

Identifying club convergence of regional wage in Indonesia and the influencing factors

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Abstract

This paper aims to empirically evaluate regional wage convergence of 34 Indonesian provinces. By applying the club convergence technique (Phillips and Sul, 2007, 2009) on the proxy of real wage data at province level from 2008-2020, we find three significant convergence clubs of regional wage. Furthermore, we explain the influencing factors of club convergence formation. Estimates from ordered logit model inform that the formation of club convergence is significantly explained by the following variables: initial level of wage, share of employment on manufacturing sector, investment share to GDP and labor force participation rate. Our findings support the evidence from most of club convergence studies that emphasize the role of initial condition and regional characteristics on the formation of club convergence. From a policy perspective, our result of multiple convergence clubs and their influencing factors should alert the national and regional policymakers to redesign appropriate strategies meant to increase the economic and social cohesion at regional level.

Keywords: regional wage, club convergence, ordered logit model

1. Introduction

Modern economic theories predict that labor that have same skills will earn equal payments in a fully integrated labor market (Hicks, 1963; Marhsall, 1920). This theory of equalization in pay differentials is reminiscent of the so-called 'law of one price'. The law of one price stating that the price of an identical asset or commodity will have the same price globally, regardless of location, when certain factors are considered and that theory frequently used in research on convergence in commodity prices (Federico, 2012) is also a useful metaphor for the labor market (Galizia, 2015; Rosenbloom, 1998; Rosenbloom & Sundstrom, 2002).

Furthermore, there is another study find that the convergence in country wages was not caused by the mechanism attributable to 'the law of one price' alone, rather, it was caused by markets and institutions interchangeably (Prado et al., 2020). In the other hand, another study also find that labor markets of the past have failed to confirm the theory which predict small wage differentials among workers and geographic locations, provided that human capital does not vary much because there is consistent evidence that large wage differentials across space were commonplace (Collin et al., 2019).

In Indonesia, topic about wage convergence or income disparity is very relevance because it often becomes the main factor for many people do the migration which increased in the last few years. Based on theory, economy is one aspect that could influence migration and several theories that underlie this among them were delivered by Mantra (1992) and Todaro & Smith, (2003). Both agree that economic motives are one's reasons do the migration, especially migration from rural to urban areas. Work as a sources of economic livelihoods become a push factor if there is no work with feasible wages available in origin area. Indonesian Central Bureau of Statistics recorded that the percentage of population in urban areas on 2020 is 56.7% increase from 2010 which only 49.8%. Furthermore, that percentage projected to increase up to 66.6% in 2035, due to massive development in urban area which requires a lot of workers. Another study from Indonesian Central Bureau of Statistics shows that the number of lifetime migrants on 2019 in Indonesia is up to 29.8 million people with migrant workers of 5.4 million people. Java Island dominates the population of migrants in Indonesia, with around 51.2% of lifetime migrants and 56.5% of migrant workers residing in Java Island. The high number of migrants in Java is mainly influenced by wage condition, living cost, and the availability of living facilities. Other than that,

depth analysis about wage convergence is supposed to be an answer from the high number of Gini ratio in Indonesia.

Examining wage convergence across regions in Indonesia is also appealing for at least two following reasons. First, it can enrich the literature by providing a comparative study on wage convergence in a developing country like Indonesia with a large diversity and unique geographical condition compared to the other countries. Second, wage convergence analysis often unveils hidden patterns and is thus useful in understanding critical issues such as the degree of market integration among regions and the role of spatial factors especially in diverse archipelago country like Indonesia (Aginta, 2021).

The focus of this paper lies on convergence analysis of the long-run behavior of regional wages in Indonesia and its influenced factors. Despite numerous studies on regional income convergence, little is known about regional wage convergence in Indonesia. Furthermore, in this paper we use average net income per month of employee and laborer in 34 provinces from 2005-2020 as main indicator instead of regional minimum wage (UMR). In many cases, regional minimum wage usually influenced by local government policy and other unconditional factors, so it does not optimally represent the real market situation. We also remove the effect of inflation on regional wage by converting the data from nominal into real term using provincial Consumer Price Index (CPI) of 2005 as the base.

By applying club convergence technique (Phillips & Sul, 2007), we find three significant convergence clubs of regional wage. Interestingly, the composition of the clubs by using real wage is very similar to the one we obtained by using nominal wage, implying the existence of price-adjusted mechanism in regional wages. Provinces that converge into the higher wage clubs (club 1 and club 2) have similar characteristic where there are many national strategic projects are being built and have high traffic of migrant workers. Our further analysis using ordered logit model suggests that the formation of club convergence is significantly explained by the following variables: initial level of wage, share of employment on manufacturing sector, investment share to GDP and labor force participation rate. Our findings reveal that investment and manufacturing share to GDP have significant role to determine the club formation. These findings also confirm the assumption of similar characteristics from those are as mentioned above.

