Wages of Workers Spatial Analysis in Indonesia Region 2019

Maghfirah[1], **O B Samosir**[1]

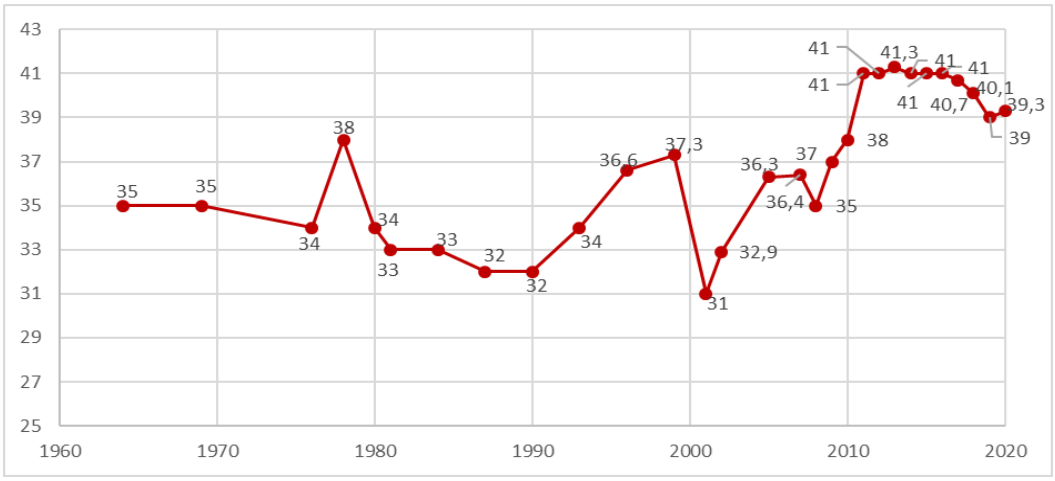
[1]Department of Economics, Faculty of Economics and Business, Universitas Indonesia, Depok, 16424

*Corresponding author's e-mail: maghfirah@bps.go.id

Abstract. The wage inequality of workers in Indonesia is one of the main problems and concerns that are important to be addressed by the government. The determination of the regional minimum wage (UMR) by the local government has not been able to solve the problem of inequality. On a larger scale, the wage inequality of workers can affect the stability of the national economy. Research on the spatial analysis of workers' wages is very important to be carried out as a basis for making appropriate policies by the government. In this study, we have succeeded in analyzing the dependence and spatial relationship of a region with the wages of its workers and have identified the factors that affect the wages of workers in a region. The result reveals the spatial dependences are detected among districts, followed by the spatial clusters and spatial outliers through global and local spatial autocorrelation. Applying two spatial autoregressive models, spatial autoregressive lag model (SAL) and spatial autoregressive error model (SEM), SAL confirmed that there are 4 significant independent variables with a level of 10 percent and have a positive relationship, namely education (E), age (A), internet (I), and sex ratio (R) variables. And SEM confirmed that there are significants 5 significant independent variables with a level of 10 percent and have a positive relationship, namely education (E), age (A), technology (T), internet (I), and sex ratio (R) variables. As the policy implication, since regional inequality in term of wage is still a major issue, it will be a call for better coordination and cooperation within and between regions.

