

## The Role of Human Capital and Regional Effects on Earnings: *Multilevel Mixed Effect Regression Approach*

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### Abstract

Indonesia has an abundant labor supply, so examining the determinants of earnings that reflect labor productivity is essential. This study is keen to estimate the effect of human capital, demographic factors, and regional (Regency/City) effects on workers' earnings in the Province of Central Java in 2022. The data is collected from the National Labor Force Survey (Sakernas). The multilevel mixed-effect regression is employed to assess the effect of individual characteristics and district-level variation on earnings. The study found that human capital, demographic factors, and regional (Regency/City) effects significantly affect earnings. Education and training are essential to improve workers' skills, leading to higher performance. Further, regional characteristics have contributed to explaining earnings variation across workers in Central Java.

**Keywords:** Labor earnings, human capital, demographic factors, regional effects

**JEL classification:** J00, J01, J10, J12

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### 1. INTRODUCTION

The earnings gap is still a problem in Indonesia. According to reports from World Economic Forum (2016), globally there is a difference in the earnings ratio of female workers to male workers, 0.68. This explains that female workers receive lower earnings than male workers. In addition, data released by the Central Statistics Agency (BPS) states that there is still much inequality in the earnings received by workers when compared to the stipulated Provincial Minimum Earnings (UMP). This problem still occurs in Central Java Province in 2022, the province with the lowest UMP. By using monthly earnings, on average males' workers received IDR 2,171,595 and the female workers received IDR 1,556,835 (please see figure below).

The level of labor productivity influences earnings in producing output. Productivity is

how the ability of the workforce in producing goods and services. The higher the value of goods and services produced per input unit, the more productive that input. One important factor affecting productivity is human capital. Human capital is an investment to support the quality of the workforce. This investment can be made through education. The level of education as an investment in human capital plays an essential role in increasing the quality of labor capital which is better so that it will increase labor productivity (Arshad and Malik, 2015). The higher the education, the earnings received will also increase (Muhi, 2010). In addition to education, the workforce's quality can be improved through increased skills obtained through training, and the use of technology can encourage an increase in the workforce's quality, increasing labor productivity.

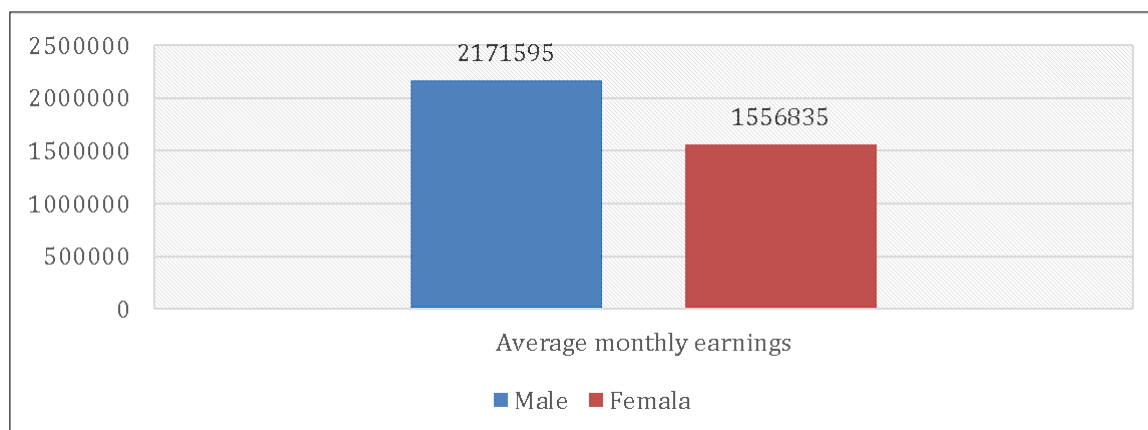


Figure 1: The earnings gaps between male and female worker in the Central Java Province, 2022