The remaining of this paper is organized as follows. In Section 2 we review related literature and in Section 3 we discuss the methodologies and data. Section 4 presents and

discusses our results on the formation of convergence clubs and the influencing factors. Finally, Section 5 concludes the paper with remarks.

2. Literature review

2.1. Previous studies on wage convergence

Analyzing wage convergences within a country has some benefits. The main benefit is it will improve and provides a deeper understanding of wage dynamics across different regions. In a labor market context, the 'law of one price' would entail wages across workers and locations would converge as transports and communication technologies increase labor mobility (Prado et al., 2020). Several studies provide evidence that regional wages seem to have converged since pre-industrial times, whether for the distribution of wages across space in the late twentieth and the early twenty-first century was rather flat (Collin et al., 2019). However, another study shows the empirical implication of the law of one price in a labor market context is that wages will converge across space in line with huge improvements in transports and communications expanding the geographical extent of labor markets. In the absence of migration barriers, migration from low-wage regions to high-wage regions tends to decrease regional wage differentials (Collin et al., 2019). Based on that study, there should be an interesting finding in Indonesia due to the vast transportation and communications infrastructure development in the last decade. One of proofs rapid development of transportation infrastructure in Indonesia was shown by the number of airports in Indonesia which increase from 148 unit in 2004 to 235 unit in 2018. As a result, the traffic of domestic passengers was skyrocketing during that period from 34 million passengers per year in 2004 to 94 million passengers per year in 2018. Meanwhile, there is also a rapid development in communication infrastructure due to massive base transceiver station (BTS) construction which built by Indonesia's telco state-owned enterprise from only around 26 thousand unit in 2008 to 231 thousand in 2020.

On the other hand, our research also possible to examine which factors are the driving forces behind the formation of multiple steady states of wages across Indonesia regions. Some studies have investigated whether initial conditions put forward by a certain class of theoretical models (e.g., Azariadis & Drazen, 1990) are responsible for the observed convergence clubs. Moreover, in order to address that issue, there is a study that propose a two-step procedure consisting of first step which endogenously identify groups of regions that converge to the same steady state level and the second step investigating the role of starting conditions for club

membership while controlling for the regions' structural characteristics (Bartkowska & Riedl, 2012). That study also is most closely related to the work of Corrado et al. (2005), who analyze per capita income across European NUTS1 regions (where NUTS stands for Nomenclature of Territorial Units for Statistics). Based on their study, convergence clubs are determined endogenously using cointegration test proposed by Hobijn & Franses (2000). Furthermore, from the work of Bartkowska & Riedl (2012) reveals that European regions form six separate groups converging to their own steady state paths. Their finding states that starting conditions such as a region's initial level of human capital and per capita income, can indeed explain to which club it will belong, hence they conclude that initial condition play a crucial role in determining a region's equilibrium steady state level.

2.2. The present paper's contribution

The present paper brings a huge contribution for the existing literature as none of the studies have analyzed the club convergence of real wages in Indonesia. Previously, there are several studies examine convergence in Indonesia but mainly focused in GDP per capita and total GDP in each province. The study by Firdaus & Yusop (2009) examines income convergence among provinces in Indonesia using dynamic panel data approach. The results show that static and dynamic panel data approaches produce different results of convergence patterns. Furthermore, their study showed that convergence process prevails among provinces in Indonesia for the period 1983 – 2003, however the speed of convergence is relatively very slow (0.29) compared to other studies in developing countries. Another study which by Kharisma & Saleh (2013) try to analyze the income dispersion and test both absolute convergence and conditional convergence of income among 26 provinces in Indonesia during 1984- 2008 using static and dynamic panel data approach. There was a strong indication of the existence of absolute convergence and conditional convergence among 26 provinces in Indonesia during 1984-2008. Thus, there was evidence that the economy of poorer provinces tends to grow faster compared to the more prosperous provinces. The last suggests that there was a tendency to catch up. Based on the system GMM estimation, it is found that the provinces in Java have faster speed of convergence comparatively to those outside Java. Meanwhile another study conducting by Vidyattama (2006) tries to examine the pattern of inequality and convergence of Indonesia's regional income since the 1970's. It shows the pattern has been affected by a few major changes in Indonesian policies and economic

development, including macroeconomic conditions and structural change. The most recent study on regional income convergence in Indonesia has been conducted by Aginta et al. (2020). Analyzing income per capita across 514 Indonesian districts from 2000-2017 using club convergence framework, they conform the lack of convergence in per capita income during post-decentralization era.

On the other hand, there is a study that using club formation methodology which similar to this paper but has different object. Aginta (2021) identifies convergence clubs in regional price across 34 provinces in Indonesia and investigate conditioning factors of club formation. His study analyzes regional monthly consumer price data from January 2012 to December 2019 with club convergence test and shows that regional consumer price does not converge into a single universal equilibrium. Instead, there are four convergence clubs identified. As conclusion, to the best of our knowlegde, none of previous studies investigates club of wage convergence in Indinesia. The present article fills this research gap with its attempt to reveal the determining factors of wage convergence clubs identified endogenously by club convergence test.

