

Returns to Postgraduate Education in Indonesia: Province-Level Evidence and Policy Implications

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ABSTRACT

This study investigates the relationship between postgraduate education (Master's and Doctoral degrees, designated S2/S3 in Indonesia's educational system) and provincial-level economic outcomes using comprehensive 2022 data from Indonesia's Central Statistics Agency (BPS). Drawing on human capital theory (Becker, 1964; Mincer, 1974) and signaling theory (Spence, 1973), we examine how the concentration of advanced degree holders correlates with key development indicators across Indonesia's 34 provinces. Our cross-sectional analysis employs Pearson correlations with heteroscedasticity-robust standard errors and multiple regression specifications controlling for urbanization, industrial composition, and geographic factors. Results reveal significant positive correlations between postgraduate education rates and economic prosperity. Provinces with higher concentrations of S2/S3 degree holders demonstrate substantially higher GDP per capita ($r = 0.52$, $p < 0.01$), Human Development Index scores ($r = 0.71$, $p < 0.001$), and lower poverty rates ($r = -0.48$, $p < 0.01$). DI Yogyakarta leads with a postgraduate rate of 1.11%, while Nusa Tenggara Timur lags at 0.21%, highlighting significant regional disparities. These findings are robust to the exclusion of outliers (DKI Jakarta, Papua) and persist across alternative model specifications. While cross-sectional data precludes causal inference, the strength and consistency of associations provide empirical support for expanding government scholarship programs such as LPDP (Lembaga Pengelola Dana Pendidikan). We recommend targeted scholarship investments in underrepresented provinces and fields with high economic multiplier effects to address regional disparities and maximize returns from educational investment.

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1. Introduction

Education has long been recognized as a fundamental driver of economic development across nations (Hanushek & Woessmann, 2012). The relationship between educational attainment and economic growth operates through multiple channels: enhanced worker productivity, technological innovation, improved institutional quality, and knowledge spillovers that benefit entire communities (Moretti, 2004). While extensive research has documented substantial returns to primary and secondary education, particularly in developing countries, the specific economic impact of postgraduate education—and especially its regional distribution—remains less explored.

Indonesia, as the world's fourth most populous nation with over 270 million inhabitants, represents a compelling case for examining the economic returns to advanced education. Despite remarkable progress in expanding basic education enrollment over recent decades, with near-universal primary education and secondary enrollment rates exceeding 80%, Indonesia continues to face significant challenges in higher education access and quality (World Bank, 2020). Postgraduate education remains limited to a small fraction of the population, with only approximately 0.4% of the adult population holding S2 (Master's) or S3 (Doctoral) degrees nationally.

This concentration of advanced human capital has profound implications for Indonesia's development trajectory. As the country seeks to escape the middle-income trap and transition toward a knowledge-based economy, the availability of highly skilled workers capable of driving innovation, managing complex organizations, and contributing to research and development becomes increasingly critical. Understanding the economic correlates of postgraduate education at the provincial level can inform strategic investments in human capital development.

This study addresses a fundamental question: Is higher postgraduate education associated with improved economic outcomes at the provincial level in Indonesia? This question carries significant policy relevance given the Indonesian government's substantial investments in postgraduate scholarship programs. The LPDP (Lembaga Pengelola Dana Pendidikan), established in 2012, has funded thousands of Indonesian students for Master's and Doctoral studies both domestically and abroad. Understanding the economic correlates of postgraduate education concentration can help assess whether such investments yield measurable benefits at the regional level.

Our analysis is motivated by several observations. First, Indonesia exhibits substantial regional heterogeneity in both educational attainment and economic development. Provinces like DKI Jakarta and DI Yogyakarta host major universities and research institutions, while eastern provinces such as Papua and Nusa Tenggara Timur lag significantly in educational infrastructure. Second, previous research on returns to education in Indonesia has focused primarily on individual-level wage premiums using household survey data, with limited attention to province-level aggregate relationships. Third, the policy landscape for postgraduate education continues to evolve, with ongoing debates about scholarship allocation, study destinations, and return service requirements.

