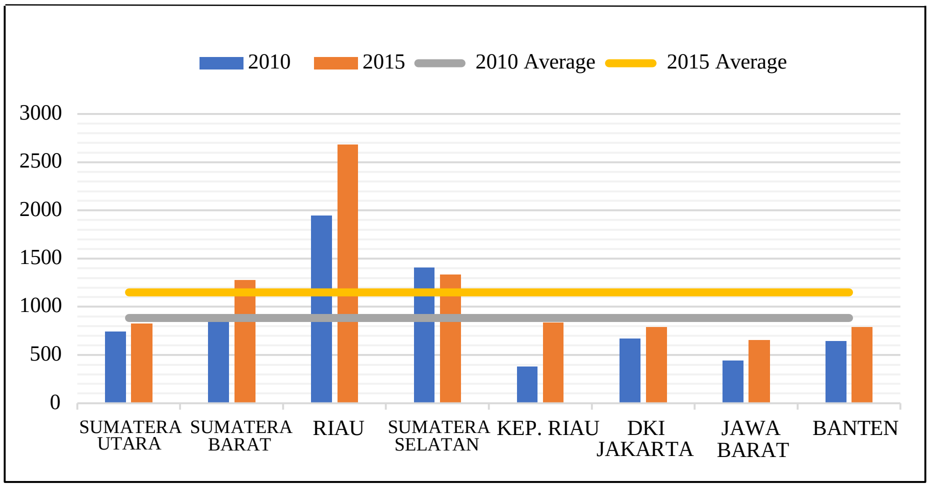
Fig 2. Bar chart of capital-labor ratio (in Rupiah) by provinces in Sumatera and Java EC. 2010

Analyzing the role of the manufacturing subsector in Appendix 2, in general in the labor-intensive group, the contribution of the food and beverage manufacture subsector was most dominant among the other subsectors. Although in some provinces, this subsector is not the highest contributor, but its value is quite significant in the economy. For example, the dominant subsector in the DI. Aceh, namely the chemical, pharmaceutical and traditional medicine industries. Meanwhile, Kepulauan Bangka Belitung is dominated by the basic metal industry. The contribution of the food and beverage industry sub-sector in the two provinces, respectively, amounted to 30.81 percent and 30.96 percent.

Capital-intensive groups are more heterogeneous in the role of the manufacturing sub-sector. Some of the subsectors with the largest contribution in the group are the food and beverage industry and the metal goods industry; computers, electronic goods, optics; and electrical equipment. Meanwhile, the largest manufacturing industry subsector in DKI Jakarta and Sumatera Selatan was the transportation equipment industry and the coal, oil, and gas refinery industry.

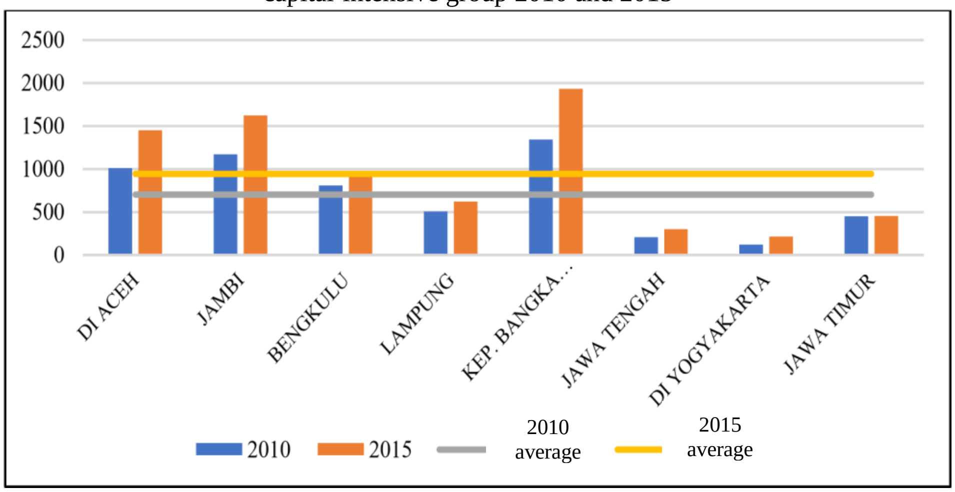
3.2 Productivity Overview of the Manufacturing Industry at Sumatera and Java EC.