3. Methods and data

3.1. Econometric methods

3.1.1. Testing for club convergence

The log t convergence test developed by Phillips & Sul (2007) to investigate the existence of multiple convergence clubs is favorable because it does not require the time series to be co-integrated (Bartkowska & Riedl, 2012). In other words, the absence of co-integration in respective time series does not necessarily disprove convergence. With this advantage, large number of researchers have applied the method in various convergence analyses on different focuses including income, productivity, financial development and other social economic indicators.

To identify the presence of club convergence on regional wage, in this study we apply the modern approach of club convergence test developed by Phillips and Sul (2007). According to the model, a panel-data variable, for instance, y_{it} can be derived from the conventional panel data representation as follows:

$$y_{it} = \delta_{it}\mu_t \quad (1)$$

where i refers to individual unit 1, 2, ..., N across time $t = 1, 2, \dots, T$, y_{it} is the dependent variable, δ_{it} indicates individual unit and time-specific component or a time-varying idiosyncratic element. μ_t is not unit-specific and thus represents the aggregated common behavior of y_{it} . In the context of our study, intuitively δ_{it} reflects the transition path of each province towards its equilibrium while μ_t is a hypothesized equilibrium common to all provinces. According to Phillips & Sul (2007), the dynamics of the idiosyncratic component, δ_{it} , can be expressed as:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{\log(t)t^\alpha} \quad (2)$$

where δ_i is time-invariant individual specific effect, and ξ_{it} is a weakly time-variant process with mean 0 and variance 1 across individual units. Under equation 2, the null hypothesis is that convergence occurs when all individual units move to the same transition path, such that:

$$\lim_{t \rightarrow \infty} \delta_{it} = \delta_i \text{ and } \alpha \geq 0 \quad (3)$$

Intuitively, the alternative hypothesis is $H_A: \delta_i \neq \delta$ for all i and $\alpha \geq 0$. To evaluate the convergence over the long-run time horizon, a relative transition parameter of individual units, h_{it} , is formulated as follows:

$$h_{it} = \frac{y_{it}}{\frac{1}{N} \sum_{i=1}^N y_{it}} = \frac{\delta_{it}}{\frac{1}{N} \sum_{i=1}^N \delta_{it}} \quad (4)$$

Basically, h_{it} represents the distinctive behavior of individual unit i against cross-sectional average. In the state of convergence under equation 3, $\delta_{it} \rightarrow \delta_i$, then $h_{it} \rightarrow 1$. This also implies that the cross-sectional variance of h_{it} converges to 0 ($H_t \rightarrow 0$),

$$H_t = \frac{1}{N} \sum_{i=1}^N (h_{it} - 1)^2 \rightarrow 0, \quad t \rightarrow \infty \quad (5)$$

where $H_t = \sigma_t^2$.

To investigate the presence of convergence, Phillips & Sul (2007) empirically test the null hypothesis by using the log t regression model based on the variance ratio $\frac{H_1}{H_t}$:

$$\log\left(\frac{H_1}{H_t}\right) - 2 \log\{\log(t)\} = a + b \log(t) + \epsilon_t \quad (6)$$

for $t = [rT], [rT] + 1, \dots, T$ with $r > 0$

where rT is the initial observation in the regression, which implies that the first fraction of the data (that is, r) is discarded. Based on Monte Carlo experiments, Phillips & Sul (2007) suggest to set $r = 0.3$. The null hypothesis is rejected when $t_b < -1.65$, and if that is the case, the next step is identifying relative convergence or club convergence.

3.1.2. Identifying club convergence

As mentioned before, the club convergence method of Phillips and Sul (2009) is able to reveal the presence of multiple club convergence in sub-sample when overall convergence does not exist. Thus, to identify club convergence, we implement data-driven algorithm by Phillips and Sul (2009). We provide a brief summary of this clustering algorithm in Appendix 1.¹

3.1.3. Investigating conditioning factors of club convergence

Literature proposes important discussion on the conditioning factors of club convergence from two different convergence perspectives. On one hand, the club convergence hypothesis emphasizes the importance of initial condition for the transition of an economy. On the other hand, the approach of conditional convergence argues that structural characteristics completely affect the long-run growth path, while the initial condition are exogenous (Von Lyncker & Thoennessen, 2017).

The convergence clubs method of Phillips & Sul (2007) estimates the transition paths of each individual unit and then clusters them accordingly. However, this does not explain the driving factors of club formation and club convergence hypothesis (Azariadis & Drazen, 1990; Galor, 1996). In fact, understanding the determinants of convergence club formation is important in particular from the policy point of view. For this reason, following Bartkowska and Riedl (2012), we apply ordered logit technique to examine the conditioning factors of convergence clubs formation. Based on theoretical considerations discussed above, we test both initial condition and structural characteristics as explanatory variables in ordered logit estimation.