Many studies have been conducted on the effect of human capital on workers' earnings and have varied results. Literatures suggest that human capital has a significant and positive effect on productivity, and so is workers' earnings. Muhi (2010) explained that the education level contributes to the earnings received. The level of education as an investment in human capital is essential in improving the quality of a better workforce to increase labor productivity (Arshad and Malik, 2015). The higher the level of education, the higher the performance (Dhian et al., 2013). A study in middle-income countries revealed that the disparity of human capital contributed to income inequality (Pratysto and Panjaitan, 2019). Experience also influences worker earnings (Ratna and Fauziah, 2018). Education, experience, marital status, and residence in urban areas affect income. However, with increasing age, the workforce can no longer increase their ability to work optimally, so that their productivity decreases (Mulyaningsih et al., 2021). Marital status influences earnings differences, especially among young and married female workers. Meanwhile, married male workers are unaffected by the earnings decrease (Diaz and Sanchez, 2013).

Labor characteristics such as demographic factors also affect earnings rates (Haughton, J & Khandker, S.R., 2012). Demographic factors that influence earnings are age, gender, and marital status (Santoso, 2012). Age is an indicator of labor experience. The older the workforce, the

more work experience they have. However, the older the workforce can also cause a decrease in performance capabilities so that productivity decreases (Prayudo et al., 2017). Under these conditions, older workers can earn a lower earnings rate than younger workers. In addition, differences in earnings are also influenced by gender. Male workers tend to earn higher earnings than workers. Women traditionally have responsibility for domestic household tasks, so women have less time to work in the labor market than men (Laili and Damayanti, 2018). Thus, marital status also affects differences in earnings receipts. Married women tend to earn less than unmarried women. Married women are more committed to household production and choose to invest less in education and training and thus earn lower earnings than male workers.

Moreover, literatures suggest that the area of residence affects labor earnings. Differences in earnings also occur based on regions or provinces with different levels of economic growth (Mulyadi, 2003). Differences in human capital characteristics in each individual who lives in each particular region (Regency/City) influence workers' earnings. In addition, there are differences in policies applied to each region that can affect productivity and differences in earnings rates (Ridhwan, 2021). In addition, the existence of local competition and the diversity of cities also impact differences in earnings received. Workers who live in areas with the dominance of the agricultural sector

have different characteristics from those with the industrial sector as support (Glaeser et al., 2016).

Some recent published papers also highlighted the existence of earning inequality for example between educated and uneducated workers (Rokhedi Priyo et al., 2022); male and female (Halim, Hambli and Purnamasari, 2023; Zhu, Xing and Li, 2023), between workers working in the formal and informal sectors (Wulandari, Susilo and Satria, 2018), Considering the existence of earnings inequality among workers in Indonesia, we are keen to examine the determinants of earnings by focusing on the effect of human capital and the effect of the area of residence (Regency/City) on workers' earnings in Central Java Province. Furthermore, another contribution of this study is in terms of methodology. We analyze the effect of the area of residence (Regency/City) on workers' earnings by using a multilevel mixed-effect regression which has not been used in previous studies. Multilevel mixed-effect regression is an approach technique used to analyze hierarchical data, namely where there are variations in different units considering the data structure. This approach has also been used in research conducted by Mulyaningsih et al., (2021) to explain certain data levels that determines the children health outcome in Indonesia to provide more comprehensive results.

Based on the description above, this study aims to: (1) Determine the effect of human capital on workers' earnings in Central Java Province in 2022; (2) Knowing the effect of demographic factors on workers' earnings in Central Java Province in 2022; and (3) Analyze the effect of the region (Regency/City) on the level of earnings of workers in Central Java Province in 2022.

