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The Effect of Education on Monthly Wage in Indonesia

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Abstract: In this paper, an Ordinary Least Squares (OLS) regression model is used to analyze the effect of education on monthly wages in Indonesia. It emphasizes both the primary factors—years of education and monthly wages—as well as side factors, such as the year of birth, the children population in 1971, average education among the old, and the urban birth population. The study starts by giving an explanation of the chosen factors and establishing the theoretical justification for their potential impact on wages. The OLS model is then used with several decades of data to examine the relationship between these factors. The paper concludes by interpreting these results and discussing their implications for policymaking, particularly in the realms of education and wage regulation. It emphasizes the significance of education as a major factor influencing wage levels in Indonesia while also highlighting the impact of demographic and sociological factors.

Keywords: education, wage, the effect of education on wage

1. Introduction

1.1. Background

Economists, experts in education, and politicians have all long been interested in the relationship between education and salaries. Understanding this relationship is essential for guiding policy addressing income equality and education in emerging nations like Indonesia. The relationship between education and salaries becomes a crucial predictor of economic mobility and a potential remedy for income inequality. However, the relationship between education and wages may be complicated by several additional societal and demographic factors, making research into this topic difficult.

1.2. Related Research

The connection between education and earnings has been the subject of numerous studies, both internationally and regarding Indonesia. In a thorough analysis of the returns on investments in education across many nations, Psacharopoulos and Patrinos found a strong positive link between educational attainment and earnings [1]. Suryadarma et al.'s research in Indonesia, which focused on the importance of high-quality instruction in raising student achievement and resulting economic gains, supported this global trend [2]. A more targeted method was adopted by Newhouse and Suryadarma, who investigated the importance of vocational education in Indonesia [3]. According to

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their findings, the type of high school and the type of vocational training could have a big impact on the outcomes and salary levels of the job market.

Research from Tran illustrates that in Vietnam, individuals with a lower secondary school diploma tend to secure higher wage incomes [4]. Zhangaliyeva's study identifies a pattern across industrial economies where graduates from vocational schools have a higher probability of employment compared to their peers from other institutions [5]. Further supporting the benefits of education, Bicakova's study leverages data from nearly 40 cohorts of American college graduates and reveals a positive correlation between the unemployment rate at the time of college enrollment and subsequent yearly earnings, a trend particularly pronounced for women [6]. As for older workers, increased education and improved health have been linked to extended working ages, as evidenced by Amilon's study [7]. Finally, Bhattacharjee underscores the critical role of education in wage disparity, highlighting its significant influence on the wage gap between Hindu and Muslim communities [8].

Additionally, demographic factors and their impact on earnings have been researched. By examining the effects of Indonesian school construction on the labor market, Duflo provided a novel viewpoint [9]. This study offered proof that educational possibilities have a big impact on salaries and job market results. The Indonesian Family Life Survey, carried out by Strauss et al. in 2010, also contributed crucial data on the interactions between various demographic characteristics and pay patterns [10].

1.3. Objection

There is still a need for a thorough knowledge of how education affects monthly wages in Indonesia when taking important side factors into account, despite the huge body of research that is currently accessible. By using the Ordinary Least Squares (OLS) regression model to examine the relationship between years of education and monthly wages while accounting for factors like year of birth, the children population in 1971, average education among the elderly, and the urban birth population. This study tries to close this knowledge gap. The results of this study may be useful in understanding Indonesia's wage structures and the factors that influence them, which will help shape future policies regarding income regulation and education.

2. Methodology

This study employs the Ordinary Least Squares (OLS) regression model to investigate the relationship between education and monthly wages in Indonesia, taking into account a number of demographic and societal factors. The OLS model is well-suited for this analysis as it provides efficient, unbiased, and consistent estimates of the relationship between the dependent and independent variables under the assumptions of linearity, independence, homoscedasticity, and normality of residuals. It is particularly useful in this context because it allows for the precise quantification of the effect of an additional year of education on monthly earnings while controlling for the impact of other variables.