We classify each province into one unique club convergence, denoted as $c = 1, 2, \dots, C$, where C is in categorical form according to the number of club convergence identified. Note that the clubs identified by the method of Phillips & Sul (2007, 2009) are ranked according to the long-run trend of each individual in the respective club. Therefore, C can also be arranged as an ordinal variable. We assume that there is an underlying latent continuous metric y_t^* that force provinces being clustered in a certain club. This unobserved dependent variable is also related to the long-run wage dynamics of provinces. Thus, the specification can be written as

$$y_t^* = X_t\beta + \epsilon_t \quad (9)$$

¹ See Phillips and Sul (2009) for further detailed discussion.

Where X_i is a vectors consists of potential explanatory variables for club convergence membership, with $i = 1, \dots, 34$, indicating the province, and ϵ_t have a logistic distribution. The model uses maximum likelihood (ML) estimator to compute the probabilities of observing values of c . Note that although one can assess the directional effect of explanatory variables towards club membership with the sign of β coefficients, the magnitude does not contain any economic information. Therefore, in addition to the directional information given by the sign of β coefficients, we further compute the marginal effects of a unit change in the mean of a single explanatory variable on predicted probability, while holding the mean of other variables constant.

3.2. Data

As a proxy of regional wage, we use provincial average of net nominal income per month (in thousand rupiahs) of employee and laborer data published by Indonesian Central Bureau of Statistics. [Explain a bit the definition of data in 4-5 sentences]. The range of our data is from January 2008 to December 2020. The original data is in nominal terms. We then deflated the data using provincial Consumer Price Index (CPI), 2005=100. The summary statistics of our data is provided in Appendix (Table A1).

4. Results and discussion

4.1. Regional wage disparities across Indonesian provinces

Before implementing the club convergence test, it is important to document the pattern of dispersion of wage across provinces over time. As reported in Fig 1, the regional wage dispersion decreased from 2008 to 2013 but increased significantly in 2014 and remained high thereafter. Overall, the regional wage dispersion ended up higher in the last period compared to the initial period.

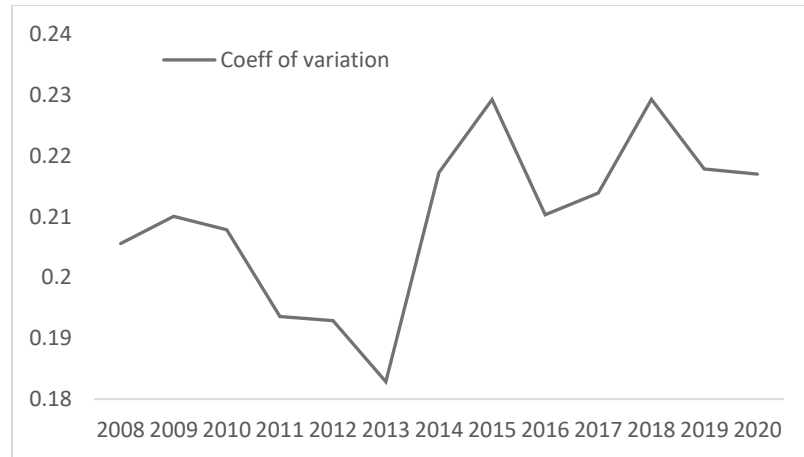


Fig. 1. Dispersion of provincial real wage, 2008-2020

We also illustrate how regional wage disparities across provinces in Indonesia have evolved over time. Fig 2 shows how the quantiles of the distribution have evolved over time. It indicates that when we evaluate the regional dynamics of wage, regional disparities have been increasing over time, similar to what is shown on Fig 1. Increasing disparities are evident not only when we measure the gap between the quantile 95 and quantile 5, but also when we measure the gap between the quantile 75 and 25. It is also worth noting the stable and large different between the quantile 95 and the rest quantiles. This implies initial conclusion of lack of convergence in regional wage across Indonesian provinces. However, this conclusion will be tested within formal econometric framework.