## **2. RESEARCH METHOD**

This research analyzed the influence of human capital, demographic factors, and regional (Regency/City) effects on workers' earnings in Central Java Province using the 2022 National Labor Force Survey (Sakernas) data. Sakernas is a survey of the state of the workforce in Indonesia. The data used includes data on earnings, education level, training, experience, marital status, gender,

and area of residence (Regency/City) of workers in 35 Regencies/Cities in Central Java Province 2022.

The outcome variable is earnings which is defined as compensation for goods and services produced based on the amount of time worked. The Individual-level variables are education, training, experience, marital status, and gender. The education level is the length of the highest education school completed by the workforce in Central Java Province with the unit of length of the school year. Training is defined as a form of investment outside of education to improve skills. The data used is training data attended by workers in Central Java Province. In this study, labor participation is measured by dummy variable equals one if you have attended training and 0 if you have never. Experience is defined as knowledge and skills acquired through involvement in a job. The data used results from the difference between the age of the workforce and the last age of education owned by workers in Central Java Province. Marital status is defined as a demographic characteristic that includes social, economic, biological, legal, and religious aspects. The data used is the marital status of workers in Central Java Province. In this study, the marital status of workers was measured by dummy variable, which equals one if you are married and 0 if you are single, divorced, and widow. Gender is defined as the biological differences between men and women. The data used is the sex of the workforce in Central Java Province. In this study, the gender of the workforce is measured by category in the form dummy variable, which is one if male and 0 if female. The Region-level variable is Region (Regency/City), defined as the location of an individual's residence. The data used are districts/cities in Central Java Province where the workforce resides.

### **2.1 Statistical methodology**

The study employed multilevel mixed effects regression to examine the determinants of earnings among workers in the Central Java Province. In the first stage, we conducted model identification to determine whether it is suitable to utilize the first level and the second level in the empirical model. The first level in the model consists of the

individual level using the variables of the level of education, training, experience, marital status, and gender. Further, the second level in the model consists of the district/city level using data on residential locations in districts/cities in Central Java Province.

Multilevel regression is divided into null model and the conditional model. The null model is only consisted of random intercept and does not include independent variables. The conditional model is a model that includes independent variables and random intercept model allows for the intercept to take different values from a distribution. Below are the null model, conditional model and random intercept model, where  $\beta_0$  is intercept;  $u_{oj}$  group effect or residual;  $\pi/(1-\pi)$  is referred to as the odds that  $y = 1$  and  $\log[\pi/(1-\pi)]$  is the log-odds;  $\beta_{1i}$  coefficient of education;  $\beta_{2i}$  is coefficient for training;  $\beta_{3i}$  is coefficient for experience;  $\beta_{4i}$  is coefficient for marital status and  $\beta_{5i}$  is coefficient for gender of male.

#### Multilevel Regression Models

Null Model:

$$\ln \left[ \frac{\pi_{ij}}{1 - \pi_{ij}} \right] = \beta_0 + u_{oj}$$

Conditional Model:

$$\ln \left[ \frac{\pi_{ij}}{1 - \pi_{ij}} \right] = \beta_0 + \beta_1 \text{education}_i + \beta_2 \text{training}_i + \beta_3 \text{experience}_i + \beta_4 \text{married}_i + \beta_5 \text{male}_i + u_i$$

Random intercept model:

$$\left[ \frac{\pi_{ij}}{1 - \pi_{ij}} \right] = \beta_0 + \beta_1 \text{education}_i + \beta_2 \text{training}_i + \beta_3 \text{experience}_i + \beta_4 \text{married}_i + \beta_5 \text{male}_i + \varepsilon_{ij}$$

Then a significance test was carried out random effect to determine the best model to use. Variance Partition Coefficients (VPCs) are useful for interpreting the variant components within them. Interclass Correlation Coefficient (ICC) explains the differences in characteristics between groups. A simultaneous parameter significance test is used to see the significance of all explanatory variables simultaneously by conducting test  $G^2$  ( $G^2$  tests). A partial parameter significance test was used to see the effect of each parameter. Parameter interpretation is used to see if there is a tendency for events to occur in the first observation compared to the second observation.