2.1. Source Of Data

The 'inpresdata.tab' dataset from 'Replication Data for Internal Migration and Labor Market Outcomes in Indonesia' by Bharati, Fakir, and Yoman is ideal for this study due to its significant size of 152,990 observations across 26 variables. Additionally, the dataset allows for a nuanced exploration of the interplay between education, demographic, social, and economic variables, and wages.

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2.1.1. Dependent Variable

The dependent variable in our study is the 'monthly wage'(wage) in Indonesia. Monthly wages in this analysis are considered as continuous and are likely to be influenced by the independent variables. Inflation-adjusted real wage rates are used to reflect the true purchasing power of a person's income for the purposes of this study.

2.1.2. Independent Variable

The primary independent variable under examination is the 'years of education.'(yeduc) This variable represents the total years of formal education that an individual has completed. It is presumed that as the years of education increase, the skill level and thus, the employability of an individual increases, leading to higher monthly wages. The side factors included in our model are 'year of birth,(p504thn)' 'children population in 1971,(ch71)' 'average education among the old(moldyed),' and 'urban birth population(urban).' These variables have been selected based on previous research indicating their potential influence on wages. The 'year of birth' may capture generational effects on wages, 'children population in 1971' might act as a proxy for population growth and labor market competition, 'average education among the elderly' can reflect societal changes in educational norms, and 'urban birth population' may account for wage differentials between urban and rural areas.

2.2. Data Processing

Data processing for the OLS regression models involved a series of steps, progressively integrating more variables and interaction terms into the analysis.

The initial model (3.1.1) explored the bivariate relationship between the 'monthly wage' (dependent variable) and 'years of education' (yeduc) as the only independent variable. Subsequent steps (3.1.2) gradually introduced additional independent variables and their interaction terms.

Model 1) incorporated the variable 'p504thn' along with an interaction term with 'yeduc,' capturing the potential modifying effect of 'p504thn' on the education-wage relationship. In Model 2) the variable 'ch71' and its interaction with 'yeduc' were included, while Model 3) introduced 'moldyed' into the equation. These iterations allowed the exploration of how the addition of demographic and societal factors, and their interactions with education, could influence wages. The final model 4) included 'urban,' the last independent variable. By sequentially building up the model, it's possible to analyze the incremental effect of each additional variable and interaction term on wages. This step-by-step approach aids in maintaining control over the model's complexity and enables a more nuanced understanding of the factors influencing wages in Indonesia.

$$\text{Wage} = \beta 0 + \beta 1 * \text{yeduc} + u \tag{1}$$

$$\text{Wage} = \beta 0 + \beta 1 * \text{yeduc} + \beta 2 * \text{p504thn} + \beta 3 * \text{yeduc} * \text{p504thn} + u \tag{2}$$

$$\text{Wage} = \beta 0 + \beta 1 * \text{yeduc} + \beta 2 * \text{p504thn} + \beta 3 * \text{yeduc} * \text{p504thn} + \beta 4 * \text{ch71} + \beta 5 * \text{yeduc} * \text{ch71} + u \tag{3}$$

$$\text{Wage} = \beta 0 + \beta 1 * \text{yeduc} + \beta 2 * \text{p504thn} + \beta 3 * \text{yeduc} * \text{p504thn} + \beta 4 * \text{ch71} + \beta 5 * \text{yeduc} * \text{ch71} + \beta 6 * \text{moldyed} + u \tag{4}$$

$$\text{Wage} = \beta 0 + \beta 1 * \text{yeduc} + \beta 2 * \text{p504thn} + \beta 3 * \text{yeduc} * \text{p504thn} + \beta 4 * \text{ch71} + \beta 5 * \text{yeduc} * \text{ch71} + \beta 6 * \text{moldyed} + \beta 7 * \text{urban} + u \tag{5}$$

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2.3. Evaluation Metric

The evaluation of the OLS regression models in this study is primarily based on standard statistical measures that assess the model's goodness of fit and the statistical significance of the parameter estimates. The coefficient of determination, or R-squared, is a key metric used to quantify the proportion of the variance in the dependent variable (monthly wage) that is predictable from the independent variables (years of education and other demographic and societal factors). A greater R-squared indicates that the model fits the data better.