Based on the average labor productivity of the IBS capital-intensive group in 2010 and 2015, there was an increase. In 2010, the average IBS workforce productivity group was 885.68 million rupiah per workforce. Then, the average productivity of the IBS workforce increased in 2015 to 1.15 billion rupiah per workforce. Based on the corridor, the average productivity of the IBS workforce in each province in the Java EC. tends to be low, even compared to all provinces in Sumatera EC. is included in the capital-intensive group. In contrast, the majority of provincial IBS workforce productivity is the average in Sumatera EC. is above the group average, both in 2010 and 2015. This shows the average productivity of Economic Corridors IBS workforce in Java is still low compared to Sumatra EC., even though it is in the capital-intensive group.



Source: IBS Survey 2010, data processing

Fig 3. Bar chart of mean IBS productivity (million rupiah per labor) by province in capital-intensive group 2010 and 2015



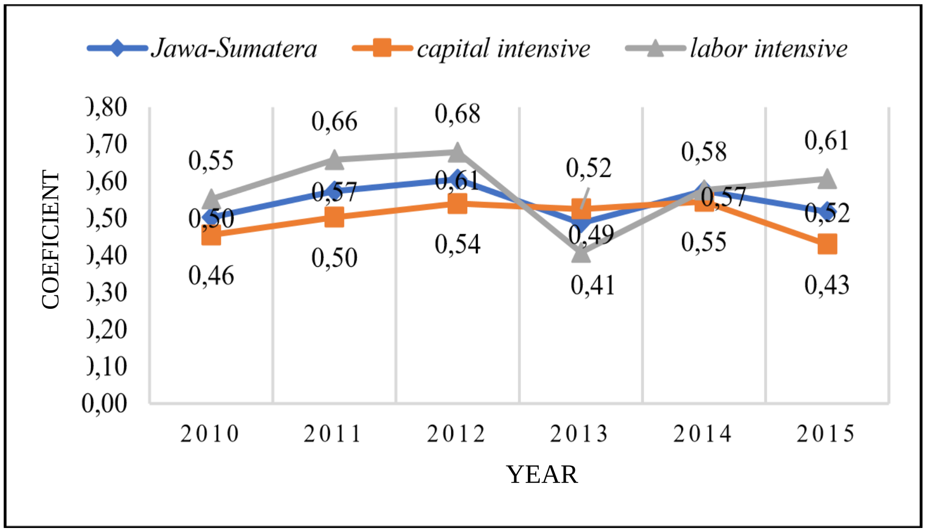
Source: IBS Survey 2010, data processing

Fig 4. Bar chart of mean IBS productivity (million rupiah per labor) by province in labor-intensive group 2010 and 2015

Based on the average labor productivity of the IBS labor-intensive group in 2010 and 2015, there has also been an increase. In 2010, the average IBS workforce productivity group was 702, 06 million rupiah per workforce. Then, the average productivity of the IBS workforce increased in 2015 to 943.19 million rupiah per worker. Average labor productivity of the IBS labor-intensive group in 2010 and 2015 was lower than the average capital-intensive group. When viewed based on the corridor, the average productivity of the IBS workforce in each province in the Java EC. tends to be low, even compared to all provinces in Sumatera EC. is included in the labor-intensive group. In contrast, the majority of provincial IBS workforce productivity is the average in Sumatera EC. is above the group average, both in 2010 and 2015. From Figures 3 and 4 it can be concluded that between the two groups, differences in IBS workforce productivity are still shown through regional or corridor differences.

3.3 Sigma Convergence of Manufacturing Productivity in Sumatera and Java EC.

The coefficient of variation is one indicator of inequality which is a development of the Williamson index. The greater the coefficient value indicates the growing inequality between the provinces in the group, and vice versa. Sigma convergence occurs when the coefficient of variation varies from year to year.



Source: IBS Survey 2010, data processing

Fig 5. Line graph of weighted labor productivity coefficient variation in Sumatera and Java EC. 2010 - 2015

In general, Sumatera and Java EC. in 2010 had a dispersion value of 0.50, which showed that productivity trends within the group varied considerably close to the high dispersion limit. The dispersion limit is said to be high if the coefficient of variation exceeds 0.50 [28]. Although the tendency of the coefficient of variation after 2010 increased, the movement of the value throughout 2013 to 2015 tends to fluctuate. In 2015, the coefficient of variation in Sumatera and Java EC. as a whole show a high value of 0.52. This means that there is no sigma convergence among the provinces as a whole at Sumatera and Java EC. during that period.