The second stage is to carry out multivariate analysis of the equation multilevel regression that followed by post-estimation tests namely winsorize to deal with the problem of distorted data distribution or the presence of outliers without changing the contents of the main data (Reifman & Garet, 2016). Outliers are extreme data deviations from other data. Next, a multicollinearity test was performed to see whether or not there was a correlation between the independent variables in the model.

### 3. RESULTS AND DISCUSSION

The univariate distribution of the frequency of the research variables explains the general description of the descriptive data used in the research variables. The variables consisted of labor earnings, level of education, training, experience, gender, and marital status.

The research was conducted in the Province of Central Java with a total sample of 39,619 individuals in 35 districts/cities. Table 1 shows that the study's total sample consisted of 24,330 male workers and 15,289 female workers. Furthermore, the study sample also consisted of 30,212 workers who were married and 9,407 workers who were never married. Workers with a training history were only 7,920, and the remaining 31,699 had no training history. Workers in Central Java Province have an average length of schooling of 7 years. Meanwhile, the average labor earnings is IDR 1,876,419, with an average experience of almost 22 years after graduating from the last education.

**Table 1. Characteristics of Variables**

	Mean	Std. Deviation	Minimum	Maximum
Earnings (IDR)	1,876,419	1,557,196	137,000	10,000,000
Education (years of schooling)	7.21	3.52	0	20
Experience (years)	21.92	16.15	0	91
Training	0.20	0.40	0	1
Yes		20%		
No		80%		
Gender	0.614	0.49	0	1
Male		61.4%		
Female		38.6%		
Marital Status	0.76	0.43	0	1
Married		76%		
Not Married		34%		

Source: STATA Data Processing

**Table 2. Null Model Testing Results**

Variable	Model 1	Model 2
constant	14.14	14.14
District Level Variances	-	0.049
Individual Level Variance	0.68	0.63
District ICC	-	0.072
ICC Districts and Individuals	-	-
AIC	-	94,256.8
BIC	-	94,265.39
Level Group	Regency	Regency; Individual
Number of Groups	35 Regencies/Cities	35 Regencies/Cities; 39,619
Observation	39,619	39,619
Likelihood ratio test (LR)	-	2,778.73
Prob > chi2	-	0.000

Source: STATA Data Processing

Employees' length of schooling has an average of 7.21. the workforce has an average experience of close to 22 years, with the lowest experience being 0 years and the highest being 82 years. The average earnings for workers in Central Java Province is IDR 1,876,419, with the lowest value of IDR 137,000 and the highest earnings of IDR 10,000,000.

The multicollinearity test is done by looking at the value Variance Inflation Factors (VIF) it was

found that the average VIF <10 was 1.40, which indicated that there was no correlation between the explanatory variables. Then the best model is selected by testing the null model by comparing the two models: model 1, which includes random effect for the district level, and model 2, which includes random effect for district and individual levels. The best model is selected by looking at the value of variation, ICC, likelihood test, probability chi-squares, AIC, and BIC for each level.

Table 2 shows that the second model is the best model by looking at the variance value, ICC value, LR test, AIC, and BIC. So, model 2 (including district and individual random effects) is the best model for multilevel effects. Next, a significance test was carried out with random effect to determine whether there are group differences at the district and individual levels in Central Java. Inspection of random effect done by comparing value deviance in a one-level model with a multilevel regression model without independent variables (null model) by test likelihood ratio.

Table 2 shows that with multilevel regression, a p-value of 0.000 is obtained with  $\alpha = 5\%$  ( $p\text{-value} < \alpha$ ), and the value likelihood ratio of 2778.73 and the value of  $X(0.05; 1)$  is 3.84 so that the LR value  $>$  the chi-squares which mean rejecting  $H_0$ . At the 95% confidence level, a random effect area (Regency/City) significantly affects workers' earnings in Central Java Province. Hence, the multilevel model is better than the one-level regression. The next step is to calculate the value Variance Partition Coefficients (VPCs) as representative of the community-level variance calculated using the variance of the standard logistic distribution, i.e. (equal to 3.29) as the level 1 variance where in this study, level 1 is the individual level.