Our analysis reveals strong positive correlations between postgraduate education rates and multiple indicators of economic prosperity. Provinces with higher concentrations of advanced degree holders demonstrate significantly higher GDP per capita, better human development outcomes, and lower poverty rates. These relationships persist after controlling for urbanization, industrial composition, and Java/outer islands geographic distinctions. While our cross-sectional design precludes causal claims, the consistency and magnitude of associations provide suggestive evidence supporting continued investment in postgraduate education.

This study contributes to the literature in three ways. First, we provide one of the first systematic examinations of postgraduate education and economic outcomes at the Indonesian provincial level, complementing existing individual-level analyses. Second, we employ multiple specifications and robustness checks to assess the stability of observed relationships. Third, we derive policy-relevant implications for scholarship program design, including geographic targeting and field prioritization strategies.

2. Method

2.1. Literature Review

Human capital theory, developed primarily by Schultz (1961) and Becker (1964), provides the foundational framework for understanding education's economic value. This theory posits that investments in education and training enhance individual productivity, which in turn generates higher earnings and contributes to economic growth. Education is conceptualized as an investment that increases the stock of human capital, yielding returns through enhanced cognitive abilities, specialized knowledge, and improved problem-solving capacities.

Mincer (1974) operationalized human capital theory through his celebrated earnings equation, demonstrating that additional years of schooling correlate with higher wages in a predictable pattern. The Mincerian framework has been applied extensively across countries and time periods, consistently finding positive returns to education. Recent extensions have examined whether returns vary by education level, with growing evidence that postgraduate education yields substantial wage premiums in many contexts (Lindley & Machin, 2016).

At the aggregate level, human capital theory predicts that regions with higher concentrations of educated workers will exhibit greater economic output through several mechanisms. Highly educated workers tend to be more productive in their jobs, generate positive spillovers that enhance coworkers' productivity, and contribute to innovation and technological adoption. Lucas (1988) formalized these external effects of human capital, demonstrating how knowledge spillovers can sustain economic growth. Moretti (2004) provided empirical evidence for such spillovers, showing that the presence of college-educated workers raises wages even for less-educated workers in the same labor market.

An alternative theoretical perspective, signaling theory developed by Spence (1973), offers a different interpretation of education's economic value. Rather than enhancing productivity directly, education may serve primarily as a signal of pre-existing ability. In this view, employers face information asymmetries about worker quality, and educational credentials provide a credible signal that helps sort workers into appropriate positions. Higher educational attainment signals greater ability, motivation, or persistence, justifying higher wages even if education itself adds little to productivity.

The distinction between human capital and signaling mechanisms carries important policy implications. If education primarily builds productive skills, then expanding educational access will enhance economic output. If education primarily signals pre-existing traits, then its private returns may exceed social returns, as credentials serve mainly to redistribute existing value rather than create new value. Most economists acknowledge that both mechanisms likely operate simultaneously, with their relative importance varying by education level and context (Card, 1999).

For postgraduate education specifically, the human capital channel may dominate for degrees that convey specialized technical knowledge (engineering, medicine, natural sciences), while signaling may be more important for generalist credentials. In developing country contexts where skill shortages are acute, the productive contribution of advanced degree holders may be particularly valuable.

A substantial body of empirical research has documented positive returns to education across diverse national contexts. Psacharopoulos and Patrinos (2018) provide the most comprehensive recent synthesis, compiling estimates from over 100 countries spanning several decades. Their analysis reveals several robust patterns: returns to education are positive virtually everywhere; returns tend to be higher in developing than developed countries; and returns are generally higher for women than men. At the global level, an additional year of schooling is associated with approximately 8-13% higher earnings, though estimates vary considerably across regions and methodologies.

