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Does Vertical Educational Mismatch Hinder Economic Growth?: Evidence from Indonesia

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Abstract

Most studies have examined the effects of overeducation and undereducation on individual wages; however, only a few scholars have investigated the impact of this vertical educational mismatch on economic growth. Therefore, this study attempts to enter this area of analysis. The effect of overeducation and undereducation on economic growth was examined using panel data from 33 provinces in Indonesia between 2012 and 2022. Using the System Generalized Method of Moments (Sys-GMM) estimator, this study found empirical evidence that overeducation reduces economic growth. This implies that even if overeducation yields a positive return on individual wages, it remains detrimental at an aggregate level. The negative effect of overeducation on economic growth suggests that overeducation is a form of human capital and external education inefficiency. Thus, it needs to be addressed seriously by the Indonesian government. On the other hand, this study found no evidence that undereducation has an impact on Indonesia's economic growth.

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INTRODUCTION

Vertical educational mismatch remains a global issue. In this context, vertical educational mismatches are overeducation and undereducation (Wu and Wang, 2018). Overeducation is a condition in which a worker has a higher level of education than the level required to perform their current job. Conversely, undereducation is a condition where a worker has an educational background that is too low compared to the educational requirements for their current job (Mehta et al., 2011).

The International Labor Organization (ILO) noted that in 2021, as many as 52.4% of the workforce did not work in a position commensurate with their educational level. From these numbers, 36.9% were undereducated, and 15.5% were overeducated. This could potentially reduce individual wages and hinder economic growth. However, most studies only examine the effect of vertical educational mismatch on individual wages. Studies discussing the impact of overeducation and undereducation on economic growth are still rare (Battu and Bender, 2020).

The effect of undereducation and overeducation on economic growth seems unclear due to theoretical diversity. Referring to Thurow's (1975) job competition theory, wages are determined by the level of productivity, which is not always directly related to the level of education. As a result, undereducated workers would receive a wage premium because their work requires a skill level higher than their education level. Using the Verdugo and Verdugo (1989) model, several studies, such as Bauer (2002), Nieto (2014), Cattani et al. (2014), Park and Jang (2017), Johnes (2019), Carmichael et al. (2021), and Sun and Kim (2022), found an undereducation wage premium. If accumulated on a macro scale, the wage premium from undereducated workers is predicted to have a positive impact on economic growth.

Nevertheless, the wage premium of undereducated workers can be a double-edged sword. On the one hand, high wages for undereducated workers may encourage economic growth by increasing individual income. On the other hand, employers who provide wages that are too high for undereducated workers seem to bear an inefficiency. It is challenging to determine whether the impact of undereducation on economic growth is positive or negative. Conversely, human capital theory, as proposed by Becker (1992), predicts that undereducated workers will receive lower wages. Therefore, too many undereducated workers would reduce economic growth. Shin (2012) demonstrated this by finding that undereducation hinders economic development and even reduces economic growth, particularly in countries with a knowledge-based economy.

Most of the workforce in developing economies tends to be undereducated (Iyigun & Owen, 1996). In developed countries, however, the percentage of overeducated workers is likely to be higher than that of undereducated ones. Therefore, if most of the workforce experiences undereducation in developing countries, it will reduce the unemployment rate, thereby increasing economic growth (Iyigun and Owen, 1996). This contradicts the human capital theory (Becker, 1992), which suggests that undereducation would harm economic growth, while overeducation would enhance it.

From the perspective of human capital theory, the level of education determines productivity. Workers with higher education (even if they are overeducated) will still get positive wage returns. Using the ORU (overeducation, required, and undereducation) model from Duncan and Hoffman (1981), several studies, such as Iriondo and Amaral (2016) and Clark et al. (2017), found a positive return on overeducation. In other words, the high level of overeducation in a country shows that the distribution of education, the average length of schooling, and the human capital of society in that country are also high. The high level of human capital, as reflected in a high proportion of overeducated workers, could contribute to increased economic growth. Ramos et al. (2012) confirmed this assumption. They mentioned that

countries with high economic growth tend to have high rates of overeducation.

Nevertheless, the primary issue with vertical educational mismatch is inefficiency in human capital. This inefficiency can hinder the contribution of education to economic growth. The wage penalty resulting from vertical mismatch indicates a low rate of return to education. The level of this rate of return can influence economic growth because educational attainment, often measured by the human capital index, can drive economic growth, as explained in the endogenous growth theory by Mankiw et al. (1992) and Romer (1994).

According to the job satisfaction hypothesis, overeducation is a form of underutilization detrimental to the company or employer (Brynin and Longhi, 2009). Even if overeducated workers have a positive return, the employers bear the inefficiency (Duncan and Hoffman, 1981; Hartog and Oosterbeek, 1988). Therefore, even if overeducation still has economic value, it has a potential obstacle to obstructing economic growth.