The constant value for the district level is 0.0487 while the total variance is  $0.0487 + 3.290 = 3.3387$  so that the VPC values for the district and individual levels can be obtained as follows:

$$VPC_{Line} = \frac{0,0487}{(0,0487+3,290)} = 0,0146 \quad (1,5\%)$$

$$VPC_{In} = \frac{3,290}{(0,0487+3,290)} = 0,9854 \quad (98,5\%)$$

The calculation above shows the district and individual level VPC values of 0.0146 which explains that differences influence 1.5% of the variance in workers' earnings in characteristics between districts. The individual level VPC is 0.9854, which explains that individual characteristics influence 98.5% of the variance in workers' earnings. Next, calculate the variation in response variables that can be explained by differences in characteristics between groups Interclass Correlation Coefficient (ICC).

Based on Table 2, the ICC model 2 value obtained interclass correlation at the district level is 0.072. This means that the variation at the district level influences 7.2% in explaining workers' earnings in Central Java Province. Then carried out parameter estimation through Maximum Likelihood Estimation, which is used to calculate the significance of parameters simultaneously to see the effect of all explanatory variables with test (tests). The parameter estimation results show that the value log-likelihood null model of -47127.399 and the value log-likelihood conditional model of -43107.096. Thus, a test was carried out using the formula  $-2(\text{Loglikelihood null model} - \text{Log likelihood conditional model})$ , and the result is 8040.606. Then the value is obtained likelihood ratio with  $X(0.05; 5)$ , which equals 11.07, so the LR value is greater than the table. That is, it can be concluded that rejecting  $H_0$  means that at least one independent variable affects workers' earnings with a 95% confidence level. Next, a partial parameter significance test is carried out by looking at the value p-value and coefficients so that the effect of each parameter can be seen. The decision to reject  $H_0$  if p-value less than  $\alpha$ , so it can be concluded that the independent variables in the multilevel model are in table 3.

Based on Table 3, the test results Likelihood Ratio and value from Variance Partition Coefficients show that there is a random effect area (Regency/City) which is significant for workers' earnings in Central Java Province even though it is only 1.5%. In comparison, for 98.5% it is influenced by differences in characteristics between individuals. This following research conducted by Ridhwan (2021) found that the characteristics of individuals who live in certain regions (regencies/cities) influence workers' earnings. This happens because there are differences in policies between regions that can affect productivity and differences in earnings rates. The non-physical environment, namely social capital, influences productivity and increases income. High social capital will provide impetus to increase human capital so that in various aspects (Kholifa, 2016).

**Table 3. Partial Test Results**

Variable	Coefficient	p-value	Information
<b><i>Fixed Effect</i></b>			
constant	13,52 (0.038)	0,000***	Significant
<b><i>Household Level</i></b>			
Level of education	0,051 (0,001)	0,000***	Significant
Training	0,14 (0,01)	0,000***	Significant
Experience	0,01 (0,00)	0,000***	Significant
Quadratic Experience	-0,0002 (1.34e-05)	0,000***	Significant
Dummy married	-0,12 (0,01)	0,000***	Significant
Male dummy	0,18 (0,02)	0,000***	Significant
Interaction of gender and marital status variables [male]*[married]	0,33 (0,018)	0,000***	Significant
<b><i>Regency level</i></b>			
<b><i>Random Effect</i></b>			
District Influence		0,185 (0,022)	
Individual Influence		0,72 (0,003)	
Likelihood ratio test (LR)		8040,06	
Prob>chi2		0,000	
<b>Observation</b>		<b>39,619</b>	