1. Introduction

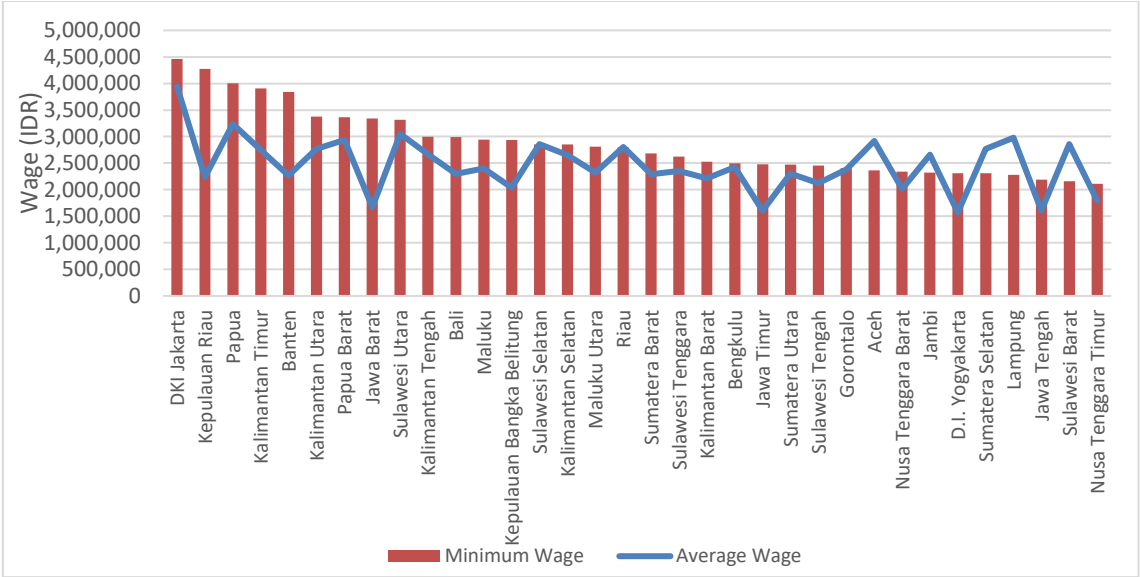
The wage inequality between regions in Indonesia is still a problem in terms of employment now. This can be seen from the trend of Indonesia's Gini coefficient [1], where the Gini coefficient value will increase as wage inequality increases.



Source: Ourworldindata and Statistics Indonesia, 2021

Figure 1. Indonesia Gini Coefficient

One of the government policies that are effective in overcoming wage inequality in Indonesia is to set a minimum wage [2]. However, in practice, there are still workers who earn below the minimum wage set by the local government.

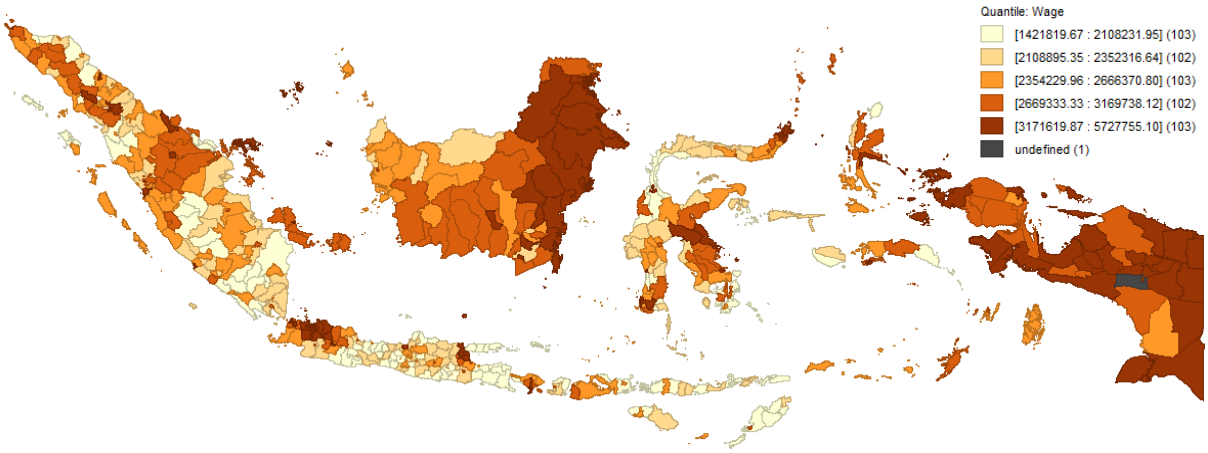


Source: National Labor Force Survey (Sakernas) August, 2019

Figure 2. Average and Minimum Wages by Province in Indonesia, 2019

Figure 2 describes that from 34 provinces in Indonesia, there are only seven provinces in Indonesia that have an average wage for workers which is above the minimum wage in 2019, Sulawesi Selatan, Riau, Aceh, Jambi, Sumatera Selatan, Lampung, and Sulawesi Barat.

