**Identifying club convergence of regional wage in Indonesia and their influencing factors**

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**A B S T R A C T**

This paper aims to empirically evaluate regional wage convergence of 34 Indonesian provinces. By applying the club convergence techniques (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.

JEL Classifications:

E24, J31, J58, R11

Keywords: Regional Wage, Club Convergence, Labor Force, Log t test, Logit Model

1. **Introduction**

Modern economic theories predict that labor that have same skills will earn equal payments in a fully integrated labor market (Marshall, 1920, book 6, Ch. 3; Hicks, 1932, Ch. 4). 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 (Svante Prado, Christer Lundh, Kristoffer Collin & Kerstin Enflo, 2021). 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 (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.

1. **Related literature**
   1. **Related 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 K, Lundh C, Prado S. 2018). 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 Unites 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.

* 1. **The contribution to previous studies**

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.

1. **Methods and data**
   1. **Econometric methods**
      1. **Conceptual framework of club convergence**

This study closes the research gap in investigating whether regional wages across Indonesia form a single or multiple common trend by employing the innovative approach of club convergence test developed by Phillips and Sul (2007). As a starting point, the test considers that a panel-data variable, for instance, , can be decomposed into systematic and transitory component, and , respectively as follows:

|  |  |
| --- | --- |
|  | (1) |

Then, in this study, we consider wage in province *i* at time *t*, , follows this process:

|  |  |
| --- | --- |
|  | (2) |

where is a province specific component that interact with common component to define , while is the error term. In this setting, a time-varying factor representation contained in can be derived from the conventional panel data representation as follows:

|  |  |
| --- | --- |
|  | (3) |

where indicates province-specific component and is allowed to have a random component, which absorbs error term , and thus representing a time-varying idiosyncratic element. represents the aggregated common behavior of . Intuitively, describes each province’s transition path towards its equilibrium and refers a hypothesized equilibrium that is common to all provinces. More formally, equation 3 is a dynamic factor model where the transition path of towards its own equilibrium is explained by a factor loading coefficient that represents the difference between the observed variable, with a hypothesized common path of wage movements, .

Next, according to Phillips & Sul (2007), we may characterize the dynamics of the idiosyncratic component, , with the following semi-parametric specification:

|  |  |
| --- | --- |
|  | (4) |

where refers to the time-independent province heterogeneity, and is a time-dependent process with mean 0 and variance 1 across provinces. Under equation 4, convergence occurs when all provinces move to the same transition path:

|  |  |
| --- | --- |
|  | (5) |

Equation 5 is thus the null hypothesis of convergence. To estimate the transition coefficient , a relative transition parameter, , is formulated as follows:

|  |  |
| --- | --- |
|  | (6) |

where a common component, in equation 2 and 3 is eliminated by dividing with the panel average. Thus, represents the transition path of province *i* against cross-sectional average, referring to distinctive behavior of a particular province relative to others. In the state of convergence, that varies across provinces moves toward a common transition path in the long-run (, when ). The notion of convergence defined in equation 5 is then reformulated into the following equation that describe the cross-sectional variance of ,

|  |  |
| --- | --- |
|  | (7) |

where the cross-sectional variance converges to zero, 0.

The null hypothesis in equation 5 is verified in counter to the alternative hypothesis for all *i* and . Finally, Phillips & Sul (2007) empirically evaluate this null hypothesis by using the following log t regression model:

|  |  |
| --- | --- |
|  | (8) |

where is the initial observation in the regression, which implies that the first fraction of the data (that is, ) is discarded. Based on Monte Carlo experiments, Phillips & Sul (2007) suggest to set when the sample is small or moderate . A fairly conventional inferential procedure is also suggested for equation 8. To be more specific, a one-sided t test with heteroskedasticity-autocorrelation consistent (HAC) standard errors is used. In this setting, the null hypothesis of convergence is rejected when . The sign and magnitude of in equation 8 indicate different convergence patterns; when 0, the model suggests divergence, when , the model suggests convergence in growth rates (relative convergence), when , the model suggests convergence in levels (absolute convergence).