Predicting the effect of overeducation on economic growth based solely on its impact on individual wages is inaccurate. In analyzing the impact of vertical educational mismatch on economic growth, data on the incidence of overeducation and undereducation need to be aggregated on a macro scale—for instance, data at the country, regional, or provincial level. Several studies, including those by Grammare and Guironnet (2009), Abidin and Zakariya (2018), and Neycheva (2020), investigate the macroeconomic effects of overeducation on economic growth. They found that overeducation hinders economic growth.

This current study adopts this approach. We analyze the effect of vertical educational mismatch using panel data from 33 provinces in Indonesia. We used province-based data due to the high prevalence of vertical educational disparities across all provinces in Indonesia. The severity of vertical educational mismatch heterogeneity between provinces tends to be determined by urban and rural areas, as revealed by Hakim et al. (2024), who found that the vertical mismatch rate among college graduates was quite high in both urban and rural areas, but higher in the latter.

The vertical mismatch problem across Indonesia's provinces also tends to be resilient. This condition develops relatively slowly, with systematic changes related to the expansion of educational access and the dynamics of labor supply and demand. Consequently, vertical educational mismatches (i.e., over- and undereducation) are relatively endogenous (Cutillo & Pietro, 2006; Murillo et al., 2012). Therefore, we employ the generalized method of moments (GMM) estimator to address this potential endogeneity issue. We employ data from Indonesia's National Labor Force Survey (Sakernas), conducted by the Central Bureau of Statistics (BPS), for the period 2012 to 2022. The Sakernas survey produces Indonesia's most complete employment database.

Once the incidence of vertical educational mismatch is determined, it is aggregated to the provincial level. Additionally, as a form of novelty, three distinct indices were developed and tested for measuring both overeducation and undereducation. The first index is the logarithmic value of the number of workers experiencing undereducation or overeducation. The second index is the percentage value of undereducated or overeducated workers in the provinces. The last index is a province's average annual educational surplus and deficit. This study chose Indonesia as the object for two main reasons. First, Indonesia exhibits a significant level of vertical and horizontal educational mismatch; for instance, the ILO noted that in 2021, 66.53 million Indonesian workers, or approximately 70.7% of the total workforce, had a vertically mismatched education. Second, Indonesia is currently experiencing a demographic bonus; if the government mishandles the incidence of vertical educational mismatch, it could lead to a demographic catastrophe. Murillo et al. (2012) found that a high vertical educational mismatch, especially overeducation, indicates ineffective implementation and allocation of educational resources to achieve economic development.

RESEARCH METHODS

This study utilized data from Indonesia's National Labor Force Survey (Sakernas), conducted by the BPS from 2012 to 2022. We compiled overeducation and undereducation indices for each province from that database. Theoretically, there are three methods to measure overeducation and undereducation: subjective, job analysis (JA), and statistical. In the subjective method, researchers ask respondents whether they experienced a vertical educational mismatch. Meanwhile, the JA method generates the vertical educational mismatch by matching one or more digits of the job type code in the International Standard Classification of Occupations (ISCO) with the minimum years of education required to obtain or perform that job. If the education attained by the worker exceeds the required years, then they are overeducated. Conversely, if the years of education attained are lower than required, they are undereducated (Duncan and Hoffman, 1981).

In this study, the measurement of overeducation and undereducation utilizes the Job Analysis (JA) method. The JA method operates by matching the first-digit occupational code from ISCO with the individual's year of educational attainment. The required education is determined by the JA method based on the skill level derived from the 2011 International Standard Classification of Education (ISCED). For instance, the minimum skill level required to become a technician and associate professional is ISCO 5, which corresponds to short-cycle tertiary education and, when converted into years of education, is equivalent to 15 years (approximately equivalent to a Diploma III). If the years of education of individuals working as technicians and associate professionals are exactly 15, they are declared matched; if below 15, they are undereducated, and those with more than 15 years are overeducated. The number of undereducated and overeducated workers for each province is then aggregated. That vertical educational mismatch is mapped at the provincial level into logarithmic values, percentage values, and average educational surplus and deficit years of schooling. This study prefers the JA method due to the large sample available in the Sakernas database. This large sample size could result in a high standard deviation, potentially introducing bias to the resulting vertical educational mismatch if estimated using the Regression Method (RM). Therefore, this study considers the JA method relatively more accurate when the available sample is large. However, no consensus among researchers exists regarding which method is the most accurate in estimating vertical educational mismatch to date. If overeducation and undereducation are defined as years of surplus and deficit education, their effect on economic growth is as follows:

$$\mathrm{GROWTH}_{it} = \alpha + \beta_1 \mathrm{YOVER}_{it} + \beta_2 \mathrm{YUNDER}_{it} + \beta_j X_{jit} + u_{it} \quad \text{..... (1)}$$

The term GROWTH refers to economic growth, which is measured based on the growth rate of real GDP per capita. YOVER is defined as the average number of years of surplus education (overeducation) in province i in year t, while YUNDER is the average number of years of deficit education. *Xj* are vectors to control individual heterogeneity: domestic investment (DI), foreign direct investment (FDI), proportion of formal sector (FORMALPERCENT), mean years of schooling (MYS), average inflation rate (INFLATION), and Gini coefficient (GINIPERCENT). Meanwhile, the composite error term uit follows the one-way error component model, where uit = μi + νit. In this specific case, μi represents the unobserved individual-specific effect (or unobserved province heterogeneity) that remains constant over time, while νit denotes the idiosyncratic error term (or usual stochastic regression disturbance) that varies across individuals and time.