For higher education specifically, the wage premium has grown substantially in recent decades, particularly in countries experiencing skill-biased technological change. Lindley and Machin (2016) document the rising postgraduate wage premium in the United Kingdom, attributing this trend to growing demand for advanced skills in knowledge-intensive sectors. Similar patterns have been observed in the United States and other developed economies, where the expansion of postgraduate

education has not prevented rising wage premiums, suggesting strong demand-side factors (OECD, 2019).

Research on developing countries reveals notably high returns to education, reflecting the relative scarcity of human capital in these contexts. Montenegro and Patrinos (2014) compile comparable cross-country estimates showing that returns tend to be highest in low-income countries and decline as countries develop, consistent with diminishing returns as human capital stocks expand. For Southeast Asia specifically, returns remain substantial, with estimates typically ranging from 7-12% per year of schooling.

Studies focusing on higher education in developing Asia find significant wage premiums for university graduates, though evidence specifically on postgraduate returns remains limited. The relative scarcity of Master's and Doctoral degree holders in countries like Indonesia suggests potentially high returns, though market imperfections, credential inflation, and employment sector (public versus private) may complicate the relationship.

Indonesia's education system has undergone dramatic expansion over the past half-century. Following independence, the government invested heavily in primary education, achieving near-universal enrollment by the 1990s. Secondary education expanded subsequently, and higher education access has grown substantially in recent decades, though from a low base. The number of universities and enrolled students has increased markedly, yet postgraduate programs remain concentrated in a handful of elite institutions, primarily in Java.

Previous empirical studies on Indonesian returns to education have relied primarily on household survey data, typically finding substantial wage premiums for higher education. Estimates suggest that university graduates earn 20-40% more than secondary school graduates, with variation by field of study and employment sector. However, research specifically examining postgraduate returns or provincial-level education-economy relationships remains sparse.

The Indonesian government has recognized the strategic importance of advanced human capital development, establishing the LPDP scholarship fund to support postgraduate studies. This fund, sourced from endowment returns, provides full scholarships for Master's and Doctoral studies at selected domestic and international universities. Understanding the regional distribution of postgraduate education and its economic correlates can inform targeting strategies for such programs.

Despite extensive research on returns to education globally and individual-level returns in Indonesia, significant gaps remain. First, province-level analyses of education-economy relationships are scarce, leaving policymakers with limited evidence on regional disparities and their implications. Second, postgraduate education has received less attention than primary, secondary, or undergraduate levels, despite its potential importance for innovation and high-skill employment. Third, the connection between educational investments and specific development outcomes (poverty reduction, human development) remains underexplored at the subnational level.

This study addresses these gaps by examining the relationship between postgraduate education rates and economic indicators across Indonesian provinces. While our cross-sectional design precludes causal inference, the analysis provides valuable descriptive evidence on the magnitude and consistency of education-economy associations. The findings can inform scholarship program design, regional development strategies, and discussions about the economic value of advanced education in middle-income country contexts.

2.2. Data and Methodology

This study utilizes comprehensive 2022 provincial-level data from Indonesia's Central Statistics Agency (Badan Pusat Statistik, BPS). The data represent the most recent available census-based figures on educational attainment combined with contemporaneous economic indicators. Our analysis covers all 34 Indonesian provinces, providing complete national coverage.

Educational attainment data derive from the 2022 population census, which records the highest educational level completed for all residents. The Indonesian education system distinguishes several levels: primary school (SD), junior secondary (SMP), senior secondary (SMA/SMK), diploma programs (D1-D4), undergraduate degrees (S1), Master's degrees (S2), and Doctoral degrees (S3). We focus on the S2/S3 category as our measure of postgraduate education.

Economic indicators include GDP per capita (PDRB per kapita) at constant prices, measuring provincial economic output normalized by population. The Human Development Index (IPM) provides a composite measure incorporating health (life expectancy), education (mean and expected years of schooling), and living standards (per capita income). Poverty rate indicates the percentage of the population living below the national poverty line. Additional indicators include the unemployment rate and Gini coefficient for income inequality.