* + 1. **Identifying convergence clubs**

Note that even though the null hypothesis of overall convergence in full sample is rejected, it does not necessarily mean that the convergence in the sub sample of the panel is not present. Indeed, perhaps the most appealing feature of the model of equation 8 is its ability to reveal the presence of multiple convergence clubs in sub-sample. In order to do that, Phillips and Sul (2009) suggest an innovative a data-driven algorithm, which can be summarized into four steps (for details see Appendix 1).

* + 1. **Ordered logit model**

It is clear that the convergence clubs method of Phillips & Sul (2007) estimates the transition paths of each region and then clusters the regions accordingly. Apart of its advantage to endogenously identify convergence clubs, however, this does not provide any information about driving factors of club formation. 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), in this study we conduct ordered logit technique to examine the conditioning factors of convergence clubs formation. Since conditional convergence literatures suggest that structural characteristics play important roles in determining the long-run dynamics, we selected important variables based on theoretical backgrounds that represent province’s characteristics as explanatory variables in ordered logit estimation.

Following the general form of ordered logit model firstly introduced by McKelvey and Zavoina (1975), in this study each region is classified into one unique convergence club, denoted as = 1, ..., , where is the variable to be explained and a categorical form. In this study, takes value from 1 to 4. Since the clubs identified by the method of Phillips & Sul (2007) can be ranked according to the long-run wage levels of regions in the respective club, this *c* variable can also be arranged as an ordinal variable. It is important to assume that the possibility of provinces clustered in a certain club is related to a latent continuous metric that represents a province’s individual long-run inflation dynamics. Thus, the specification can be written as

|  |  |
| --- | --- |
|  | (9) |

where consist of explanatory variables and a constant term, with indicating the province, and have a logistic distribution. To assess the unobserved dependent variable , the model is estimated with maximum likelihood (ML) techniques where the probabilities of observing values of is computed.

While the sign of coefficients is useful for explaining the directional effect of determinants variables to club membership, the magnitude does not provide any economic rationals. Thus, to further quantify the directional information, as suggested in related literature, we record marginal effects of a unit change in the mean of a single explanatory variable on predicted probability, with the mean of other variables held fixed.

* 1. **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. 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).

1. **Results and discussion**
   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. indicates 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.