The t-statistics and associated p-values for the individual coefficients are examined to assess the statistical significance of each independent variable. The standard errors of the coefficient estimates are used to gauge the precision of these estimates, with smaller standard errors indicating more reliable estimates. Lastly, the residuals from the models are analyzed for any patterns that might suggest violations of the assumptions of OLS regression. This comprehensive approach to model evaluation ensures that the models are statistically sound and provide valid insights into the effect of education on monthly wages in Indonesia.

In addition to the elements already discussed, the standard error, usually denoted as SE, is also considered. It measures the accuracy with which a sample represents a population by assessing the dispersion of the sample mean around the population mean. Moreover, the error term often symbolized as 'u', also called residual, was inspected. This term accommodates the unobserved factors that influence wages, enabling the regression model to accommodate the inherent randomness in the dataset, which in turn enhances the validity and accuracy of the data interpretation.

3. Results

3.1. Correlation Analysis

3.1.1. Single Regression: Monthly Wage (wage) and Year of Education (yeduc)

Table 1: Single Regression with wage and yeduc.

Linear regression				Number of obs = 61,136 F(1, 61134) = 4804.44 Prob > F = 0.0000 R-squared = 0.1225 Root MSE = 1.9e+05	
Wage	Coefficient	Std.err	T	P>|t|	[95% conf. interval]
yeduc	17910.03	258.3896	69.31	0.000	17403.58 18416.47
_cons	57405.06	2029.331	28.29	0.000	53427.56 61382.55

From table 1, the formula was used to analyze the effect of years of education (yeduc) on monthly wages (wage) in Indonesia. With 61,136 observations, the model proved statistically significant with an F-value of 4804.44 and a p-value of less than 0, indicating that the model fits the data substantially better than an empty model.

The coefficient for years of education (yeduc) is estimated to be 17910.03, suggesting that an additional year of education is associated, on average, with an increase in monthly wage by about IDR 17,910.03, assuming other factors are held constant. This effect is statistically significant, with a t-value of 69.31 and a p-value of 0, indicating a strong positive relationship between education and wages.

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The constant term (β0) in the model, also known as the y-intercept, is estimated to be 57405.06. This can be interpreted as the estimated average monthly wage for individuals with zero years of education.

However, it should be noted that the R-squared value for the model is 0.1225, suggesting that only about 12.25% of the variation in the monthly wage can be explained by years of education alone. This indicates that there are other factors not included in the model that also influence the monthly wage which leads to multi regression analysis in the next step. The Root Mean Square Error (MSE) of 1.9e+05 indicates the standard deviation of the residuals and represents the dispersion of the observed values from the predicted values. The robust standard errors indicate that the model's estimates are reliable, accounting for potential heteroskedasticity in the residuals.

3.1.2. Multi Regression

1) Introducing Factor Year of Birth (p504thn)

Table 2: Multiple Regression with wage, yeduc, p504thn, and their interactions.

Linear regression			Number of obs = 61,136 F(3, 61132) = 1839.52 Prob > F = 0.0000 R-squared = 0.1649 Root MSE = 1.9e+05		
Wage	Coefficient	Std.err	T	P>|t|	[95% conf. interval]
yeduc	70241.23	2820.406	24.90	0.000	64713.22 75769.23
p504th	2056.27	356.4039	5.77	0.000	1357.718 2754.82
c.yeduc#c.p504thn	-846.7073	45.42034	-18.64	0.000	-935.7313 - 757.6833
_cons	-67235.16	21687.55	-3.10	0.002	-109742.8 - 24727.5

From table 2, the model, with 61,136 observations, was statistically significant, as indicated by an F-value of 1839.52 and a p-value of less than 0.0001. This implies the model significantly fits the data better than an empty model.

The coefficient of years of education (yeduc) is 70,241.23. This means, on average, an additional year of education corresponds to an increase in monthly wage by IDR 70,241.23, assuming other factors are held constant. This effect is statistically significant (t=24.90, p<0.0001), reinforcing the strong positive association between education and wage.