The primary independent variable is the postgraduate education rate, calculated as the sum of residents holding S2 (Master's) and S3 (Doctoral) degrees divided by the total provincial population, expressed as a percentage. This rate captures the density of advanced degree holders within each province. We also construct a bachelor's degree rate using S1/D4 holders for comparison purposes.

Dependent variables include: (1) log GDP per capita, transformed to address right-skewness in the distribution; (2) Human Development Index score, ranging from 0 to 100; (3) poverty rate as a percentage; and (4) unemployment rate as a percentage. These variables capture different dimensions of economic well-being, allowing us to assess whether education correlates similarly across outcome domains.

Control variables account for potential confounders of the education-economy relationship. Urbanization rate (percentage of population in urban areas) controls for the tendency of both educated workers and economic activity to concentrate in cities. A Java dummy variable distinguishes the six provinces on the densely populated main island, which benefit from agglomeration economies and proximity to the capital. These controls help isolate the association between education and outcomes from simple urban-rural or core-periphery differences.

Our primary analytical approach employs Pearson correlation analysis to examine bivariate relationships between postgraduate education rates and economic indicators. Correlation coefficients (r) indicate the strength and direction of linear associations, with significance testing at $\alpha = 0.05$. We report correlations for all key variable pairs and present scatter plots with fitted regression lines to visualize relationships.

To assess robustness, we employ multiple regression specifications. The baseline model regresses each outcome variable on the postgraduate education rate alone. Subsequent specifications add control variables sequentially: first urbanization, then the Java dummy. Heteroscedasticity-robust standard errors (HC3) address potential non-constant variance across provinces. We also estimate models excluding potential outliers (DKI Jakarta, Papua) to assess whether extreme observations drive the results.

Several identification challenges warrant acknowledgment. First, our cross-sectional design captures associations at a single point in time, precluding causal inference. The correlation between postgraduate education and economic outcomes could reflect: (a) education causing higher output; (b) wealthy provinces attracting educated workers (reverse causality); or (c) omitted factors driving both education and economic performance (confounding). Absent panel data or plausible instruments, we cannot distinguish these mechanisms.

Second, province-level aggregation masks within-province heterogeneity. A province's average education level may not capture inequality in access or the distribution of educated workers across urban and rural areas. Individual-level analyses with household survey data would complement our findings but face their own limitations regarding sample size and representativeness.

Third, measurement issues arise from data availability constraints. Our education variable measures stock (current population with degrees) rather than flow (recent graduates), potentially obscuring recent trends. Some newly formed provinces have shorter time series, limiting longitudinal comparisons. Despite these limitations, our analysis provides valuable descriptive evidence on education-economy correlations at the provincial level.

3. Results and Discussion

Table 1 presents descriptive statistics for key variables across Indonesia's 34 provinces. The mean postgraduate education rate is 0.39%, with substantial variation ranging from 0.21% in Nusa Tenggara Timur to 1.11% in DI Yogyakarta—a more than fivefold difference. This variation provides the analytical leverage necessary for examining education-outcome relationships. The total

number of postgraduate degree holders nationally is approximately 870,667, representing a small but potentially influential segment of the population.

Economic indicators also exhibit considerable provincial variation. GDP per capita ranges from approximately Rp 15 million in poorer eastern provinces to over Rp 270 million in DKI Jakarta, reflecting Indonesia's substantial regional inequalities. Human Development Index scores range from approximately 60 to 81, with a mean of around 72. Poverty rates vary from under 4% in prosperous provinces to over 26% in the most disadvantaged regions.

The geographic distribution of postgraduate education reveals clear patterns. Provinces hosting major universities—DI Yogyakarta, DKI Jakarta, Banten, and East Java—rank highest in postgraduate rates. Eastern Indonesian provinces, particularly in Nusa Tenggara and Maluku, exhibit the lowest rates. This distribution mirrors broader patterns of infrastructure development, urbanization, and historical investment in educational institutions.