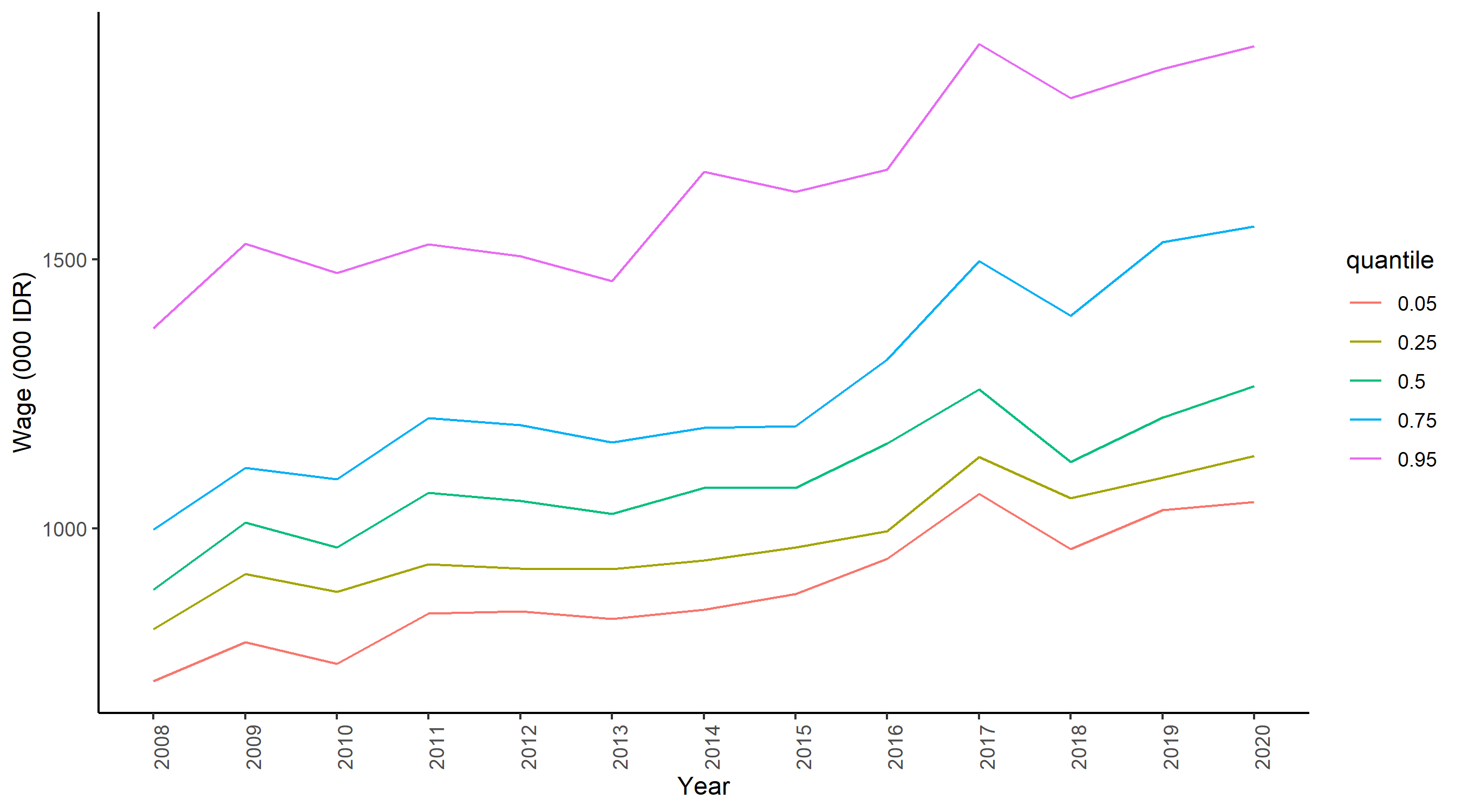


Fig. 2. Dispersion of provincial real wage, 2008-2020

* 1. **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 ( 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 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.[[1]](#footnote-1) 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.