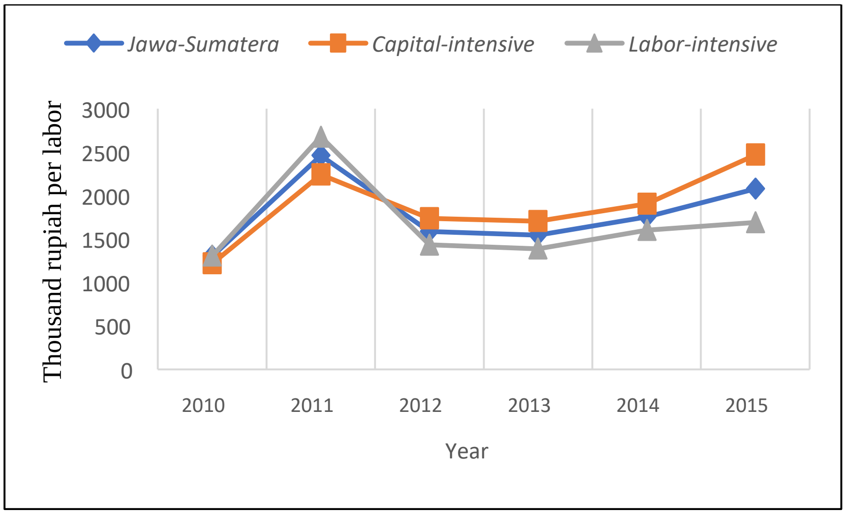
The coefficient of variation in capital-intensive groups in 2010 tended to be low at 0.46. After 2010, the coefficient movement tends to increase until 2014 with a coefficient of variation of 0.55. Then, the coefficient of variation tends to decrease in 2015 with a value of 0.46. Based on Figure 16, it can be seen that the provincial group line graph with the capital to labor ratio above the median is below the overall provincial group line graph. Therefore, it can be concluded that there is a sigma convergence among the provinces in the capital-intensive group. Provinces in Sumatera EC., in general, tends to experience an average decline in the productivity of the IBS workforce. Meanwhile, the provinces in Java EC. experienced an increase in the average productivity of the IBS workforce.

In addition, the coefficient of variation in the labor-intensive group in 2010 was highest among the other groups, amounting to 0.55. The coefficient of variation during 2010-2015 tended to increase at the value of 0.61 (in 2015). If seen from the coefficient of variation from 2010 to 2013, the labor-intensive group converges to sigma convergence. The decrease in the coefficient of variation from 0.55 to 0.41 was due to a disparity in productivity among the groups that was decreasing, so that the difference in the average provincial productivity and the average productivity of the group had decreased in 2013. In addition, Jawa Tengah Province, which is the lowest productivity in the labor-intensive group, experienced a large increase in output due to an increase in the value of intermediate goods stocks and other revenues from non-industrial services. More specifically, the increase was due to the textile and tobacco sub-industry. In 2012, the difference between the stock of the semi-finished tobacco industry was 2.81 billion rupiah, so that in 2013 it became 224.76 billion rupiah. Meanwhile, other revenues from non-industrial services by the textile sub-industry amounted to 286.46 billion rupiah in 2012 to 5.81 trillion rupiah in 2013.

3.4 Real Wage Overview of the Manufacturing Industry Sumatera and Java EC.

The tendency of real wages to increase significantly from 2010-2015, both as a whole, and by region grouping. Based on BPS data, a significant increase in wages was marked by the largest growth rate of the y-o-y manufacturing sector during 2011-2015, which was 6.26 percent. The high growth rate was due to the non-oil and gas processing industry sub-sector, which grew 7.46 percent with the contribution of the base metal industry increasing to 25.19 percent. This is in accordance with Ricardo's opinion that the increase in production due to high profit increases will create a high increase in capital [29]. The increase in capital was followed by additional labor demand that was stimulated by high wage increases.