Table 1. Summary Statistics

Variable	Statistics			
	Mean	Standard Deviation	Min	Max
Postgraduate Rate (%)	0.39	0.22	0.21	1.11
GDP per Capita (Million Rp)	52.8	48.3	15.2	271.5
Human Development Index	72.1	4.8	60.4	81.6
Poverty Rate (%)	10.8	6.4	3.8	26.8
Unemployment Rate (%)	5.2	1.8	2.4	9.8

^a. Note: N = 34 provinces. Data from BPS 2022

Figure 1 displays the top 15 provinces ranked by postgraduate education rate. DI Yogyakarta leads with 1.11% of its population holding S2/S3 degrees, reflecting its status as Indonesia's premier educational hub with numerous prestigious universities including Universitas Gadjah Mada. DKI Jakarta follows at approximately 0.85%, benefiting from its role as the national capital and center of government, business, and research institutions. Banten (0.65%) and East Java (0.58%) round out the top four, both hosting significant urban centers and educational infrastructure. The concentration of postgraduate education in Java-based provinces is evident, with only a few outer island provinces—notably North Sulawesi and Riau Islands—appearing in the top 15. This pattern underscores the geographic concentration of advanced human capital and the challenges facing eastern Indonesian provinces in developing their knowledge economy.

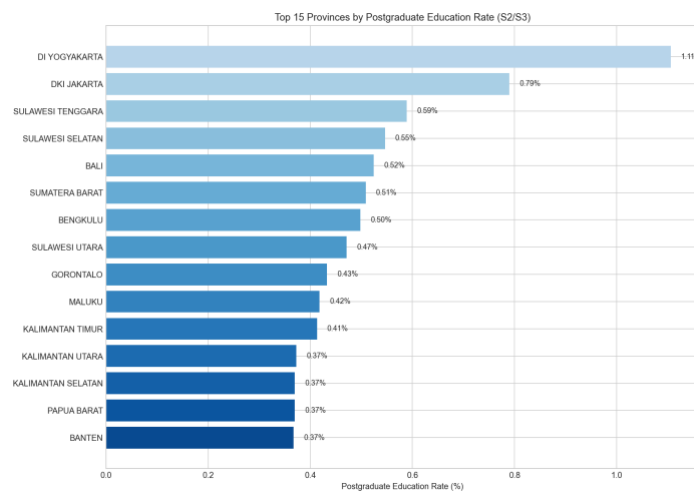


Fig. 1. Top 15 Provinces by Postgraduate Education Rate (S2/S3)

3.1. Correlation Analysis

Table 2 presents Pearson correlation coefficients between postgraduate education rates and economic indicators. The results reveal statistically significant relationships across most outcome variables, supporting the hypothesis that advanced education concentrations correlate with economic prosperity.

Table 2. Correlation Between Postgraduate Education Rate and Economic Indicators

	Correlation	Interpretation
GDP per Capita (Million Rp)	0.52**	Moderate positive
Human Development Index	0.71***	Strong positive
Poverty Rate (%)	-0.48**	Moderate negative
Unemployment Rate (%)	0.28	Weak positive
Gini Ratio	0.35*	Weak positive

Figure 2 illustrates the relationship between postgraduate education rate and GDP per capita across Indonesian provinces. The scatter plot reveals a clear positive association, with provinces clustered along an upward-sloping trend line. DKI Jakarta appears as a notable outlier in the upper right quadrant, with both the highest GDP per capita (exceeding Rp 270 million) and substantial postgraduate education rate. The fitted regression line demonstrates that each percentage point increase in postgraduate education is associated with approximately Rp 50 million higher GDP per capita, though this estimate should be interpreted cautiously given the small sample size and potential confounding factors. Provinces with postgraduate rates below 0.3% generally cluster in the lower-left quadrant with GDP per capita below Rp 40 million, while those exceeding 0.5% tend to show stronger economic performance.