Source: STATA Data Processing

Note: Figures in less indicate the value of the standard deviation

\*\*\*significant at alpha=0.01; \*\*significant at alpha=0.05; \*significant at alpha=0.10

The study results show that education level positively and significantly affects workers' earnings. Thus, the higher the level of education, the earnings received will increase by 5.1%. These results align with research conducted by Jordahl (2009), who found that the education pursued by individuals affect the abilities of these individuals so that it contributes to income. And vice versa, if the education is low, it affects the earnings. Thus, having a higher education level may boots the income as education increase the quality of human capital that subsequently enhance the ability to work (Gong & Pan, 2023). Another study

by Tran, Paweenawat and Warunsiri., (2023) also provided evidence on the return on education in Vietnam that is approximately 6.5%.

The study results show that training positively and significantly affects workers' earnings. Thus, when workers have attended training, the earnings received will increase by 14.3%. These results follow research conducted by Muhi (2010), which says that training has an essential role in increasing knowledge and skills so that productivity by providing broader knowledge of future work. Training is a form of investment that can increase labor productivity,

so earnings will also increase as skills increase (Pedrini & Gappiello, 2022).

The study results show that experience positively and significantly affects workers' earnings. For every additional year of experience, the earnings received will increase by 1%. These results are per research conducted by Ratna and Fauziah (2018); Dhian et al. (2019), which state that the length of time workers carry out work after completing education contributes to increased workers' skills, leading to higher earnings received. The length of the term of office increases work experience, affecting skills and increasing workforce competence (Mulyaningsih et al., 2021).

The study results show that experience squared negatively and significantly affects workers' earnings. These results align with research conducted by Dhian et al. (2019) and Mulyaningsih et al. (2021), which said that the older the workforce, the lower the ability to absorb new experiences. Thus, the longer they work, the effect of adding experience on earnings will decrease. If the length of work experience has passed the peak point, the increase in experience (long work) harms earnings due to age.

The results showed that the male dummy positively and significantly affected workers' earnings. This means that male workers earn 51.4% higher earnings than female workers. These results were obtained from the sum of the coefficient values of the male dummy (18.5%) and the interaction coefficient values of the male and married dummy (32.9%). Male workers have a higher chance of earning higher earnings than female workers. These results align with research conducted by Zveglic (2019) that men's earnings are higher than women's. Female workers tend to earn less than male workers because the achievements of female workers in specific sectors are lower than those of male workers (Wang & Cai, 2006).

Based on the estimation results, marital status positively and significantly affects workers' earnings. Workers with married status earn 20.5% more than those with unmarried status. These results were obtained from the sum of the coefficient values of the mating dummy (-12.4%)

and the interaction coefficient values of the male and married dummy (32.9%). These results are per research conducted by Pasaribu (2018), which says that married workers think that their work is a guarantee for the future. Hence, they feel more satisfied in carrying out their duties, and labor turnover will be lower than unmarried workers.

The study results show that married male workers positively and significantly affect workers' earnings. Thus, male workers who are married will earn 32.3% higher earnings. These results are per research conducted by Diaz and Sanchez (2013), which states that married male workers have a greater opportunity to increase earnings than women. The company views male workers as the head of the family who must meet the household's needs so that they receive greater benefits from the company.

The results of the study show that there is an association between labor earnings and individual characteristics and area of residence. Individual characteristics consist of the level of education, training, experience, marital status, and gender. The differences in these characteristics lead to differences in earnings receipts between workers.

The level of education has a contribution to the receipt of earnings. The higher the level of education an individual receives, the earnings received will increase. This is because education will increase one's knowledge and skills. The statement also supports the effect of training on labor earnings. Education and training are a form of investment in developing the quality of human capital, thereby increasing productivity. This finding is supported by previous studies such as Rokhedi Priyo et al, (2022) that education has a statistically significant effect on earnings gap between young and old cohorts. Further, Prabowo (2021) that provided evidence on the earnings difference across workers in 2007 and 2014 due to education and experience. Finally, Wulandari, Susilo and Satria (2018) also revealed that the endowment factor that affects earnings inequality namely age, experience, and job training.