Indonesia itself consists of 514 regions spread from Sabang to Merauke. The difference in resources owned by each region in improving its economy makes the inequality between regions. Regional development such as increasing electricity distribution, infrastructure development, and investment is increasingly adding to the inequality that occurs in the western and eastern regions of Indonesia [3]. Economic inequalities between regions lead to wage inequality for workers. The following is an illustration of the wage disparity of workers in the region in Indonesia based on 2019 National Labor Force Survey (Sakernas) data.



Source: 2019 National Labor Force Survey (Sakernas) August, 2019

Figure 3. Inequality in the Average Wages of Workers in Indonesia, 2019

From figure 3 can be seen that the average wage for workers in the most region in Papua and Kalimantan is relatively high. Meanwhile, the average wage for workers in the region in Sumatera, Java, and Sulawesi is still mostly low.

Research on the spatial analysis of worker's wages and the determinants that influence it in the region in Indonesia is considered important to take the right policies, considering that each region in Indonesia has different demographic, social, and economic characteristics. However, in conducting the spatial analysis test, it is important to pay attention to the spatial relationship between regions because it can lead to biased estimation results [4]. Thus, in conducting a spatial analysis of the average wage of workers between the region in Indonesia and the determinants that influence it, neighboring regions are needed as a weighing.

From the background that has been stated above, it can be concluded that the research questions used in this study are as follows:

- What is the spatial dependence on the average wage of workers and its determinants in the region in Indonesia?
- What is the spatial relationship between the average wages of workers between the region in Indonesia?
- What factors affect the average wage of workers in the region in Indonesia by considering spatial relationships as a weight?

2. Theoretical Background

Education and work experience which are usually interpreted as measuring the impact of job training are the two variables that make up the wage/earnings function of workers [5]. The income function proposed by Mincer (1974) is as follows

$$log\, w = as + bt - ct^2 + u \quad (1)$$

where w is wages, a, b, and c is constant of each variable, s is the length of the school, t is the length of work experience, and u is another variable

From the Mincer wage function, it can be seen that education and length of work experience as measured by the impact of job training have a positive relationship with the addition of workers' wages.

The companies recruit workers and determine worker wages by looking at the education of prospective workers because productivity is something that is not visible. This is referred to as education is a signal where worker productivity is measured by the level of education [6]. Empirically, several studies [7,8,9] show that an increase in the level of education is positively correlated with an increase in the level of wages. Research [10] found that there was an impact on the increase in the wages of workers in areas affected by the construction of the Presidential Instruction Elementary School in Indonesia in

1973. This shows that there is a rate of return from education on the increase in the wages of workers in Indonesia.

Investment in human capital provides an age-earning profile. One of the important things about the age-earning profile is that it explains that income increases over time as workers age, but the rate of growth decreases [11].

When technological advances are introduced in production, there is a shift in the demand for labor from unskilled labor to skilled labor. Technological advances also contribute to wage inequality [12]. This starts with the introduction of computer technology which has an impact on the wage structure. Workers who can operate computers will earn more than workers who cannot operate computers [13]. The use of internet at work also increases workers' wages. Workers who use the internet have higher wages tha those who do not use the internet on the job [14].

Research [15] found that the labor market with a higher population density tends to be more competitive and limits the ability of employers to discriminate against women. The gender pay gap is substantially lower in metropolitan cities than in rural areas. Research [16] also found that there is a wage gap between genders, especially for workers in the formal sector, where the wages of female workers are lower than the wages of male workers. Research [17] using 2016 Sakernas data also found that there was wage inequality for each gender group.

Many things about demography can be learned and formed using a spatial approach [18]. Several studies have also used spatial analysis in analyzing wage differences [19,20].