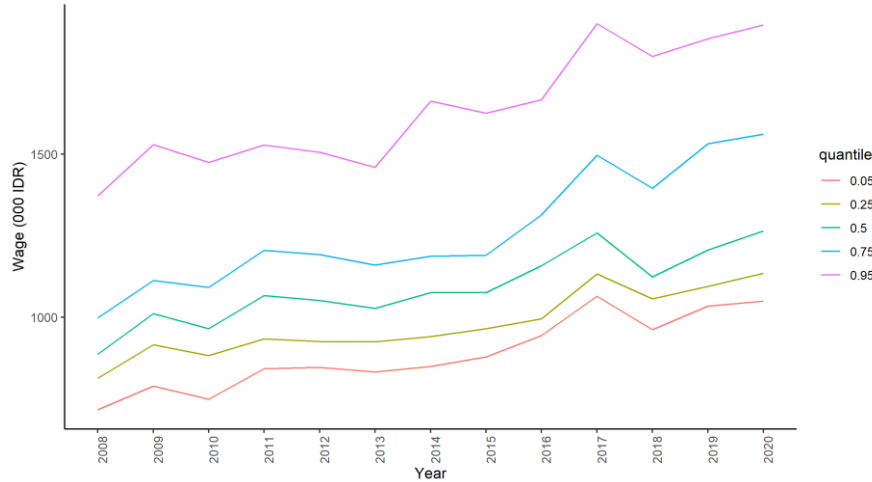


Fig. 2. Dispersion of provincial real wage, 2008-2020

4.2. Testing for convergence clubs

We first applied log t regression test on the wage of 34 Indonesian provinces over the period of 2008:01 to 2020:12. The results show the rejection of null hypothesis of overall convergence at the 5% significant level (\hat{b} is significantly < 0 with t -statistic -79.721). This rejection means that the overall convergence for the entire provinces is not observed, indicating that the wage movements in 34 Indonesian provinces during the observation period do not move to a single equilibrium. This result is consistent with the findings of Jangam & Akram (2019) and Aginta (2021) where the overall convergence is not observed in regional price dynamics across Indonesia prices.

Table 1. Overall convergence test

	Coefficient	Standard error	t -statistics
Log(t)	-1.130	0.014	-79.721

Note: The null hypothesis of convergence is rejected when the t -statistic is less than -1.65.

However, as mentioned before, the test developed by Phillips & Sul (2009) can observe the existence of several convergence clubs even when we do not observe overall convergence. Therefore, we apply the test to identify convergence clubs. Table 2 presents the results.

Table 2. Club convergence test

	Club 1	Club 2	Club 3
Coefficient	0.113	0.745	-0.014
t -statistics	0.486	3.081	-0.126
Number of regions	3	9	22

Note: The null hypothesis of convergence is rejected when the t -statistic is less than -1.65.

We find three significant initial clubs that represent the convergence dynamics of regional wage across Indonesian provinces.² The first convergence club consists of 3 provinces; the second club consists of 9 provinces; and the third club consists of 22 provinces. The first two rows correspond to the fitted coefficients and t-statistic in each club. The order of the convergence clubs is sorted from the provinces with the highest to the lowest wage; club 1 refers to the highest wage and club 3 represents the lowest wage provinces. Overall, the result of this club convergence test implies that the development of wage in 34 Indonesian provinces can be grouped into three common trends during 2008–2020 period.

In Fig 3 we plot the transition paths of clubs over time. However, instead of using the absolute value of wage on Y axes (like in Fig 2), we compare the transition of clubs relative to the cross-sectional average of all three clubs. The parallel pattern of the clubs' transition path indicates that the clubs do not converge over time. Instead of forming converging shape, that is smaller gaps between clubs over time, it appears that the transition path of the clubs reflects prolonged and higher dispersion between clubs, where club 1 and 2 are systematically above the average, while club 3 is consistently below the average. We also plot the transition path of provinces in each club in Fig 4. Unlike the diverging pattern shown in Fig 3, the transition path in Fig 4 (a), (b), and (c) clearly demonstrate convergence pattern, although the gap between provinces remained.

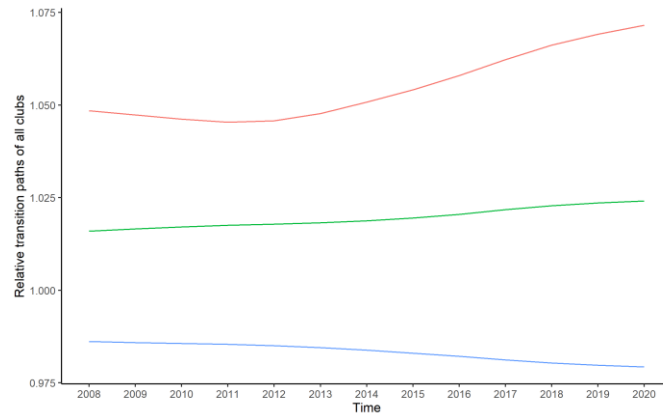


Fig. 3. The transition path of convergence clubs, 2008-2020

² We used merging method of Phillips & Sul (2009) described in Appendix 2 to test whether we can form larger convergence clubs based on the formation of initial clubs. The merging test result suggests that the convergence hypothesis is rejected (\hat{b} is significantly < 0 and t -statistics is smaller than -1.65). Hence, the initial three clubs are confirmed as the final convergence clubs.