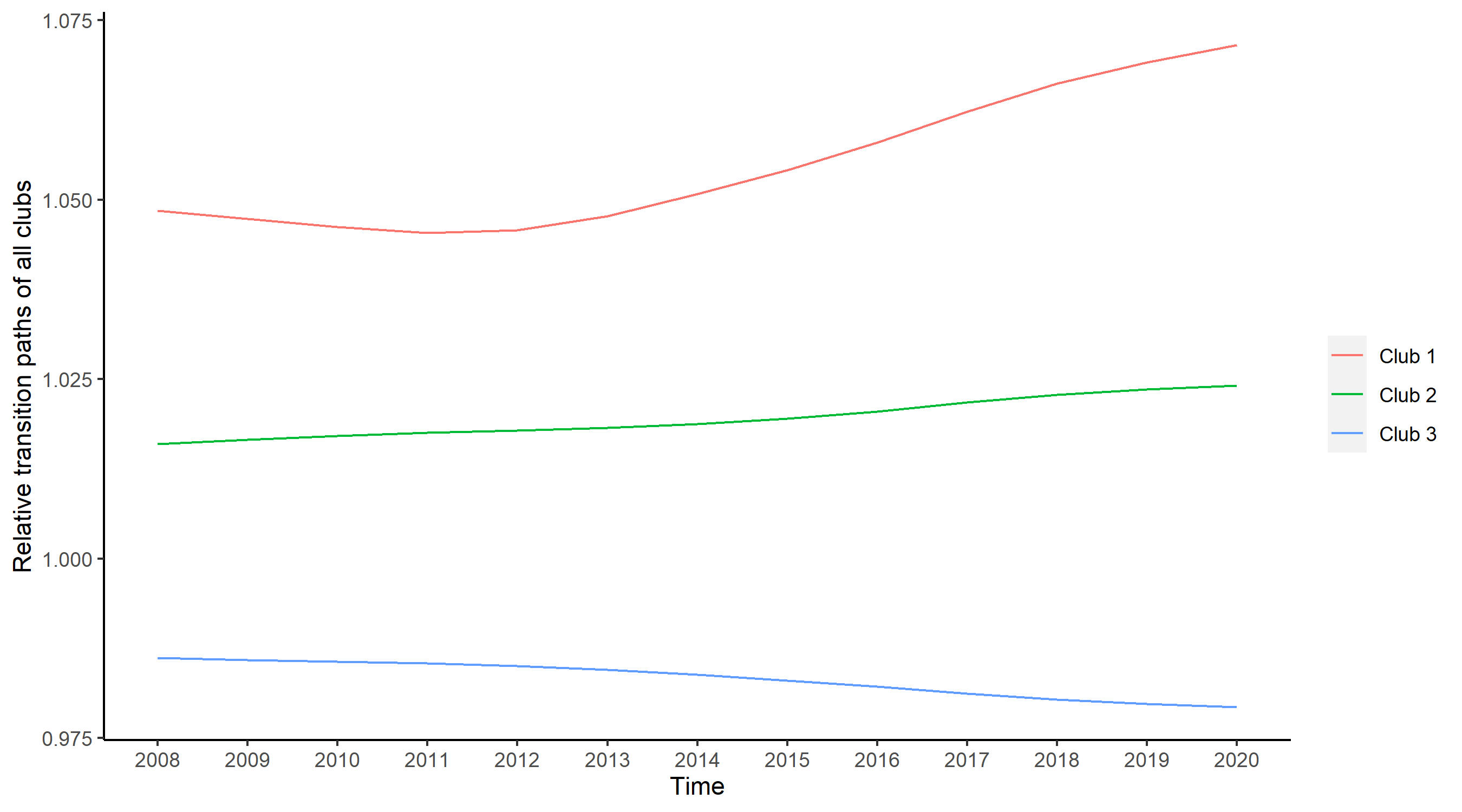


Fig. 3. The transition path of convergence clubs, 2008-2020

|  |
| --- |
| 1. Club 1 |
| 1. Club 2 |
| 1. Club 3 |

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

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?

* 1. **Factors influencing the convergence clubs**

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 |  | BPS |
| Investment share to GDP |  | BPS |
| Labor force participation rate |  | 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 chi2 | 42.29 |  |  |  |
| Prob (LR Stat) | 0.00 |  |  |  |
| Pseudo R2 | 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

Point-point penjelasan:

* Higher level of initial wage in 2008 increases probability to be in higher wage clubs (club 1 and club 2) 🡪 consistent with the convergence theory
* Higher share of people employed in manufacturing sectors increases probability to be in higher wage clubs (club 1 and club 2) 🡪 reflects the higher productivity of labors in manufacturing industries
* Higher private investment to GDP ratio increases probability to be in higher wage clubs (club 1 and club 2) 🡪 means higher demand of labor force amidst the relatively higher level of wage. This reflects regional imbalance in economic development where investment activities are largely concentrated in few provinces that have advantage in terms of better infrastructures, strategic geographical position, and natural resource endowment.
* Higher labor force participation rate decreases probability to be in higher wage clubs (club 1 and club 2) 🡪 reflects the standard labor supply and demand condition. Higher labor supply relative to its demand leads to downside pressure on wage.
* The effect of GDP is not significant implies that the size of economy is less important in explaining the regional difference in wage across Indonesian provinces.
* Overall conclusion from ordered logit model: the formation of club convergence in provincial wage is mostly explained by regional labor market condition.