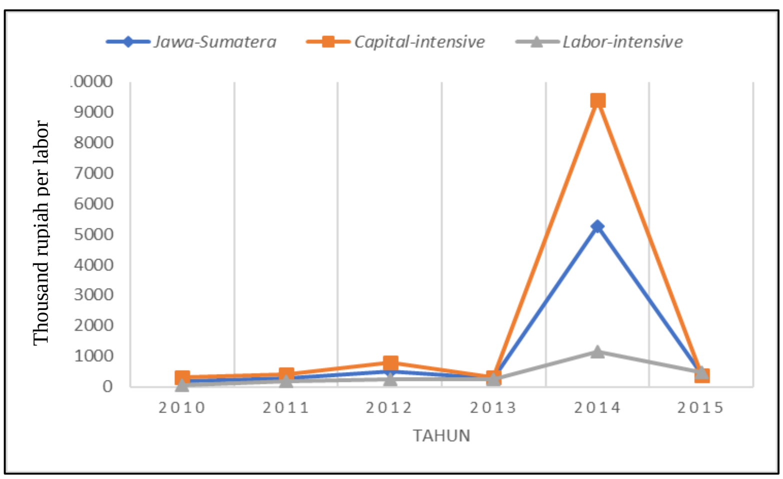
The average monthly real wage in 2010 in the Sumatra and Java EC. was 1.31 million rupiah. Meanwhile, the average real wages per month in the capital-intensive and labor-intensive groups were 1.22 million rupiah and 1.31 million rupiah, respectively. Initially, the average wage for capital-intensive provincial industrial labor was smaller than labor-intensive during 2010-2011. Towards the years 2012 to 2015, the average wages of both of them overlap with the average wages of capital-intensive industry industrial labor force greater than labor-intensive. In fact, the difference between the two grew bigger throughout the year.



Source: IBS Survey 2010, data processing
Fig 6. Line graph of labor real wage (thousand rupiah/month) in Sumatera and Java EC. 2010 - 2015

3.5 Physical Capital Overview of the Manufacturing Industry at Sumatera and Java EC

In general, the average tendency of IBS physical capital stagnated in 2010 towards 2015. However, fluctuations throughout the year were shown by changes in 2012 to 2014. Significant increases in peak were in 2014, both in the capital-intensive and labor-intensive groups. However, there were significant differences throughout this period in which capital-intensive provinces had a significant accumulation of gross fixed capital.

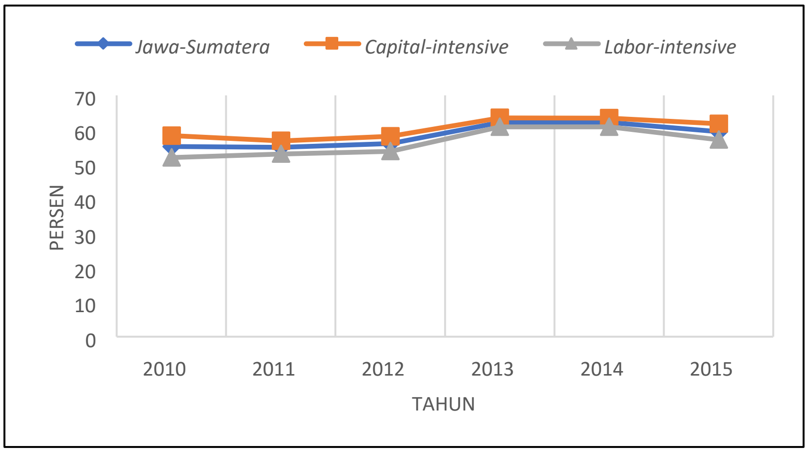


Source: IBS Survey 2010, data processing
Fig 7. Line graph of estimated total physical capital (thousand rupiah/labor) in Sumatera and Java EC.2010 - 2015

Some causes of the increase in capital expenditure are influenced by external and domestic influences. The cause of the significant increase was inward investment from both Foreign Direct Investment (PMA) and Domestic Investment (PMDN) in the food industry. In 2014, investment from foreign direct investment rose about 50 percent from the previous year, with a value of 3,139.60 billion USD.

3.6 Human Capital Overview of the Manufacturing Industry at Sumatera and Java EC.

The tendency to increase slowly is actually shown by the percentage of IBS workers with high school education and above. In 2010-2015, consistently, the percentage of IBS workers with a minimum of high school education in the capital-intensive group was greater than the labor-intensive group. Based on the review in the economic corridor, the percentage of 55.18 percent shows the low quality of human capital to encourage productivity in the processing industry. The difference between capital-intensive groups that are not much different from the labor-intensive groups indicates a fairly homogeneous condition in terms of education fulfillment in both groups.