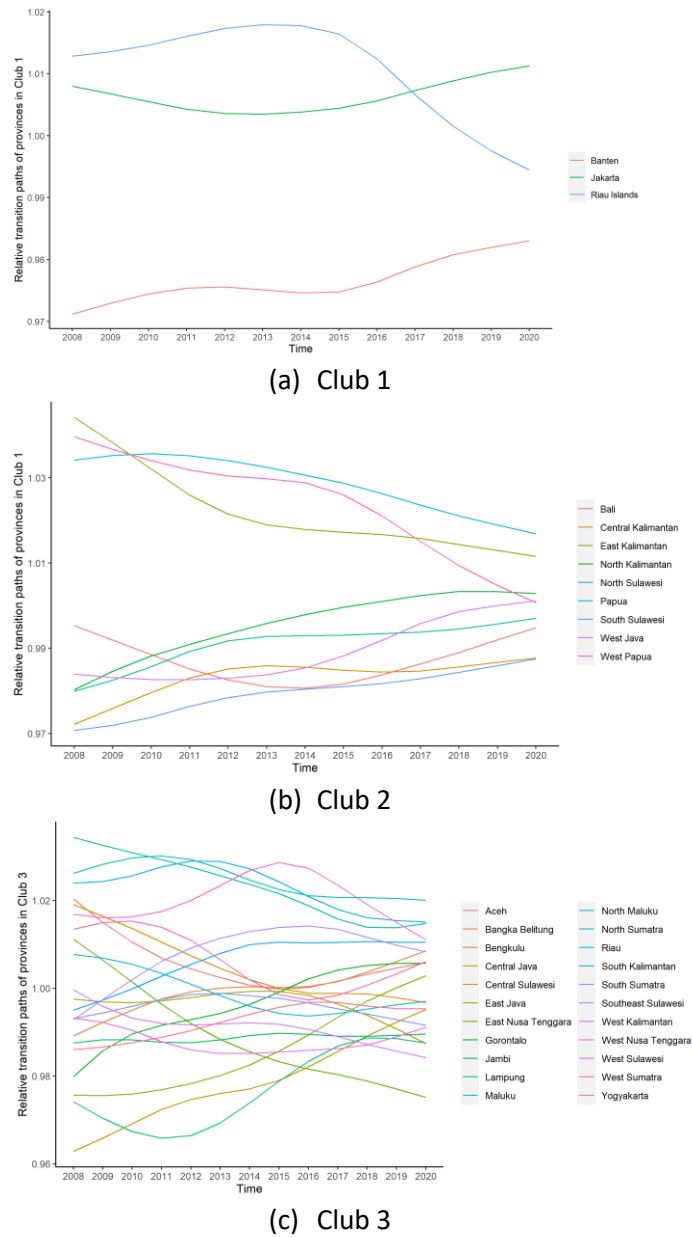


Fig. 4. The transition path of provinces within each convergence club, 2008-2020

Finally, we visualize the geographical distribution of club convergence in Fig 5.
 [Explanation of the map about 4 sentences].

The results of club convergence test suggest the existence of persistent gap in regional real wage across Indonesia provinces. This reflects wage rigidity in which the law of one price does not apply. It also reflects heterogeneity in macroeconomic condition and labor market across provinces. However, by this far we do not know which components of macroeconomic and labor market condition explain regional wage disparity across Indonesian provinces. Therefore, in the next section, we will investigate the important factors that contribute to the persistent regional wage disparity. More specifically, we want to answer the following question: what regional factors influence the formation of club convergence?

4.3. Factors influencing the club convergence

This section examines important conditioning factors that contribute to the convergence club formation by applying ordered logit model as explained in sub section 3.1.3. Before implementing ordered logit regression, we re-classified the clubs as the outcomes based on the value of wage in each club as mentioned before; high (Club 1), middle (Club 2), and low (Club 3). Then, following the literature, these ordered outcomes are regressed as the dependent variable against a set of independent variables as the influencing factors of convergence clubs described in Table 3.

Table 3. Variables used in ordered logit model

Variable	Definition	Source
Initial value of wage (2008)	Real wage in 2008 (in 000 IDR)	BPS
Manufacture employment share	$\frac{\text{Number of people employed in manufacturing sector}}{\text{Total number of people employed}}$	BPS
Investment share to GDP	$\frac{\text{Total investment}}{\text{Total GDP}}$	BPS
Labor force participation rate	$\frac{\text{Number of persons in the labor force}}{\text{Population aged ten (10) years and over}}$	BPS
GDP	Real GDP (2010 = 100) in log form	BPS

Note: BPS (Badan Pusat Statistik) is Indonesian Central Bureau of Statistics.