1. **Conclusion**

**References**

Aginta, H. (2021). Spatial dynamics of consumer price in Indonesia: Convergence clubs and conditioning factors. Asia-Pacific Journal of Regional Science, 5(2), 427–451. https://doi.org/10.1007/s41685-020-00178-0

Aginta, H., Gunawan, A. B., & Mendez, C. (2020). Regional income disparities and convergence clubs in Indonesia: New district-level evidence. Journal of the Asia Pacific Economy, 1–33.

Azariadis, C., & Drazen, A. (1990). Threshold Externalities in Economic Development. The Quarterly Journal of Economics, 105(2), 501–526. JSTOR. https://doi.org/10.2307/2937797

Bartkowska, M., & Riedl, A. (2012). Regional convergence clubs in Europe: Identiﬁcation and conditioning factors. Economic Modelling, 29(1), 22–31.

Collin, K., Lundh, C., & Prado, S. (2019). Exploring regional wage dispersion in Swedish manufacturing, 1860–2009. Scandinavian Economic History Review, 67(3), 249–268.

Corrado, L., Martin, R., & Weeks, M. (2005). Identifying and Interpreting Regional Convergence Clusters across Europe\*. The Economic Journal, 115(502), C133–C160. https://doi.org/10.1111/j.0013-0133.2005.00984.x

Federico, G. (2012). How much do we know about market integration in Europe? 1. The Economic History Review, 65(2), 470–497.

Firdaus, M., & Yusop, Z. (2009). Dynamic analysis of regional convergence in Indonesia.

Galizia, P. C. (2015). Mediterranean labor markets in the first age of globalization: An economic history of real wages and market integration. Springer.

Hobijn, B., & Franses, P. H. (2000). Asymptotically Perfect and Relative Convergence of Productivity. Journal of Applied Econometrics, 15(1), 59–81. JSTOR.

Kharisma, B., & Saleh, S. (2013). Convergence of Income Among Provinces in Indonesia 1984-2008: A Panel Data Approach. Journal of Indonesian Economy and Business, 28(2), 167–187.

Mantra, I. B. (1992). Pola dan arah migrasi penduduk antar propinsi di Indonesia tahun 1990. Populasi, 3(2).

McKelvey, R. D., & Zavoina, W. (1975). A statistical model for the analysis of ordinal level dependent variables. Journal of Mathematical Sociology, 4(1), 103–120.

Phillips, P. C. B., & Sul, D. (2007). Transition Modelling and Econometric Convergence Tests. Econometerica, 75(6), 1771–1855.

Phillips, P. C. B., & Sul, D. (2009). Economic transition and growth. Journal of Applied Econometrics, 24(7), 1153–1185. https://doi.org/10.1002/jae.1080

Prado, S., Lundh, C., Collin, K., & Enflo, K. (2020). Labour and the ‘law of one price’: Regional wage convergence of farm workers in Sweden, 1757–1980. Scandinavian Economic History Review, 1–22.

Rosenbloom, J. L. (1998). Strikebreaking and the labor market in the United States, 1881-1894. Journal of Economic History, 183–205.

Rosenbloom, J. L., & Sundstrom, W. A. (2002). The decline in hours of work in us labour markets, 1890–1903. In Labour Market Evolution (pp. 175–198). Routledge.

Vidyattama, Y. (2006). Regional Convergence and Indonesia Economic Dynamics. Economics and Finance in Indonesia, 54, 197–227.

**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 ≤ kN).
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 reaming 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 and 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



Note: In thousands of IDR, monthly

Source: Authors’ computation

1. We used merging algorithm 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 ( is significantly < 0 and *t*-statistics is smaller than -1.65). Hence, the initial three clubs are confirmed as the final convergence clubs. [↑](#footnote-ref-1)