From mentioned theoretical and empirical studies, the theoretical framework is built as follows

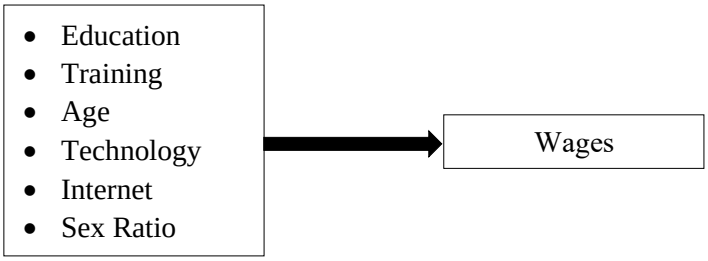


Figure 4. Theoretical Framework

3. Methodology

This study uses the Sakernas August 2019 data source with an analysis unit of the population aged 15 years and over who work in the formal sector. The analytical method used is the Moran Index univariate test to see the number of spatial dependence on each variable, the Local Indicators Spatial Autocorrelation (LISA) test to see the spatial relationship of the average wage between the region in Indonesia, and the Spatial Autoregressive Model Test using the Spatial Lag (SAL) and Spatial Error Model (SEM) to find a fit model.

The Moran Index divides the spatial autocorrelation across the region into 4 quadrants. Quadrant I is the High-High group (areas with high variable values with neighboring areas with high values). Quadrant II is a group of Low-High regions (regions with low variable values surrounded by regions bordering high values). Quadrant III is a group of Low-Low regions (regions with low variable values surrounded by regions bordering low values). And quadrant IV is a group of High-Low regions (regions with high variable values surrounded by regions bordering low values).

The model to be formed consists of two models, namely SAL and SEM model with the following details

- SAL model

$$\ln \boldsymbol{w_{ij}} = \boldsymbol{\rho w_i y} + \boldsymbol{\beta x_i} + \boldsymbol{\varepsilon} \quad \text{where } \varepsilon \sim N(0, \sigma^2 I) \tag{2}$$

- SEM model

$$\ln \boldsymbol{w_{ij}} = \boldsymbol{\beta x_i} + \boldsymbol{u} \quad \text{where } u = \lambda w u + \varepsilon, \varepsilon \sim N(0, \sigma^2 I) \tag{3}$$

Data processing using the Geoda application and the weight used is queen contiguity where the neighboring area is the region that intersects with the origin region.

Informing the observation value, the unit of analysis is divided into 514 regions of origin. The variables used consist of the dependent variable in the form of the average wage of workers in the 514 region and the independent variables in the form of education, training, age, technology, internet, and gender (figure 4). The operational definition variables used in this study are as follows

Table 1. Operational definition variables

Variable type	Operational definition	Data type
Dependent variable		
Wages average	Natural logarithm of the average wages received by all workers	Non-categoric
Independent variable		
Education	Percentage of workers with a minimum education of high school/equivalent	Non-categoric
Training	Percentage of workers who have attended training who received certificates	Non-categoric
Age	The average age of workers	Non-categoric
Technology	Percentage of workers who use digital technology in carrying out their work	Non-categoric
Internet	Percentage of workers who use the internet in carrying out their work	Non-categoric
Sex Ratio	The ratio of male workers	Non-categoric

4. Result and Discussion

The results that will be discussed are Univariate Test using the Moran index, Local Indicators Spatial Autocorrelation (LISA) Test to see the correlation between average wages between regions, and Spatial Autoregressive Model Test to get a fit model.

4.1. Moran Index Univariate Test

Moran's Index Univariate Test results show a positive spatial relationship for wages and its determinants. Variables that have a fairly large number of dependence, namely wages of 0.626 and education of 0.582. This means that the process of increasing wages and education of workers in a region depends on the process of increasing wages and education of the region that is its neighbor. This is in line with the results of research [21] which states that there is spatial wage inequality between skilled and non-skilled workers in France in 1976-1998. Also, research [22] found that there was a spatial relationship between the region minimum wages in Central Java Province in 2013.