The year of birth (p504thn) has a coefficient of 2056.27, indicating that individuals born a year later are associated, on average, with an increase in monthly wage by IDR 2056.27, given other factors remain constant. This effect is also statistically significant (t=5.77, p<0.0001).

However, the interaction term between years of education and year of birth shows a negative coefficient of -846.7073, which is statistically significant (t=-18.64, p<0.0001). This suggests that the wage benefits of education decrease for individuals born in later years, holding all else constant.

The R-squared value is 0.1649, suggesting that about 16.49% of the variance in monthly wage is accounted for by the years of education, year of birth, and their interaction. This represents an improvement from the previous model that included only years of education. However, it still leaves

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a substantial proportion of the variance in wages unexplained by the model, suggesting other factors not included in the model also influence the wage. The Root Mean Square Error (MSE) of 1.9e+05 continues to represent the dispersion of observed values from the predicted values, and robust standard errors ensure the reliability of the estimates.

2) Introducing Children Population in 1971 (ch71)

Table 3: Multiple Regression with wage, yeduc, p504thn, ch71 and their interactions.

Linear regression			Number of obs = 61,136 F(5, 61130) = 1180.53 Prob > F = 0.0000 R-squared = 0.1703 Root MSE = 1.9e+05		
Wage	Coefficient	Std.err	T	P>|t|	[95% conf. interval]
yeduc	66430.08	2754.214	24.12	0.000	61031.81 71828.34
p504th	2086.909	355.6479	5.87	0.000	1389.838 2783.979
c.yeduc#c.p504thn	-859.574	45.44697	-18.91	0.000	-948.6501 -770.4978
ch71	-.2031026	.0184222	-11.02	0.000	-.2392103 -.166995
c.yeduc#c.ch71	.0289444	.0023415	12.36	0.000	.024355 .0335337
_cons	-35898.14	21135.68	-1.70	0.089	-77324.13 5527.845

From table 3, the regression model expands to include the variables of years of education (yeduc), year of birth (p504thn), children population in 1971 (ch71), and the interaction of years of education with year of birth and children population in 1971 to assess their influence on monthly wage (wage) in Indonesia. With 61,136 observations, the model maintains strong statistical significance, as indicated by an F-value of 1180.53 and a p-value less than 0.0001.

The years of education (yeduc) has a significant positive impact on monthly wages, with an additional year of education increasing wages by IDR 66,430.08 (coefficient: 66,430.08). Similarly, being born a year later also increases monthly wages by IDR 2086.909 (coefficient: 2086.909). However, the interaction of these two variables shows a negative impact on wages, with the benefit of education decreasing for those born in later years (coefficient: -859.574). The children population in 1971 (ch71) has a negative effect on wages (coefficient: -0.2031026), though this is offset by higher education levels (interaction term coefficient: 0.0289444).

Finally, the R-squared value for this model is 0.1703, indicating that approximately 17.03% of the variance in monthly wage can be accounted for by the model. This represents a slight increase in explanatory power from the previous model, but a significant proportion of the variance in wages remains unexplained, indicating the influence of other unaccounted factors. The Root Mean Square Error (MSE) of 1.9e+05 continues to denote the spread of the observed values around the predicted values, while robust standard errors confirm the reliability of the model's estimates.

3) Introducing Average Education Among Old (moldyed)

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Table 4: Multiple Regression with wage, yeduc, p504thn, ch71, moldyed and their interactions.