Source: IBS Survey 2010, data processing

Fig 8. Line graph of IBS labor percentage with high school education and above in Sumatera and Jawa Economic Corridors 2010 - 2015

The main cause is illustrated by the general educational conditions in each group. From the Human Development Index component, the average school length indicator is relevant as an illustration of the education. Based on group mean value, the capital-intensive group (7.76 years) is higher than the labor-intensive group (8.46 years). Both the maximum and minimum groups, the difference between the two is not significant, each different 1.70 years and 0.74 years. It can be concluded, the 12-year learning program in both groups in general has not yet been realized. This also reflects the low number of highly educated industrial workers in Figure 8.

3.7 Sigma Convergence of Manufacturing Productivity in Sumatera and Java EC.

Table 2. Dynamic Panel Sys-GMM Model Estimation in Sumatera and Java EC., *Labor-intensive*, and *Capital-intensive Group*

Variable	Sumatera and Java		*Labor-intensive*		*Capital-intensive*	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln_Produktivitas (t-1)	0,558	0,000*	0,590	0,000*	0,515	0,074**
ln_ModalFisik	0,155	0,000*	0,160	0,000*	0,223	0,166
ln_ModalManusia	1,128	0,000*	0,884	0,308	1,189	0,094**
ln_Upah	0,363	0,000*	0,402	0,067**	0,342	0,208
ln_StrukturKredit	0,154	0,000*	0,165	0,000*	0,206	0,166
Implied λ	0,074		0,077		0,069	
Half-time convergence	9,379		8,968		10,011	
Wald	163062,000	0,000*	15116,060	0,000*	96234,610	0,000*
m1	-2,050	0,040*	-1,775	0,076**	-2,000	0,045*
m2	1,051	0,293	1,157	0,247	0,391	0,696
Sargan	13,963	0,377	4,829	0,979	6,137	0,941

Significance : * 5 percent; ** 10 percent.

The equation for each group can be stated as follows:

Sumatera dan Java Economic Corridor

$$\ln(\widehat{Produktivitas_{it}}) = 0{,}558\ln\left(Produktivitas_{i,t-1}\right)^{*} + 0{,}363\ln(Upah_{it})^{*} + 0{,}155\ln(ModalFisik_{it})^{*} + 1{,}128\ln(ModalManusia_{it})^{*} + 0{,}154\ln(StrukturKredit_{it})^{*} \quad (55)$$

Labor-intensive group

$$\ln(\widehat{Produktivitas_{it}}) = 0{,}590\ln\left(Produktivitas_{i,t-1}\right)^{*} + 0{,}402\ln(Upah_{it})^{**} + 0{,}160\ln(ModalFisik_{it})^{*} + 0{,}884\ln(ModalManusia_{it}) + 0{,}165\ln(StrukturKredit_{it})^{*} \quad (56)$$

Capital-intensive group

$$\ln(\widehat{Produktivitas_{it}}) = 0{,}515\ln\left(Produktivitas_{i,t-1}\right)^{**} + 0{,}342\ln(Upah_{it}) + 0{,}223\ln(ModalFisik_{it}) + 1{,}189\ln(ModalManusia_{it})^{**} + 0{,}206\ln(StrukturKredit_{it}) \quad (57)$$

Statistically, three group models meet the criteria for estimation using the Sys-GMM method. First, the full model criteria tested through the Wald test rejects null hypothesis, which shows at least one significant variable in the model.

Sumatera and Java EC., labor-intensive, and capital-intensive are respectively significant at the 5 percent significance level. Second, the Arellano-Bond test m1 and m2 have the hypothesis that there is a relationship between first-order and second-order with errors in the first difference equation. All three models are required to meet the desired Arellano Bond test criteria, i.e. first order is related to the first difference equation error (reject H0). Meanwhile, the second order is not related to the first difference equation error (failed to reject H0). Each of the three models fulfills the Arellano-Bond test with a significance level different according to Table 2. Third, the Sargan test hypothesizes that there is no relationship between instrument and error. The instrument is said to be valid if the null hypothesis fails to be rejected. All three models also show the same results, namely failing to reject the null hypothesis.