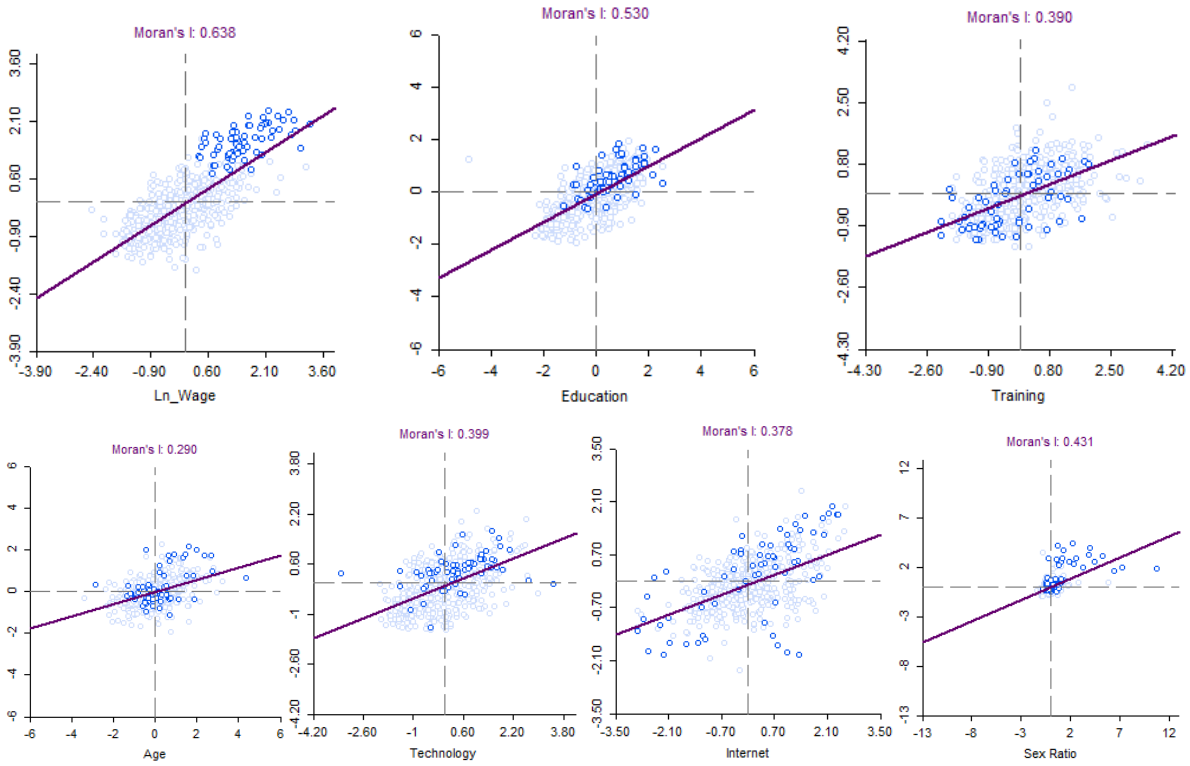


Figure 5. Moran's Index of Wages and Its Determinants, 2019

4.2. Local Indicators Spatial Autocorrelation (LISA) Test

Spatial autocorrelation is a condition where the dependent variable in each region is interconnected with the dependent variable of the neighboring region. The results of the LISA test show that there are 64 regions that have a high wage level and are dependent on their neighbors who also have a high wage level (3 Regency in Sumatra, 17 Regency in Java, 13 Regency in Kalimantan, 6 in Sulawesi, 25 Regency in Papua). There are 93 regions that have low wages and are dependent on their neighbors who also have low wages (29 Regency in Sumatra, 48 Regency in Java, 13 Regency in Nusa Tenggara, and 3 Regency in Sulawesi). However, 2 regions in Papua have a low wage level relationship while the neighboring region has high wage levels and 4 regions (3 Regency in Sulawesi and 1 Regency in Nusa Tenggara) have a high wage level relationship while the neighboring region has low wage levels.