Equation 1 potentially suffers from multicollinearity because YOVER (overeducation) may be highly correlated with YUNDER (undereducation), as both variables are determined by the number of workers in province i in year t. Therefore, this study separated the undereducation and overeducation

variables to avoid multicollinearity bias when estimating the effect of vertical educational mismatch on economic growth. It also correlated all explanatory variables to detect and further avoid multicollinearity. Besides potentially experiencing multicollinearity, Equation 1 also has the potential for endogeneity bias because the undereducation and overeducation variables are not strictly exogenous (Wu and Wang, 2018), meaning they may be correlated with past and current error terms. Apart from these two vertical educational mismatch variables, other control variables, such as the unemployment rate, DI, FDI, and the Gini coefficient, are also not wholly exogenous. Referring to Wooldridge (2001), explanatory variables that are not entirely exogenous can trigger endogeneity bias. Additionally, Baltagi (2005) states that economic indicators are susceptible to this bias. Endogeneity bias, in this context, refers to the condition where any explanatory variable is correlated with the error terms μ and v. To overcome this potential endogeneity bias, we employed the System Generalized Method of Moments (Sys-GMM) estimator, as proposed by Arellano and Bover (1995) and Blundell and Bond (1998).

The System Generalized Method of Moments (Sys-GMM) estimator was chosen because the time dimension (T) is lower than the number of cross-sectional units (N), a condition referred to as limited time series data. The model tested in this study comprises 11 time series units (2012-2022) and 33 cross-sectional units, representing provinces in Indonesia. In these specific conditions, Sys-GMM is considered more efficient than the First Difference GMM (FD-GMM) or Instrumental Variable (IV) estimators, as noted by Blundell and Bond (1998). The use of Sys-GMM also aims to control for time-unvarying regional-specific effects (in this case, provinces) that do not change over time, thereby avoiding the problem of assuming heteroscedasticity and serial correlation. Furthermore, Sys-GMM can increase precision and reduce the bias associated with limited sample sizes (Blundell et al., 2000). The Sys-GMM estimator was also chosen in accordance with the rule of thumb from Blundell et al. (2000), which suggests that if Sys-GMM is employed, the study should ensure that the estimated results from the fixed effects are higher than those from FD-GMM. However, these comparative results are not shown here for the sake of brevity.

In implementing Sys-GMM, two lag-dependent variables were used as instruments, following Ullah et al. (2018), who noted that employing two lag-dependent variables would generate more persistent instruments to address endogeneity bias. The Sargan test of overidentifying restrictions and the Arellano-Bond (AR) test were employed to ensure the instruments are valid and consistent. Valid instruments are those that are not correlated with the error term. The null hypothesis of the Sargan test is that the overidentifying restrictions in the instruments are valid. Consistent instruments have no second-order serial correlation for the idiosyncratic errors of the first-differenced equation, and the instruments are declared consistent if no significant second-order serial correlation is detected (Kiviet, 2020).

Two lag explanatory variables were added as additional instruments to observe the dynamic effects of overeducation and undereducation on economic growth. To determine which explanatory variables will be treated as potentially exogenous, each explanatory variable was correlated with the lag of the variable itself. Explanatory variables with a correlation coefficient too high for their lag will be treated as potentially endogenous variables. As a result, all explanatory variables, except the inflation variable, will be treated as potentially endogenous, while the inflation variable is treated as a predetermined variable. An overview of the model, presented in the form of a dynamic panel with Sys-GMM, in this study, is as follows.

$$\mathrm{GROWTH}_{it} = \delta\mathrm{GROWTH}_{i,t-1} + \delta\mathrm{GROWTH}_{i,t-2} + \beta_1\mathrm{YUNDER}_{it} + \beta_j X_{itj} + u_{it} \quad \ldots\ldots (2)$$

The variable GROWTH represents economic growth, measured by the growth in real GDP per capita. GROWTHi,t-1, or

L1.GROWTH and L2.GROWTH is GROWTH's first and second lag instruments to control endogeneity. YUNDER the average number of years of deficit education (undereducation) measured using the Job Analysis (JA) method. Xj is a vector of control variables used to address individual heterogeneity, including DI (Domestic Investment), FDI (Foreign Direct Investment), FORMALPERCENT (Proportion of the Formal Sector), MYS (Mean Years of Schooling), INFLATION (Average Inflation Rate), and GINIPERCENT (Gini Coefficient).

In Equation 2, YUNDER is tested as the primary explanatory variable. To understand the effect of overeducation on economic growth, YUNDER will then be replaced with YOVER (the average number of years of surplus education). To define undereducation as the logarithmic value of the number of undereducated workers in a province, YUNDER is replaced with LogUNDER. Likewise, if overeducation is defined as the logarithmic value of the number of workers experiencing overeducation, YOVER is replaced with LogOVER.