Table 4 presents the results from the ordered logit model. The second column shows the ordered logit coefficients, while the last column exhibits the marginal effects of probability that represent the individual effect of explanatory variable on the probability of a province converging to a particular club. Regarding our club convergence identification results, the selected

explanatory variables largely explain the probability of membership in club 2 (middle) and club 3 (low), while the probability of membership in club 1 (high) remain unexplained. This might be because the sample size in club 1 (high) very small. Nonetheless, the model helps to explain how those influencing factors affect the formation of convergence clubs.

Table 4. Results of ordered logit and marginal effects on probabilities

Variables	Ordered logit coefficient	Marginal effects on probabilities		
		Club 1 (High)	Club 2 (Middle)	Club 3 (Low)
Initial value of wage (2008)	0.040** (0.017)	0.000 (0.000)	0.009** (0.004)	-0.009** (0.004)
Manufacture employment share	0.888** (0.409)	0.000 (0.000)	0.189** (0.106)	-0.189** (0.106)
Investment share to GDP	0.760** (0.363)	0.000 (0.000)	0.162** (0.078)	-0.162** (0.078)
Labor force participation rate	-0.214** (0.107)	-0.000 (0.000)	-0.046** (0.022)	0.046** (0.022)
GDP	1.137 (1.002)	0.000 (0.000)	0.242 (0.211)	-0.242 (0.211)
LR chi ²	42.29			
Prob (LR Stat)	0.00			
Pseudo R ²	0.73			
Number of provinces	34	3	9	22

Note: Standard errors are reported in parentheses. *** $p < 0.1$, ** $p < 0.05$, * $p < 0.1$

Source: Authors' computation

The direction of ordered logit coefficients clearly shows that almost explanatory variables exhibit expected positive sign. The first variable is the initial value of wage that shows a positive effect for club 1 and club 2, which means the probability of province with higher initial value of wage belong in club 1 and club 2 is higher than the other provinces with lower initial value of wage. It is also confirmed by the negative effect for club 3, which means the province with higher initial value of wage has a little probability to belong in club 3. That also in line with the finding of Bartkowska & Riedl (2012), which shows that region's initial condition play a crucial role in Europe regions to determine which club their will belong.

Similar influence is also observed for manufacture employment share variable. That variable has a positive effect for club 1 and club 2, while it shows negative effect for club 3 which means the province with higher manufacture employment share has a higher wage than the rest.

This result is also consistent with the finding of Felipe et al. (2019) where there is evidence that high-tech manufacturing firms generally pay higher wages in Indonesia. Furthermore, it also reveals that differences are likely due in part to differences in skill requirements of the sector, with average levels of education and training significantly higher. Moreover, high productivity rate in manufacturing sectors often become the main reason why labor in manufacturing sector often earn higher wage than labor in other sectors. Strain (2019) finds the evidence that there is a strong linkage between productivity and wages. In detail, he describes that when properly measured, with variable definitions based on the most appropriate understanding of the relevant underlying economic concepts, trends in compensation and productivity have been very similar over the past several decades.

Investment share to GDP also demonstrate similar effect with the previous variables mentioned before. Thus, it can be concluded that the higher private investment to GDP ratio will increases probability to be in higher wage clubs. It also means that higher demand of labor force amidst the relatively higher level of wage reflects regional imbalance in economic development where investment activities are largely concentrated in few provinces that have advantage in terms of better infrastructure, strategic geographical position, and natural resource endowment. For example, provinces like Jakarta, Banten, and Riau Island in club 1 which have better infrastructure condition rather than other provinces. These provinces also have strategic geographical location which surrounded by well managed transportation infrastructure, and thus will induce higher labor and capital mobility. This result also similar with the finding of Baskoro et al. (2019) which concludes that there is a possibility the positive sign of the wage variable concerning FDI explained by the higher productivity of labor, which represents an improvement of labor skill. Moreover, they also describe that the positive relationship of wage rate and FDI and the attractiveness of capital-intensive industries are in line with the shift of Indonesian industrial character.

On the other hand, labor force participation rate shows different result due to the negative sign in club 1 and club 2 while has positive sign in club 3. It means higher labor force participation rate decreases probability to be in higher wage clubs which reflects the standard labor supply and demand condition. Higher labor supply relative to its demand leads to downside pressure on wage. Similar to what is mentioned by Herr (2002), we find evidence of negative relationship between wage and labor supply. As for the last variable, GDP shows an insignificant

role in explaining wage formation clubs. It implies that the size of economy is less important in explaining the regional difference in wage across Indonesian provinces.

In conclusion, the result from ordered logit model shows that the formation of club convergence in provincial wage is mostly explained by regional labor market condition. As we know from the result, the variables such as initial condition of wage, manufacture employment share, investment, and labor force participation can indeed explain to which club a region will belong while GDP insignificantly influence the club formation.