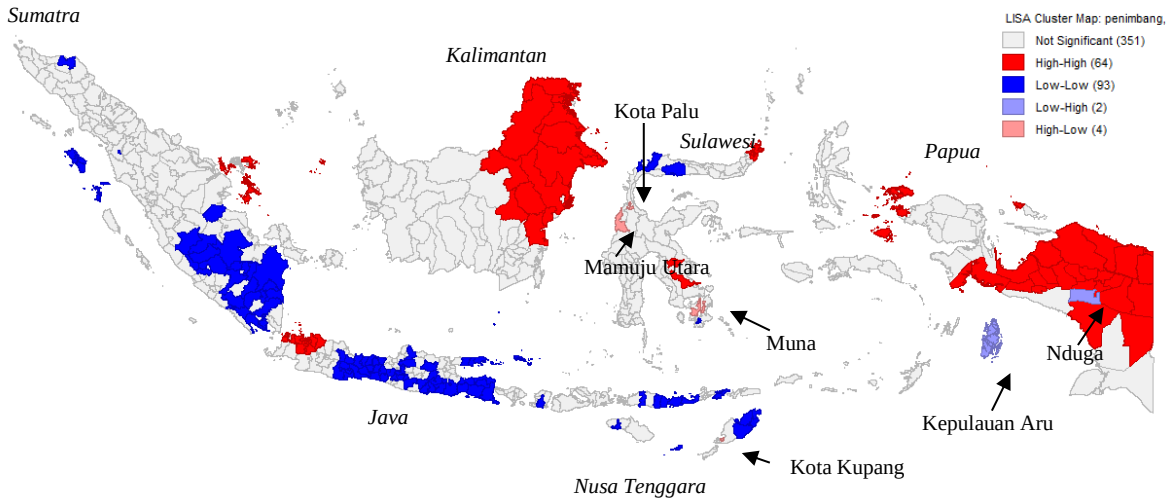


Figure 6. LISA of Wage Level, 2019

High wage levels in several regions in Papua Province have no impact on wage levels in Kepulauan Aru and Nduga Regency. This can be seen from the wage level of Nduga Regency which is still low, while the surrounding area has a high wage level. Kota Kupang, Kota Palu, Muna, and Mamuju Utara Regency shows an inverse relationship, namely by having a high wage level while the surrounding area has a low wage level.

4.3. Spatial Autoregressive Model Test

Spatial model selection is done by using Lagrange Multiplier (LM) as initial identification. Table 2 shows that the LM lag and LM error are significant at a p-value < 0.01. This means that there are spatial dependencies on the model to be formed.

Table 2. Result of Spatial Dependency Diagnostic

Test	MI/DF	Value	Prob.
Moran's I (error)	0.5379	17.2285	0.00000
Lagrange Multiplier (lag)	1.0000	296.9357	0.00000
Robust LM (lag)	1.0000	31.2646	0.00000
Lagrange Multiplier (error)	1.0000	283.2578	0.00000
Robust LM (error)	1.0000	17.5867	0.00003
Lagrange Multiplier (SARMA)	2.0000	314.5224	0.00000

The next analysis is to model the factors that affect the average wage of workers in the region in Indonesia using Spatial Lag (SAL) and Spatial Error Model (SEM) and the following results are obtained.