All explanatory variables were correlated to ensure that the models are free from multicollinearity. The tolerable correlation coefficient between explanatory variables is 0.69. If the correlation coefficient exceeds this threshold, one of the explanatory variables is removed from the model.

RESULTS AND DISCUSSION

The total number of observations in this study was 363, representing panel data from 33 provinces over an 11-year period (2012–2022). Descriptive statistics to describe the average, standard deviation, minimum, and maximum of study variables for all provinces for the period 2012 – 2022 are as follows:.

Table 1. Descriptive Statistics of Variables

	Obs	Mean	Std.Dev	Min	Max
GROWTH (%)	363	3.298	3.78	-20.13	21.061
LogUnder	363	6.054	0.425	5.285	7.091
LogOver	363	5.443	0.477	4.415	6.547
YOVER (year)	363	0.521	0.172	0.153	1.107
YUNDER (year)	363	3.853	0.971	1.415	7.453
UNDERPERCENT (%)	363	55.561	9.914	27.62	82.019
OVERPERCENT (%)	363	14.101	4.521	4.701	33.3
GINIPERCENT (%)	363	36.21	3.945	25.2	45.901
LogFDI	363	2.49	0.753	-0.699	3.874
LogDI	363	2.302	0.822	-0.518	3.778
UNEMP (%)	363	4.898	1.992	0.881	10.68
MYS (year)	363	8.333	0.957	5.761	11.31
INFLATION (%)	363	4.219	2.417	-0.025	10.87
FORMALPERCENT (%)	363	40.03	11.27	15.89	76.863

The variables GINIPERCENT (Gini Coefficient), LogFDI (Log of Foreign Direct Investment), LogDI (Log of Domestic Investment), UNEMP (Unemployment Rate), MYS (Mean Years of Schooling), INFLATION (Average Inflation Rate), and FORMALPERCENT (Proportion of the Formal Sector) are included as control variables to account for individual (province) heterogeneity and to mitigate potential omitted variable bias in the model. In this case, GINIPERCENT uses percentage units, ensuring its coefficient's effect on economic growth is comparable to that of other variables. The INFLATION variable is

defined as the average annual inflation rate for each province, while FORMALPERCENT represents the percentage of the workforce employed in the formal sector. The selection of these control variables is based on established economic theory, which suggests that investment, income gaps, inflation, and unemployment may affect economic growth. Specifically, the proportion of the formal sector and MYS are used as educational control variables because they are also suspected of determining the extent of vertical educational mismatch. Furthermore, the picture of the average vertical mismatch in education over the last 11 years in each province in Indonesia is as follows:

Table 2. Vertical Educational Mismatch by Provinces

Provinces	Undereducation (%)	Match (%)	Overeducation (%)
Aceh	48.6	34.02	17.38
Bali	49.55	33.15	17.3
Bangka-Belitung	55.87	30.36	13.77
Banten	47.6	33.67	18.73
Bengkulu	56.5	29.76	13.74
Yogyakarta	45.9	36.12	17.98
DKI Jakarta	30.52	41.71	27.76
Gorontalo	64.1	24.84	11.05
Jambi	54.32	30.84	14.84
West Java	51.29	34.31	14.4
Central Java	61.3	27.28	11.42
East Java	57.52	29.02	13.46
West Kalimantan	65.11	24.7	10.19
South Kalimantan	62.34	26.55	11.12
Central Kalimantan	58.78	28.42	12.8
East Kalimantan	48.15	35.21	16.65
Riau islands	43.24	40.37	16.39
Lampung	60.14	27.82	12.04
Maluku	53.5	33.11	13.38
North Maluku	57.88	29.61	12.51
West Nusa Tenggara	59.98	26.85	13.17
East Nusa Tenggara	70.78	21.39	7.83
Papua	74.52	18.1	7.38
West Papua	55.52	29.1	15.38
Riau	49.2	33.97	16.84
North Sulawesi	52	32.74	15.26
West Sulawesi	66.4	24.42	9.18
South Sulawesi	57.65	28.42	13.94
Central Sulawesi	60.5	27.58	11.92
Southeast Sulawesi	55.99	29.98	14.03
West Sumatra	52.77	32.52	14.71
South Sumatra	57.61	30.15	12.24
North Sumatra	48.2	35.29	16.51
Total	55.55	30.34	14.09

Table 2 shows that provinces with a majority of urban areas tend to have higher levels of overeducation. These provinces have relatively lower levels of undereducation. These provinces include Jakarta, Banten, Yogyakarta, Aceh, Bali, and Riau. In contrast, several provinces with high levels of undereducation and low levels of overeducation are Papua, East Nusa Tenggara, West Sulawesi, West Kalimantan, Gorontalo, and South Kalimantan. The significant level of undereducation in these provinces is due to the relatively unequal distribution of education (especially in higher education). Additionally, the high level of undereducation in these provinces can also be attributed to the low level of formal employment. For example, in Papua, East Nusa Tenggara, and West Nusa Tenggara, the formal sector accounts for only 19.5%, 22.5%, and 26.06%, respectively.