5. Conclusion

The study of wage regional convergence has been increasing in recent years and becoming one of the major elements in modern economic studies. However, there is still few research aims to analyze the issue of wage convergence. The purpose of this paper is to empirically investigate the convergence of regional wage in Indonesia, a large and geographically diverse developing country. We implement a two-step approach to empirically examine wage convergence across 34 provinces in Indonesia during 2008 – 2020 period. First, we apply the log t test developed by Phillips & Sul (2007, 2009) to identify the convergence clubs of regional wage. Second, we analyze the influencing factors of the convergence club formation.

Result from the first part of analysis shows that there are three significant initial clubs which represent the convergence dynamics of regional wage across Indonesian provinces. The first convergence club consists of 3 provinces; the second club consists of 9 provinces; and the third club consists of 22 provinces. Overall, the result of this club convergence test implies that the development of wage in 34 Indonesian provinces can be grouped into three common trends during 2008–2020 period.

In the second part, the result from ordered logit model shows that the formation of club convergence in provincial wage is mostly explained by regional labor market condition. The variables such as initial condition of wage, manufacture employment share, investment to GDP ratio, and labor force participation significantly influence the convergence club formation, while the role of GDP is insignificant. Finally, from a policy perspective, our findings of several convergence clubs and its determinant factor should aware the policy makers to manage regional wage condition through regional-based approaches. As we know, wage plays an important role in Indonesia's development plan and often become a push factor for capital and labor mobility.

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Appendices

Appendix 1: Steps of convergence clubs identification process.

1. Ordering: Sample units (provinces) are arranged in decreasing order according to their observations in the last period.
2. Constructing the core group: A core group of sample units (provinces) is identified based on the maximum tk , which is obtained from a series of sequential estimations of equation 8 for the k largest group ($2 \leq k \leq N$).
3. Deciding club membership: Sample units (provinces) not belonging to the core group are re-evaluated one at a time with log t regression. A new group is formed when the t -statistic > 0 .
4. Iteration and stopping rule: The regression model of equation 7 is applied for the remaining sample units (provinces). If the process shows the rejection of null hypothesis of convergence, Steps 1 to 3 are performed again. The remaining sample units (provinces) are labeled as divergent if no core group is found, and the algorithm stops.

Appendix 2: Test for clubs merging

To evaluate whether the clubs identified according to the clustering algorithm described in Section 3.1.2 and Appendix 1 can be merged, in this study, we use a “club merging algorithm” by Phillips & Sul (2009). By testing for merging between adjacent clubs, the procedure works as follows: first, apply log t test on the first two initial groups identified in the clustering mechanism. If the t -statistic > -1.65 , these two groups together form a new convergence club. Second, repeat the first step by adding the next club. Continue this process until the condition of t -statistic > -1.65 is achieved. Third, if convergence hypothesis is rejected, that is when t -statistic > -1.65 does not hold, we assume that all previous groups converge, except the last added one. Hence, we restart the merging algorithm from the club for which the hypothesis of convergence does not hold.

Table A1. Descriptive statistics of real wage in 34 Indonesian provinces

No.	Province	Mean	Std Dev	Min	Max
1	Aceh	1,057	947	968	1,231
2	Bali	1,205	1,920	1,001	1,529
3	Bangka Belitung	1,017	1,339	784	1,248
4	Banten	1,371	2,831	987	1,797
5	Bengkulu	1,049	685	955	1,178
6	Central Java	885	1,484	668	1,123
7	Central Kalimantan	1,173	1,886	857	1,452
8	Central Sulawesi	989	824	849	1,120
9	East Java	929	1,553	734	1,185
10	East Kalimantan	1,537	1,583	1,324	1,839
11	East Nusa Tenggara	938	486	880	1,037
12	Gorontalo	1,000	1,603	683	1,226
13	Jakarta	1,706	3,334	1,295	2,210
14	Jambi	941	975	755	1,092
15	Lampung	874	1,389	724	1,079
16	Maluku	1,191	793	1,075	1,370
17	North Kalimantan	1,290	2,435	880	1,613
18	North Maluku	1,205	1,060	985	1,373
19	North Sulawesi	1,243	2,143	929	1,571
20	North Sumatra	1,009	829	872	1,142
21	Papua	1,612	1,656	1,280	1,900
22	Riau	1,188	976	1,036	1,322
23	Riau Islands	1,744	2,329	1,365	2,051
24	South Kalimantan	1,066	1,402	830	1,269
25	South Sulawesi	1,145	1,978	876	1,452
26	South Sumatra	987	912	818	1,105
27	Southeast Sulawesi	1,079	1,495	810	1,350
28	West Java	1,233	2,490	942	1,645
29	West Kalimantan	954	696	845	1,077
30	West Nusa Tenggara	936	985	785	1,115
31	West Papua	1,551	1,053	1,384	1,732
32	West Sulawesi	1,170	1,304	986	1,377

33	West Sumatra	1,061	990	885	1,235
34	Yogyakarta	968	1,254	784	1,189

Note: In thousands of IDR, monthly

Source: Authors' computation