Table 3. SAL and SEM Parameter Estimation Result

Variable	SAL	SEM
ρ/λ	0,61026	0,71294
Constant	4,93149	13,6946
Education (E)	0,00349*	0,00570*
Training (T)	0,00047	0,00005
Age (A)	0,00749***	0,01101**
Technology (C)	0,00012	0,00186***
Internet (I)	0,00495*	0,00322*
Sex Ratio (R)	0,00056*	0,00037*

Notes: significant parameter at alpha *0,01, **0,05, ***0,1

The SAL model obtained with an R2 value of 0.67 which means that the model can explain the variation of the average wage of 67% is as follows

$$\hat{y}_i = 4{,}93149 + 0{,}00349\, E_i + 0{,}00749 A_i + 0{,}00495\, I_i + 0{,}00056\, R_i + \varepsilon_i \quad (4)$$

$$\varepsilon_i = 0{,}61026 \sum_{i=1, i \neq j}^{n} w_{ij} y_i \quad (5)$$

From the model, for SAL there are 4 significant independent variables with a level of 10 percent and have a positive relationship, namely education (E), age (A), internet (I), and sex ratio (R) variables. So that it can be interpreted that the increase by one unit in education, age, use of the internet, and male workers can increase the average wage of workers in a region equal to the coefficient of each independent variable.

The SEM model obtained with an R2 value of 0.69 which means that the model can explain the variation of the average wage of 69% is as follows

$$\hat{y}_i = 13{,}6946 + 0{,}00570\, E_i + 0{,}01101 A_i + 0{,}00186 T_i + 0{,}00322 I_i + 0{,}00037\, R_i + u_i \quad (6)$$

$$u_i = 0{,}71294 \sum_{i=1, i \neq j}^{n} w_{ij} y_i + \varepsilon_i \quad (7)$$

From the model, for SEM there are 5 significant independent variables with a level of 10 percent and have a positive relationship, namely education (E), age (A), technology (T), internet (I), and sex ratio (R) variables. So that it can be interpreted that an increase by one unit in the percentage in education, age, technology and internet use, and male workers can increase the average wage of workers in a region equal to the coefficient of each independent variable.

By two models formed the use of the SEM model is better than the SAL for estimating the average wage of workers in the region in Indonesia using spatial analysis because the contribution of the influence of the independent variables simultaneously on the dependent variable is greater in the SEM model compared to the SAL model.

5. Conclusion

The conclusions that can be drawn from this research are

- There is a spatial relationship between the average wages of workers, education, training, age, technology use, internet use, and the sex ratio of workers between the region in Indonesia. So that to increase the wages of workers in a region, it can't only be in the region itself, but the neighbor must also participate to increase the wages of its workers, in other words, increasing the wages of workers is a work that synergizes between regions.
- 4 region groups have a spatial relationship to the average wage of workers
  - Region group with a high average wage for workers who have region neighbors that also have high average worker wage
  - Region group that has a low average wage for workers but neighbors to a high average wage worker region
  - Region group with a low average wage for workers who have a neighboring region that also have low average worker wage, and
  - Region group with a high average wage of workers but neighbors to a low average wage worker region.

  The central government can evaluate and provide more intensive policies for region groups that still have low average wages for workers.
- There are 4 independent variables that affect the average wage using the SAL model, i.e. education, age, internet use, and sex ratio and there are 5 independent variables that affect the average wage using the SEM model, i.e. education, age, use of technology and internet, and sex ratio.
- Several efforts can be made by the government in dealing with the average wage inequality among workers in Region in Indonesia, among others: increasing the education of the people, the productive age of workers, increasing internet use, and equalizing wages between female and male workers.
- Increased use of the internet by workers can also increase the wages of workers in a Region, this is in line with the development of an all-sophisticated era, so that advice that can be given to the government is the development of the internet access that is evenly distributed in every region area.
- There is still gender gaps where region that have a ratio of male workers that are greater than women are proven to have a higher average wage. Here, the role of the government is needed to eliminate discrimination in wages between the wages of male and female workers.