On the other hand, provinces with high levels of overeducation tend to have a higher proportion of the formal sector. In Jakarta, for example, the formal sector reaches 68.8%. Similarly, in Banten, the rate was 56.2%. In Yogyakarta, it was 45.1%, and in Bali, it was 45.7%. Furthermore, an overview of the vertical mismatch trend in education in Indonesia based on provincial-level averages can be described as follows:

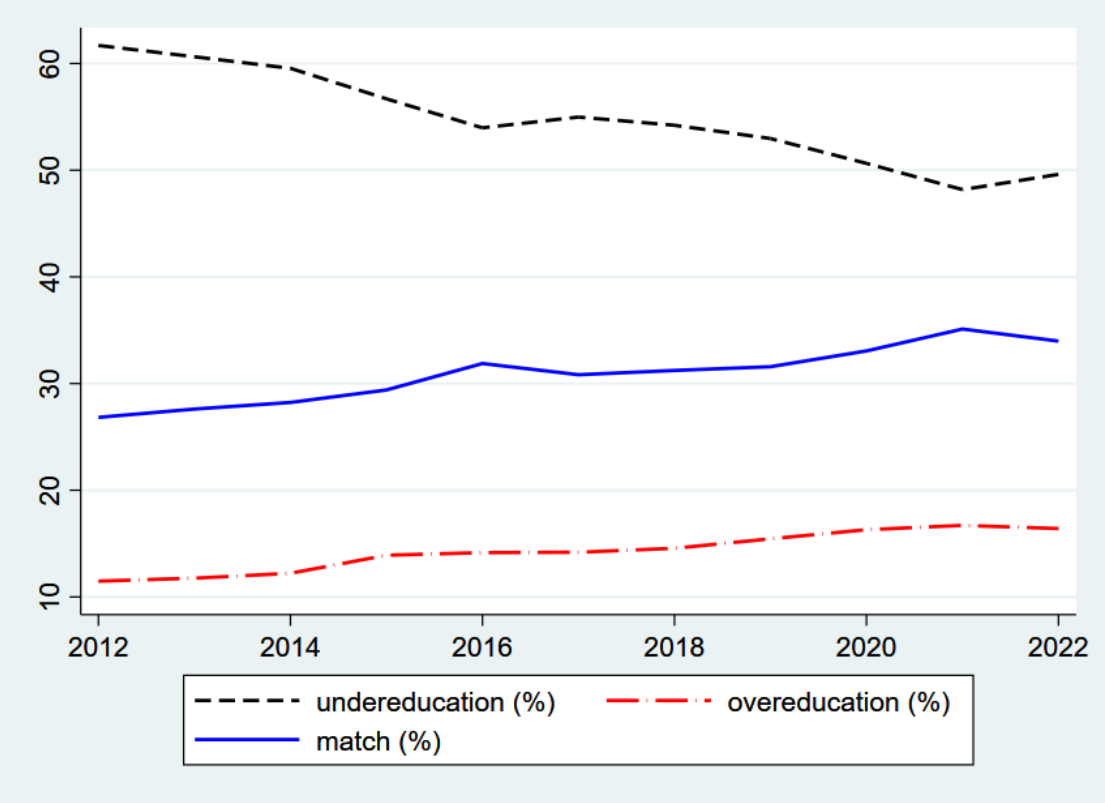

Figure 1. The Trend of Vertical Educational Mismatch in Indonesia
Source: Data Processed, 2025

Figure 1 shows that less than 50% of Indonesian workers match their education level. However, based on the above trends, there appears to be a continuous decline in undereducation and an increase in overeducation. These conditions appear to be linked to the improvement in education distribution in Indonesia. The match trend is rising, which indicates an improvement in the balance of supply and demand for educated workers. Nevertheless, Indonesia's match level is still deficient compared to the world average, which was 36.9% in 2021, for instance. For this reason, Indonesia still needs to increase its

people's educational participation, especially since the average value of Mean Years of Schooling (MYS) in Indonesia is only 8.3 years (averaged between 2012 and 2022). According to the economic perspective on education, one effort that can be made to anticipate educational mismatches is to carry out educational planning. Blaug (1985) suggested three educational planning approaches: the social demand approach, human resources planning, and the rate-of-return or cost-benefit approach. In the Indonesian context, the high level of vertical mismatch may result from the absence of precise educational planning at a macro level. If educational planning were employed, for instance, using a manpower planning approach, a country could maximize its potential supported by adequate human capital.