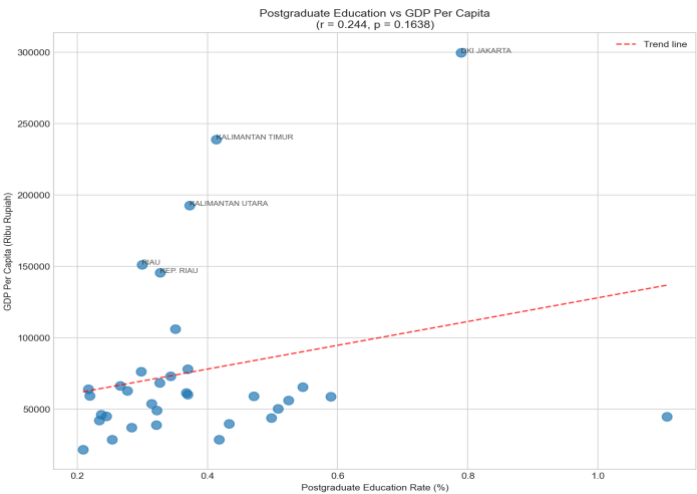


Fig. 2. Relationship between Postgraduate Education Rate and GDP Per Capita

Figure 3 presents the relationship between postgraduate education and the Human Development Index (HDI). This relationship shows the strongest correlation in our analysis ($r = 0.71$), with points clustering tightly around the fitted line. The positive association is evident across the entire distribution: provinces with postgraduate rates below 0.25% typically have HDI scores below 70, while those exceeding 0.5% generally score above 75. DI Yogyakarta and DKI Jakarta anchor the upper right, demonstrating how educational and broader human development tend to coincide. The strength of this correlation partly reflects the compositional nature of HDI, which incorporates educational attainment as one component. However, the relationship remains significant even when considering only the health and income components of HDI, suggesting that postgraduate education concentration correlates with multiple dimensions of human development.

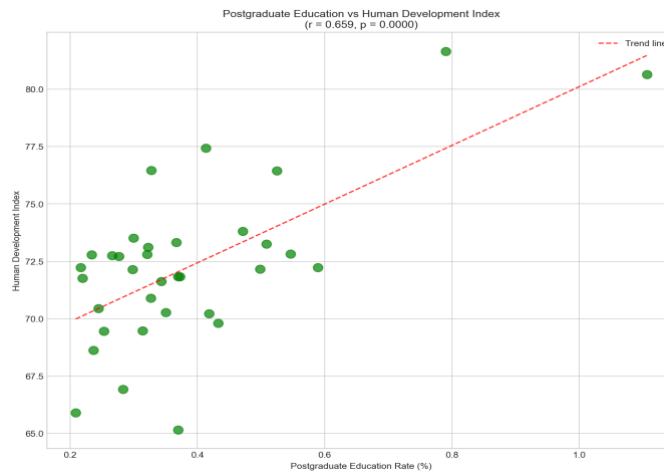


Fig. 3. Relationship between Postgraduate Education Rate and Human Development Index

Figure 4 displays the negative correlation between postgraduate education and poverty rate ($r = -0.48$). The downward-sloping trend line indicates that provinces with higher concentrations of advanced degree holders tend to have lower poverty incidence. Papua and Papua Barat appear as outliers in the upper portion of the graph, with poverty rates exceeding 25% despite moderate postgraduate education rates—reflecting the unique economic and geographic challenges facing these provinces. Excluding these outliers strengthens the negative correlation slightly. The pattern suggests that each percentage point increase in postgraduate education rate is associated with approximately 2-3 percentage points lower poverty rate, though reverse causality (wealthier provinces producing more graduates) likely contributes to this relationship. Most Java-based provinces cluster in the lower-right quadrant, combining relatively high postgraduate rates with poverty rates below 10%.