6. Acknowledgment

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References

[1] Kuznets, S. (1955). Economic growth and income inequality. *The American economic review*, 45(1), 1-28.
[2] Chun, Natalie; Khor, Niny. 2010. *Minimum Wages and Changing Wage Inequality in Indonesia*. *Asian Development Bank*.
[3] Achmad Tjahja Nugraha, Gunawan Prayitno (2020). Regional Disparity in Western and Eastern Indonesia, International Journal of Economics and Business Administration Volume VIII Issue 4, 101-110.
[4] Anselin L., Bao S. (1997) Exploratory Spatial Data Analysis Linking SpaceStat and ArcView. In: Fischer M.M., Getis A. (eds) Recent Developments in Spatial Analysis. Advances in Spatial Science. Springer, Berlin, Heidelberg.
[5] Mincer, J. A.. (1974). Schooling, Experience, and Earnings. *Columbia University Press*, p. 1-4.
[6] Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, *87*(3), 355-374. doi:10.2307/1882010
[7] Corvers, F.1997, The Impact of Human Capital on Labor Productivity in Manufacturing Sectors of the European Union, Applied Economics. 29 (8), 975- 987
[8] Jones, P., (2001). Are Educated Workers Realy More Productive? Journal of Development Economics. 64 (1), 57-79
[9] Rehman, A. dan Mughal, K. (2013). Impact of Technical Education on the Labor Productivity. International Journal of Economics, Finance and Management, 2 (7), 462-471
[10] Duflo, E. (2001). Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment. *The American Economic Review*, *91*(4), 795-813.
[11] Murphy, K., & Welch, F. (1990). Empirical Age-Earnings Profiles. *Journal of Labor Economics*, *8*(2), 202-229.
[12] Borjas, George J.. (2016). *Labor Economics* (Ed. 7th). New York: McGraw Hill.
[13] Autor, David H., Lawrence R. Katz, and Alan B. Krueger. (1998). "Computing Inequality: Have Computers Changed the Labor Market?" Quarterly Journal of Economics 113: 1169-1213.
[14] Lee, S. H. & Kim, J. (2004). Has the Internet changed the wage structure too? *In Labour economics, an international journal*.
[15] Hirsch, Boris; König, Marion; Möller, Joachim (2009) : Is There a Gap in the Gap? Regional Differences in the Gender Pay Gap, BGPE Discussion Paper, No. 83, FriedrichAlexander-Universität Erlangen-Nürnberg, Bavarian Graduate Program in Economics (BGPE), Nürnberg
[16] Ben Yahmed, Sarra, 2018. "Formal but Less Equal. Gender Wage Gaps in Formal and Informal Jobs in Urban Brazil," *World Development*, *Elsevier*, vol. 101(C), pages 73-87.
[17] Kadir, Kadir & Weni Lidya, Sukma, 2019. "Returns to Education and Wages Distribution in Indonesia: A Comparison across Gender Groups," MPRA Paper 94929, *University Library of Munich, Germany*, revised 25 Apr 2019.
[18] Matthews, S., & Parker, D. M. (2013). Progress in Spatial Demography. *Demographic Research*, *S13*(10), 271–312. https://www.demographic-research.org/special/13/10/
[19] Freguglia, R. S., & Menezes-Filho, N. A. (2012). Inter-regional wage differentials with individual heterogeneity: evidence from Brazil. *The Annals of Regional Science*, *49*(1), 17–34. https://doi.org/10.1007/s00168-010-0432-2
[20] García, I., & Molina, J. A. (2002). Inter-regional wage differentials in Spain. *Applied Economics Letters*, *9*(4), 209–215. https://doi.org/10.1080/13504850110065849
[21] Combes, P.-P., Duranton, G., & Gobillon, L. (2008). Spatial wage disparities: Sorting matters! *Journal of Urban Economics*, *63*(2), 723–742. https://doi.org/https://doi.org/10.1016/j.jue.2007.04.004
[22] Merdekawaty, Rahmah; Ispriyanti, Dwi; Sugito. (2016). Analisis Faktor-faktor yang Mempengaruhi Upah Minimum Kabupaten/Kota di Provinsi Jawa Tengah Menggunakan Model Spatial Autoregressive (SAR). *Jurnal Gaussian*, Volume 5, Nomor 3, Tahun 2016, Hal. 525-534.