Furthermore, experience also has a contribution to the earnings of workers. The longer the individual works, the more proficient the individual is in completing his work. The



amount of experience can be seen from the age at which a person completes his last education and the age when carrying out a job. Experience provides fundamental knowledge that can be implemented in the world of work. Thus, the ability to produce goods and services will increase so that the earnings received also increase. However, as we age, the individual's ability to improve skills will decrease, decreasing productivity. Thus, the longer they work, the earnings received will decrease.

Earnings rates are also affected by gender. Male workers tend to earn higher earnings than female workers. Differences in parenting styles between women and men are one of the reasons for this reduced opportunity. Parents tend to limit their daughter's choices in choosing work professions that look safe for women (Laili and Damayanti, 2018). A recent study by Halim, Hambli and Purnamasari (2023) examined the impact of Covid-19 pandemic on labour market in Indonesia. They found that the pandemic reduced the gap between participation of female and male. However, in terms of earnings, the added female labour force participation may not significant as the increase of participation is mainly from those living in rural areas with low education and working in agricultural sector with lower value added.

Another factor that affects earnings is marital status. Married workers tend to earn higher earnings, especially for men that measured by the interaction between male workers and marital status. The employer considers men as the head of the family who should meet household needs. Thus, the employer provides a commitment in the form of family allowances to male workers. In contrast, women who are currently married have priority to manage the household, so they have less time to improve their skills (Diaz and Sanchez, 2013). Another study by Zhu, Xing, and Li (2023) found that a 1% increase in husbands' wages is associated with a 0.018 percentage point decrease in married women's labor force participation and a decrease of 1.45% worked annually. This evidence implies that there is a specialization in the household between male and

female and assigned male as a bread winner and the female for taking after the families.

The characteristics of an individual's area of residence also factor into differences in earnings receipts. Different policies set in each region affect the company's decision to provide earnings. The difference in Provincial Minimum Earnings (UMP) is one example of a policy that impacts income inequality received. In addition, regional productivity, which is influenced by social and geographical conditions, also provides labor earnings. Regions with industrial economic dominance have higher earnings levels than agricultural ones. This is due to limited mobility and ability to use technology which causes an area to become undeveloped and impacts the low earnings given to workers.

#### 4. CONCLUSIONS

The study results show that the education level positively and significantly affects workers' earnings. The level of education affects individual abilities, so it will affect the level of income received. Training has a positive and significant effect on workers' earnings. Training has an impact in the form of increasing skills to add knowledge to future work. Experience has a positive and significant effect on workers' earnings. The time workers spend carrying out work after completing education contributes to an increase in workers' skills, leading to higher earnings. Meanwhile, experience squared negatively and significantly affects workers' earnings. This is because when the workforce gets older, the ability to absorb new experience will be lower, so the longer they work, the effect of adding experience on earnings will decrease. Male workers have a positive and significant effect on workers' earnings. Male workers receive higher earnings than female workers because male workers' productivity is considered higher than female workers. The gaps between male and female earnings may also explained by earnings discrimination. Workers with marital status have a positive and significant effect on workers' earnings. Workers with marital status receive benefits so that the income received has increased. Area of residence (Regency/City)

affects workers' earnings even though it is only 1.5%. The workforce living in each region has different characteristics and human capital that affect the productivity and earnings of workers.

There are policy implications generated from this study that workers must invest in education and training to improve their productivity. Government should provide more opportunities for workers to attend education and training since for many workers the cost for education and training are not affordable. Further, the earnings gaps between male and female workers should be reduced by eliminating gender discrimination in the labour market and provide more facilitation for female workers to manage their responsibility as mothers, wives and workers.

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