A country needs to consider the concept of manpower planning to accelerate its economic development, as the absence of a clear concept can result in high levels of vertical educational mismatch. Moreover, according to Geo-jaja (1990), manpower planning is necessary to address two main challenges in developing countries. The first is determining the workforce needs based on a country's potential or advantages, and the second is forecasting the demand for skilled and educated labor while guaranteeing the required educational capacity and workforce training. Before estimating the model, we correlated all explanatory variables, as shown in the appendix. After this correlation check, there was no extensive correlation between the control variables. This study will not simultaneously test any explanatory variables that are highly correlated with each other in the model, with a maximum correlation limit of 0.8 determined to avoid multicollinearity problems. Thus, the results of the Sys-GMM analysis examining the effect of undereducation on economic growth in this study are as follows:

Table 3. The Effect of Undereducation on Growth

	I	**II**	**III**
L1.GROWTH	0.142** (0.055)	0.149** (0.055)	0.139** (0.055)
L2.GROWTH	-0.133** (0.056)	-0.158** (0.055)	-0.158** (0.055)
YUNDER	1.306 (0.865)	-	-
L1.YUNDER	-2.488** (0.913)	-	-
L2.YUNDER	0.241 (0.88)	-	-
LogUNDER	-	8.798 (7.431)	-
L1.LogUNDER	-	5.821 (9.417)	-
L2.LogUNDER	-	-16.584** (7.533)	-
UNDERPERCENT	-	-	0.119 (0.094)
L1.UNDERPERCENT	-	-	0.06 (0.094)
L2.UNERPERCENT	-	-	-0.14 (0.092)
UNEMP	-0.805** (0.308)	-0.332 (0.311)	-0.425 (0.306)
L1.UNEMP	0.139 (0.33)	0.152 (0.343)	0.095 (0.334)
L2.UNEMP	-0.079 (0.27)	-0.209 (0.28)	-0.115 (0.275)
LogDI	0.539 (0.654)	0.667 (0.678)	0.404 (0.663)
L1.LogDI	0.472 (0.635)	0.883 (0.646)	0.925 (0.632)
L2.LogDI	-1.204** (0.539)	-0.857 (0.537)	-1.286** (0.536)
LogFDI	1.832** (0.793)	1.992** (0.82)	1.865** (0.803)
L1.LogFDI	1.335 (0.852)	1.449* (0.857)	1.417* (0.851)
L2.LogFDI	-1.621** (0.798)	-1.837** (0.807)	-1.913** (0.807)
GINIPERCENT	-0.192 (0.222)	-0.14 (0.22)	-0.155 (0.223)
L1.GINIPERCENT	0.098 (0.24)	-0.155 (0.238)	-0.079 (0.24)

	I	II	III
L2.GINIPERCENT	0.152 (0.187)	0.291 (0.188)	0.227 (0.186)
MYS	0.459 (1.541)	1.042 (1.492)	1.629 (1.553)
L1.MYS	-4.709** (1.577)	-4.795** (1.618)	-4.534** (1.604)
L2.MYS	4.083*** (1.028)	3.994*** (1.026)	3.526*** (1.051)
PERCENTFORMAL	0.488*** (0.09)	0.537*** (0.09)	0.541*** (0.087)
L1.PERCENTFORMAL	-0.567*** (0.092)	-0.662*** (0.089)	-0.636*** (0.089)
L2.PERCENTFORMAL	0.061 (0.082)	0.101 (0.087)	0.093 (0.086)
INFLATION	0.131 (0.125)	0.239 (0.127)	0.197 (0.128)
Constant	6.252 (10.951)	9.355 (9.862)	-5.81 (11.902)
Wald Chi2 (Prob)	176 (0.000)	173 (0.000)	167 (0.000)
Sargan (p-value)	282 (0.067)	262 (0.255)	272 (0.140)
AR (1) (p-value)	-3.113 (0.001)	-3.125 (0.001)	-3.076 (0.002)
AR (2) (p-value)	-0.592 (0.553)	0.018 (0.984)	0.153 (0.877)
N of observations	297	297	297
N of instruments	273	273	273

Notes: ***significant at level 0.001, **significant at level 0.05,*significant at level 0.10. Standard errors are in parentheses. Dependent variable = GROWTH. All explanatory variables, except INFLATION, are treated as potential endogenous. Our instruments to control for endogeneity bias are valid because the null hypothesis for the Sargan test of overidentifying restrictions cannot be rejected. Meanwhile, our instruments are also consistent because the null hypothesis for AR(2) cannot be rejected.
Source: Data Processed, 2025

Table 3 shows that all measures of undereducation (YUNDER, LogUNDER, and UNDERPERCENT) indicate that undereducation does not affect economic growth. However, this study did find an adverse dynamic effect of the first lag year of undereducation on economic growth. Specifically, a deficit in the number of education years in a province during one period will reduce economic growth in the following year; in other words, the higher the education deficit today, the lower the economic growth in upcoming years, though these dynamic effects are not the primary focus of this study.

This study finds that undereducation does not affect economic growth, refuting both the human capital theory (which indicates that undereducation should reduce economic growth) and the work assignment theory (which predicts the opposite). In work assignment theory, an individual's income is determined by the complexity of the assignment they receive, meaning the level of wages is not always determined by the level of education, but rather by the nature of the assignment itself. As a result, work assignment theory predicts that undereducated workers will earn a wage premium —higher wages—than their level of educational attainment, which, if accumulated, can potentially increase economic growth.