Linear regression			Number of obs = 61,136 F(6, 61129) = 989.41 Prob > F = 0.0000 R-squared = 0.1748 Root MSE = 1.9e+05		
Wage	Coefficient	Std.err	T	P>|t|	[95% conf. interval]
yeduc	67138.19	2750.896	24.41	0.000	61746.43 72529.96
p504th	2307.739	355.4834	6.49	0.000	1610.991 3004.487
c.yeduc#c.p504thn	-881.5999	45.44138	-19.40	0.000	-970.6652 -792.5347
ch71	-.1729203	.0023234	11.38	0.000	-.2088748 -.1369658
c.yeduc#c.ch71	.0264373	.0023415	12.36	0.000	.0218835 .0309912
moldyed	8799.146	522.8953	16.83	0.000	7774.269 9824.022
_cons	-110322.1	21624.16	-5.10	0.000	-152705.5 -67938.65

From table 4, The expanded model includes years of education (yeduc), year of birth (p504thn), children population in 1971 (ch71), average education among the older population (moldyed), and the interactions of years of education with year of birth and children population in 1971, the association with the monthly wage (wage) in Indonesia remains statistically significant. With 61,136 observations, the model's F-value is 989.41, and the p-value is less than 0.0001, affirming the model's validity.

The coefficient of years of education (yeduc) is now at 67,138.19. This means that an unit increase of year of education is associated with an average increase in the monthly wage of IDR 67,138.19, holding other variables constant. This is statistically significant ($t=24.41$, $p<0.0001$).

The birth year (p504thn) positively correlates with monthly wages, with each subsequent year increasing wages by IDR 2307.739 (coefficient: 2307.739). However, the interaction between years of education and year of birth negatively impacts wages, implying that wage benefits from education diminish for those born later (coefficient: -881.5999). The children population in 1971 (ch71) negatively affects wages (coefficient: -0.1729203), but this is mitigated by higher education levels (interaction term coefficient: 0.0264373). New in this model, the average education among the older population (moldyed) has a coefficient of 8799.146, which is statistically significant ($t=16.83$, $p<0.0001$). This implies that as the average education level among the older population increases, the monthly wage also increases, holding other variables constant.

The R-squared value is now 0.1748, indicating that approximately 17.48% of the variance in monthly wage is accounted for by the model. This is another slight improvement in explanatory power over the previous model, although a large ratio of the variance in wages remains unexplained. The Root Mean Square Error (MSE) of 1.9e+05 continues to show the spread of the observed values around the predicted values, while robust standard errors affirm the model's estimates' reliability.

4) Introducing Urban Birth Population (urban)

From Table 5, An even more comprehensive model (5), with added urban birth population (urban) variable and its interaction terms, the associations with the monthly wage (wage) in Indonesia remain

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statistically significant, and the model continues to be valid with an F-value of 851.94 and a p-value less than 0.0001.

Table 5: Multiple Regression with wage, yeduc, p504thn, ch71, moldyed, urban, and their interactions.

Linear regression			Number of obs = 61,136 F(7, 61128) = 851.94 Prob > F = 0.0000 R-squared = 0.1771 Root MSE = 1.9e+05		
Wage	Coefficient	Std.err	T	P>|t|	[95% conf. interval]
yeduc	68454.28	2763.964	24.77	0.000	63036.9 73871.66
p504th	2401.163	355.7701	6.75	0.000	1703.852 3098.473
c.yeduc#c.p504thn	-899.7435	45.60867	-19.73	0.000	-989.1366 -810.3504
ch71	-.1579981	.0182945	-8.64	0.000	-.1938553 -.1221409
c.yeduc#c.ch71	.0258853	.002317	11.17	0.000	021344 .0304266
moldyed	1526.407	711.9286	2.14	0.000	131.025 2921.789
urban	34547.61	2732.681	12.64	0.000	29191.55 39903.67
_cons	-74858.13	21380.8	-3.50	0.000	-116764.6 -32951.7

With each additional year of education (yeduc), monthly wages increase by IDR 68,454.28 (coefficient: 68,454.28). Each subsequent birth year (p504thn) associates with a wage increase of IDR 2401.163 (coefficient: 2401.163), but this benefit diminishes for those born later, as shown by the negative interaction with years of education (coefficient: -899.7435). An increase in the 1971 children population (ch71) negatively affects wages (coefficient: -0.1579981), but this is less impactful for those with more education (interaction term coefficient: 0.0258853). The average education among the older population (moldyed) has a coefficient of 1526.407, implying that as the average education level among the older population increases, the monthly wage also increases, holding other variables constant. This is statistically significant but less so than in the previous model ($t=2.14$, $p=0.032$).