The productivity lag coefficient is less than 1, which indicates the occurrence of conditional beta convergence in all provinces in Sumatera and Java EC., capital-intensive, and labor-intensive group. With the convergence rate obtained from the formula $\lambda = \frac{[\ln(b+1)]}{T}$, where b = lag coefficient and T = time span of the research, so the rate of productivity in the Sumatera and Jawa Economic Corridor at 7.40 percent per year. As for the half time convergence = $\frac{\ln 2}{\lambda}$, time needed for the provinces to cover half of initial gap in productivity to their steady state, which is for 9.38 years. These results were slightly different from Yuniasih *et al.* [15], which examined convergence of overall labor productivity in Indonesia, it took 10.63 years to cover the provincial disparity with each steady state. Meanwhile, the provinces to cover half the gap in initial productivity to their steady state, which is 8.97 years with a convergence rate of 7.70 percent per year in the labor-intensive group. In the capital-intensive group, at a rate of 6.90 percent per year, the time needed for the provinces to cover half the gap in initial productivity to their steady state for 10.01 years each. The difference in convergence speed tends not to be significantly different between the two. However, it can be concluded labor-intensive groups are faster in the process of convergence of productivity.

Based on the physical capital stock which is approximated by the estimated capital type of machinery and equipment divided by the production labor, it shows that only the Sumatera and Java EC. model and labor-intensive group that have a significant and positive effect on labor productivity at a significance level of 5 percent. An increase in the ratio of machinery and production equipment to production labor by 1 percent at Sumatera and Java EC., will increase productivity by 0.155 percent. Meanwhile, a 1 percent increase in the ratio of machinery and production equipment to production labor in the labor-intensive group will increase productivity by 0.160 percent. Harrod-Domar argued in Sukirno [29] that lack of investment will slow down the process of economic growth. Ismail [18] stated that a higher capital-labor ratio is associated with a higher level of technology. Surely both opinions are in accordance with Solow's theory refined by Romer that technology increases productivity obtained through the learning process.

Meanwhile, human capital approached through manufacturing industry workers with a minimum of high school education shows different results from physical capital. Sumatera and Java EC. and the capital-intensive group are significant and positive at the 5 percent and 10 percent significance levels. Every 1 percent increase in the workforce with a minimum of high school education will increase 1.128 percent of productivity in Sumatera and Java EC. Meanwhile, an increase of 1 percent of the workforce with a minimum of high school education would increase productivity in the capital-intensive group by 1.189 percent. The variable of human capital is the biggest on affecting labor productivity. Provinces in the capital-intensive group need to increase their human capital to support high fixed machine capital. As has been explained through the new endogenous growth theory, technological progress is achieved by the accumulation of increased human resources. After that, investment tends to be directed at increasing physical capital. As a result of a combination of the two, national income is high. In addition, Che and Zhang [14], related to industrial companies, stated that an increase in highly educated workers could enable companies to carry out various innovative activities. First, companies can enhance their own research and development (R&D) activities to facilitate the assimilation of newly imported high-tech equipment, to improve production processes and organizational practices, and to improve existing and create new products. Second, training is more valuable for workers who are better educated with higher learning abilities, so companies may allocate more worker training, which is also needed to install, operate, maintain, and improve new production equipment. This activity is related to process innovation and product innovation for increasing productivity.

Wage variable shows the results that the Sumatera and Java EC. and labor-intensive influential significantly and positively at the significance level of 5 percent and 10 percent. At Sumatera and Java EC., 1 percent increase in real wages will increase productivity by 0.363 percent. Meanwhile, 1 percent increase in real wages would increase productivity by 0.402 percent in the labor-intensive group. Of course, this is due to the industry's dependence on high labor, causing productivity to be increased through wage increases. This empirical finding is in accordance with Tjiptoherijanto [30] which stated that an increase in wages will stimulate productivity. An empirical study by Leonardi [11] found that the tendency of capital-intensive industries to pay higher wages has been documented by Katz and Summers [31] in the context of wage differentials between industries. Of course, this is related to the findings of this study that the payment of higher wages is in the capital-intensive group, in a regional context. The reason is that labor-intensive groups, which are predominantly in the food and beverage industry sub-sector, should consider increasing workers' wages for increased productivity. Moene and Wallerstein [12] stated that reducing the disparity of salaries between industry and factories can increase efficiency by accelerating the movement of labor and capital from low to very productive activities. In addition, narrowing of wage dispersion can increase cohesiveness, where company cohesiveness can increase productivity [32].