The minimum effect of undereducation on economic growth found in this study indicates that the wage premium for undereducated workers is insignificant. This suggests that even though the tasks assigned to undereducated workers are relatively more complex and higher than their educational level, their earnings remain minimal. Consequently, even if a wage premium exists, it does not cumulatively impact Indonesia's economic growth. One of the reasons behind this insignificant effect is that Indonesia is currently in the upper-middle-income category and is not primarily a knowledge-based economy, as evidenced by the high level of the informal sector in Indonesia. This context is important because, according to Shin (2012), undereducation hinders the economic development of knowledge-based countries.

This study tends to contradict the opinion of Iyigun and Owen (1996) that in developing countries, where most of the workforce experiences undereducation, this undereducation can reduce unemployment levels and increase economic growth. In the Indonesian context, the opinion of Iyigun and Owen (1996) is not entirely correct. On the one hand, undereducation reduces the unemployment rate (Hakim, 2023); on the other hand, this unemployment rate remains high, at approximately 5% (see Table 1). As a result, the impact of undereducation on reducing the unemployment rate does not significantly affect Indonesia's economic growth.

Indonesia's main economic driver is investment, primarily FDI (see tables 3 and 4). This FDI tends to be distributed across various provinces in Indonesia, rather than being concentrated solely on the island of Java. For instance, from 2012 to 2022, the most significant average economic growth was in Central Sulawesi, North Maluku, South Sulawesi, Southeast Sulawesi, and Gorontalo, where the FDI in those provinces was extensive. On the other hand, human capital aspects, such as mean years of schooling (MYS), have no significant effect on economic growth. In other words, human capital has not been a primary driver of the Indonesian economy; therefore, the magnitude of undereducation did not significantly affect economic growth.

Table 4. The Effect of Overeducation on Growth

	I	II	III
L1.GROWTH	0.175*** (0.054)	0.161** (0.054)	0.136** (0.055)
L2.GROWTH	-0.17** (0.055)	-0.147** (0.055)	-0.173** (0.055)
YOVER	-15.302*** (3.006)	-	-
L1.YOVER	10.858** (3.486)	-	-
L2.YOVER	-1.562 (3.277)	-	-
LogOVER	-	-10.575** (4.587)	-
L1.LogOVER	-	3.911 (5.297)	-
L2.LogOVER	-	3.944 (4.285)	-
OVERPERCENT	-	-	-0.433** (0.152)
L1.OVERPERCENT	-	-	0.118 (0.161)
L2.OVERPERCENT	-	-	0.131 (0.14)
UNEMP	-0.867** (0.286)	-0.631** (0.299)	-0.674** (0.291)
L1.UNEMP	0.417 (0.327)	0.238 (0.339)	0.254 (0.336)
L2.UNEMP	-0.184 (0.261)	0.05 (0.272)	-0.087 (0.268)
LogDI	0.892 (0.644)	0.97 (0.7)	0.655 (0.657)
L1.LogDI	0.548 (0.627)	0.926 (0.656)	0.642 (0.642)
L2.LogDI	-1.138** (0.511)	-1.134** (0.559)	-1.159** (0.536)
LogFDI	2.043** (0.781)	2.018** (0.821)	1.77** (0.807)
L1.LogFDI	0.361 (0.835)	1.067 (0.849)	0.938 (0.85)
L2.LogFDI	-0.812 (0.785)	-1.388* (0.813)	-1.243 (0.817)
GINIPERCENT	-0.124 (0.213)	-0.14 (0.214)	-0.07 (0.221)
L1.GINIPERCENT	0.091 (0.226)	0.041 (0.235)	-0.019 (0.232)
L2.GINIPERCEN	0.015 (0.172)	0.156 (0.18)	0.096 (0.178)
MYS	1.904 (1.413)	0.737 (1.435)	1.296 (1.431)
L1.MYS	-4.921** (1.598)	-4.428** (1.619)	-4.62** (1.598)
L2.MYS	4.043*** (0.994)	4.244*** (1.061)	4.241*** (1.072)
PERCENTFORMAL	0.444*** (0.088)	0.57*** (0.088)	0.556*** (0.088)

	I	II	III
L1.PERCENTFORMAL	-0.462*** (0.091)	-0.659*** (0.09)	-0.639*** (0.09)
L2.PERCENTFORMAL	0.059 (0.084)	0.096 (0.087)	0.105 (0.086)
INFLATION	0.177 (0.131)	0.131 (0.132)	0.132 (0.129)
Constant	-5.542 (6.384)	6.291 (8.109)	-4.751 (6.749)
Wald Chi2 (Prob)	204 (0.000)	358 (0.000)	174 (0.000)
Sargan (p-value)	270 (0.158)	266 (0.202)	269 (0.166)
AR (1) (p-value)	-3.132 (0.001)	-3.202 (0.001)	-3.163 (0.001)
AR (2) (p-value)	0.270 (0.786)	-0.165 (0.868)	-0.073 (0.941)
N of observations	297	297	297
N of instruments	273	273	273

Notes: ***significant at level 0.001, **significant at level 0.05,*significant at level 0.10. Standard errors are in percentages. Dependent variable = GROWTH. All explanatory variables, except the inflation variable, are treated as potentially endogenous. The validity of the instrument to anticipate endogeneity problems was tested using the Sargan test. Based on the Sargan test results, the instruments in the model are declared valid. Meanwhile, based on the second-order AR test, the model is not indicated to experience autocorrelation problems.