New in this model, the urban birth population (urban) has a coefficient of 34,547.61, which is statistically significant ($t=12.64$, $p<0.0001$). This suggests that being born in an urban area is associated with an increase in the monthly wage of IDR 34,547.61, holding other factors constant.

The R-squared value is now 0.1771, indicating that approximately 17.71% of the variance in monthly wage is explained by the model, a minor improvement in explanatory power over the previous model. The Root Mean Square Error (MSE) remains at 1.9e+05, showing the spread of the observed values around the predicted values, while robust standard errors continue to reinforce the reliability of the model's estimates.

3.2. Model Training and Evaluation

The evaluation of the models reveals that they are statistically significant with increasing explanatory power from the first to the final model, as indicated by the rising R-squared value. Each variable's coefficient is statistically significant, indicating its relevance in wage prediction. The consistency of the Root Mean Square Error across models suggests a stable error level. Despite incremental

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improvements with each additional variable, the R-squared value in the final model suggests that other factors, not included in the model, might also significantly influence wages.

4. Discussion

The present study employed a series of robust OLS models to analyze the effect of variables such as education, birth year, population of children in 1971, average education among the elderly, and urban birth population on wage prediction in Indonesia. The findings demonstrate the considerable influence of these variables on wages.

The educational variable (yeduc) was seen to be a significant determinant of wages across all models. As expected, a higher number of educational years correlated positively with higher wages. This result is consistent with the human capital theory, indicating that investments in education are likely to enhance economic outcomes for individuals. It also affirms the widely held belief that education is a significant determinant of earning potential.

Moreover, the birth year (p504thn) displayed significance in the models, suggesting that age may have an impact on wages. The population of children in 1971 (ch71) and the average education among the elderly (moldyed) were also found to be influential, highlighting the potential role of demographic factors and societal education levels in shaping income levels.

Interestingly, urban birth population (urban) was significantly associated with wages. This aligns with theories suggesting that urban areas, due to factors like better access to resources and opportunities, may offer higher wage potential.

However, despite the statistical significance of the models and the variables, the final model only accounted for approximately 17.71% of the variability in wages, as indicated by the R-squared value. This suggests the presence of other significant predictors that were not included in the model, emphasizing the complexity of wage determination and the multi-faceted nature of economic outcomes.

In conclusion, this study provides valuable insights into wage determination in Indonesia, highlighting the significance of education, demographic factors, and urbanization. Yet, it also underscores the need for further research to explore other potentially influential factors in wage prediction such as high program region and enrollment rate, to create a more comprehensive model.

5. Conclusion

The study set out to examine the impact of education on wages in Indonesia, incorporating factors such as urban birth population, average education among the old, and population of children born in 1971. The methodology consisted of a multistage Ordinary Least Squares (OLS) regression model that introduced variables in a staged manner to explore individual and combined impacts on wage.

The findings from this study are quite revealing. Education showed a consistent and robust positive impact on wages, underlining the well-established theory of human capital investment. The research also revealed a nuanced interaction between education and factors like the year of birth and children population in 1971. These factors when coupled with education had a significantly different impact on wages compared to their individual effects, highlighting the importance of considering multifaceted realities in wage determination. The findings underline that education does not work in isolation and that socio-demographic contexts influence its impact on wages.

Incorporating the average education among the old and urban birth population expanded understanding of the labor market dynamics in Indonesia. These variables not only directly influenced wages but also affected the wage-education relationship, demonstrating the multidimensional complexity of the labor market.

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In conclusion, the research has shown the importance of education for wage determination, confirming previous theoretical and empirical studies. It has also uncovered the nuanced influence of demographic and socio-economic variables on wages, highlighting the need for a more comprehensive understanding of labor market dynamics. Further research could explore other potential moderating variables and their interactions with education to further understand wage dynamics. Overall, the findings underscore the need for continued investment in education and consideration of demographic and socio-economic contexts to improve wage outcomes and achieve greater economic equality.

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