Then, the credit structure which is the interaction between the capital-labor ratio and the share of credit provided by banks to the industrial sector, has a significant and positive effect on the Sumatera and Java EC. and labor-intensive group were significant at the 5 percent significance level. This is consistent with an empirical study by Lin *et al.* [9] that bank credit has a better effect on the labor-intensive group compared to the capital-intensive group. The reason is that the industry size structure shows that it is an inaccurate measure of the banking sector that causes funds to be disproportionately allocated to industries that are more capital intensive while industries that are more labor-intensive that are consistent with economic comparative advantage, more labor than capital stock, cannot get enough financial support. This is also proven based on a descriptive analysis that the capital-intensive group is given a greater proportion of credit than the labor-intensive group, but the increase in physical capital tends to be significant in the labor-intensive group.

4. CONCLUDING REMARK

Based on the discussion in the previous chapter, the following can be concluded.

a. The average productivity of IBS workers in the Sumatera and Java EC. tends to vary from 2010 to 2015, both in the aggregate as well as capital-intensive and labor-intensive groups. In addition, the increase in average productivity also occurred in this period, where the average productivity of the capital-intensive group was higher than the average of the labor-intensive group.
b. In the Sumatera and Java EC., real wages, physical capital stock, human capital stock, and bank credit structure significantly and positively affect the productivity of the IBS workforce. While, real wages, physical capital stock, and bank credit structure significantly and positively affect the productivity of the IBS workforce in the labor-intensive group, whereas only the variable of human capital stock that is significant and positively influences the productivity of the IBS workforce in the capital-intensive group. The credit structure tends to be active in the labor-intensive group because capital is quite low in the group, while the capital-intensive group is not significant.
c. There was a convergence of sigma and beta in the Sumatera and Java EC., capital-intensive and labor-intensive groups. The sigma convergence in the labor-intensive group was seen in 2010-2013 while the capital-intensive group showed the convergence of sigma in 2010-2015. The conditional beta convergence of labor productivity in Large and Medium Industries (IBS) shows that the group that has the fastest convergence speed is the labor-intensive group, compared Sumatera and Java EC. and the capital-intensive group. The homogeneity of priority sub-industries in the labor-intensive group, drives the acceleration of convergence.

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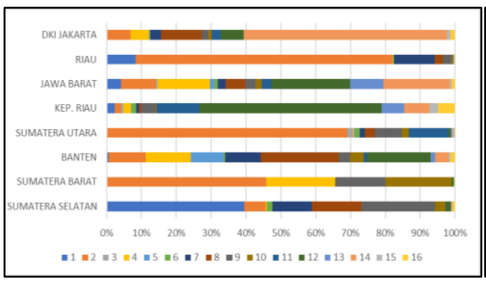
APPENDIX

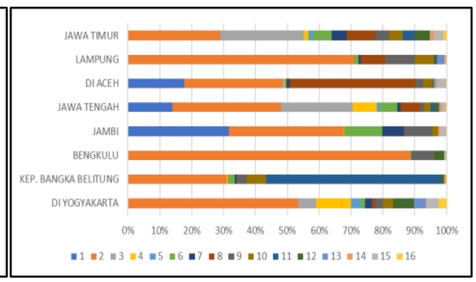
Appendix 1. Classification of the Manufacturing Industry Subsector

(1) Coal Industry and Oil and Gas Refinery. (2) Food and Beverage Industry. (3) Tobacco Processing Industry. (4) Textile and Apparel Industry. (5) Leather Industry, Leather Goods and Footwear. (7) Paper and Paper Goods Industry; Printing and Reproduction of Recording Media. (8) Chemical, Pharmaceutical and Traditional Medicine Industries. (9) Rubber Industry, Rubber and Plastics Products. (10) Non-Metal Mining Industry. (11) Basic Metal Industry. (12) Metal Goods Industry; Computers, Electronics, Optics; and Electrical Equipment. (13) Machinery and Equipment Industry (not included in others). (14) Transportation Equipment Industry. (15) Furniture Industry. (16) Other Processing Industries; Repair and Installation Services of Machinery and Equipment.

Appendix 2. Diagram of Subsector of Manufacturing Industry Added Value Contribution by Province in the Capital-Intensive (a) and Labor-Intensive (b) Groups in 2015



(a)



(b)

Source: Dynamic Table and GRDP (Industrial Origin) by Province Publication, data processing

ALFAN BAHAR: Politeknik Statistika STIS.
E-mails: 15.8486@stis.ac.id

AISYAH FITRI YUNIASIH: Politeknik Statistika STIS.
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