Source: Data Processed, 2025

Table 4 shows that overeducation reduces economic growth. These results are consistent with all measures of overeducation, including YOVER, LogOVER, and OVERPERCENT. The adverse effect of overeducation on economic growth shows human capital inefficiency. However, when overeducation is measured as surplus years of education (YOVER), there is a positive dynamic effect of the previous year's YOVER (L1.YOVER) on economic growth. This condition suggests that the education surplus from the last year can serve as a form of capital to enhance future economic growth. These findings confirm the assumption that the rate of return to overeducation will increase in the years to come.

The study's findings suggest that an adverse effect of overeducation on economic growth indicates that Indonesia's human capital investment is inefficient. Overeducation hinders the maximization of human capital investment. According to Velciu (2017), from a macroeconomic perspective, overeducation represents an inefficient allocation of human capital that can negatively impact overall productivity. This finding also aligns with Abidin and Zakariya (2018), who found that overeducation has a negative impact on economic growth in Malaysia. This study also aligns with Grammare and Guironnet (2009), who examined educational mismatch in France, and Sam (2018) in developing countries. These studies also found an adverse effect of overeducation on economic growth.

The adverse effect of overeducation on economic growth, as indicated by this study, suggests that the contribution of education to economic growth is insignificant. According to Hanushek (2013), one of the reasons human capital is unpowerful in boosting economic growth in developing countries is the quality of education itself. Even if the average length of schooling in a country is high, if the quality of education remains low, then the human capital produced tends to be low as well. As a result, human capital experiences overeducation, ultimately reducing economic growth. This can also be confirmed by the MYS's coefficient on economic growth, as shown in Tables 3 and 4. Despite being positive, the MYS's coefficient on economic growth was insignificant.

The adverse effect of overeducation on economic growth in this study confirms the relevance of the job satisfaction hypothesis. In this hypothesis, overeducation is seen as underutilization, whose losses are borne by the employer. In this context, employers experience low satisfaction with the performance of their overeducated workers. Low satisfaction means low productivity at the company level (Brynin

and Longhi, 2009). The workforce also experiences low job satisfaction due to overeducation. It can lead to low innovation and creativity, rendering overeducated workers less effective. As a result, productivity decreases, and the skills already possessed are also diminished (cognitive decline) (Grip et al., 2008).

On the other hand, this study disagrees with Ramos et al. (2012), who stated that overeducation has a positive effect on economic growth. However, Ramos et al. (2012) used the sample in European countries with more advanced human capital. As a result, this study identified a stylized fact that, in developing countries, overeducation tends to hinder economic growth. However, in developed countries, overeducation can contribute to increased economic growth. However, this fact still needs to be tested further.

CONCLUSION

The impact of vertical educational mismatches, specifically undereducation and overeducation, on Indonesia's economic growth was analyzed by aggregating these mismatches at the provincial level. By using the System Generalized Method of Moments (Sys-GMM) estimator, a harmful impact of overeducation on economic growth was found. This finding highlights that overeducation is a form of human capital inefficiency that can hinder Indonesia's economic growth, and it confirms that even if overeducation yields positive returns on individual wages, it remains detrimental to aggregate economic development.

The harmful effect of overeducation on economic growth also suggests that education, notably higher education, makes a limited contribution to economic growth. This finding underscores the importance of more comprehensive human resource planning and enhancing the quality of academic delivery in higher education institutions, thereby generating a higher return on investment in education. It also highlights the importance of addressing the overeducation problem by moratoriuming study programs deemed less relevant to industry needs, reestablishing more strategic linkages and matches, and enhancing the impact of higher education on Indonesian society and the economy.

On the other hand, no evidence was found that undereducation affects economic growth, implying that even if low-educated workers are assigned jobs exceeding their educational qualifications, this does not generate economic benefits on a macro scale. In other words, work experience and training have not yet fully maximized productivity; therefore, an undereducated worker should return to education that is appropriate to their current level and field of work.

This study has several limitations. First, undereducation and overeducation were measured only using the Job Analysis (JA) approach; therefore, future studies should employ other measurement methods, such as the Realized Match (RM) method, to compare the effect of vertical educational mismatch on economic growth. Second, the Sys-GMM instrument count is relatively large; although the Sargan test confirmed the instruments were valid, a large count could still reduce the estimator's power to eliminate endogeneity problems. Therefore, future studies are recommended to replicate this work using improved data to address these shortcomings.

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