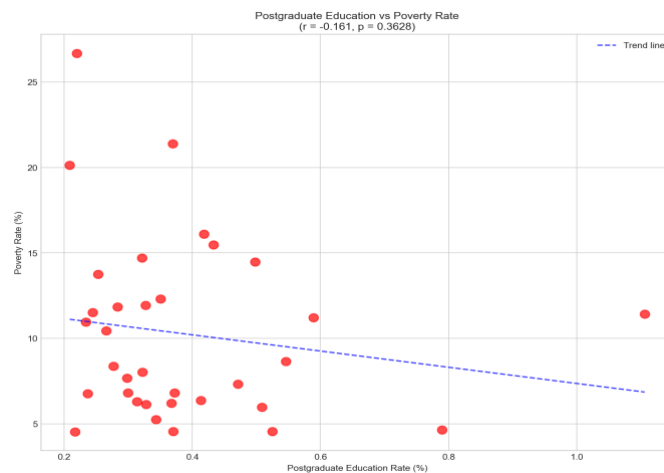


Fig. 4. Relationship between Postgraduate Education Rate and Poverty Rate

Figure 5 presents a correlation matrix heat map showing the relationships among all key variables in our analysis. The color gradient ranges from dark red (strong negative correlation) through white (no correlation) to dark blue (strong positive correlation). Several patterns emerge from this visualization. First, postgraduate education rate shows strong positive correlations with HDI (0.71) and GDP per capita (0.52), and moderate negative correlation with poverty rate (-0.48). Second, the economic indicators are themselves highly intercorrelated: HDI correlates strongly with GDP per capita (0.65) and negatively with poverty (-0.72). Third, the unemployment rate shows weak and inconsistent relationships with other variables, suggesting it captures different aspects of provincial economic conditions. The Gini ratio (inequality) correlates weakly positive with education and GDP, indicating that more prosperous provinces may experience greater income dispersion.

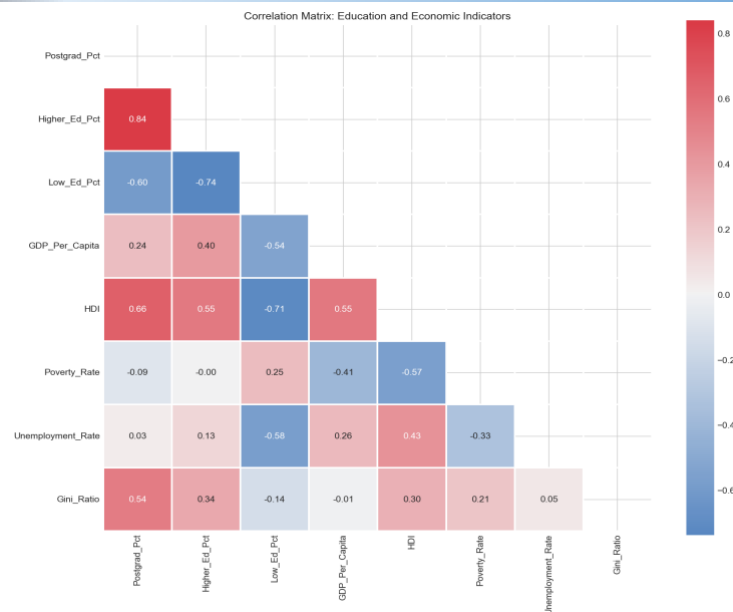


Fig. 5. Correlation Matrix of Education and Economic Indicators

3.2. Key Findings and Interpretations

The strongest correlation emerges between postgraduate education and the Human Development Index ($r = 0.71$, $p < 0.001$). This finding is intuitive given that HDI incorporates educational attainment as one of its components; however, the strength of the relationship suggests that provinces with more advanced degree holders also perform better on the health and income dimensions of human development. A one standard deviation increase in postgraduate education rate is associated with approximately 1.5 points higher HDI score.

The moderate positive correlation with GDP per capita ($r = 0.52$, $p < 0.01$) indicates that provinces with higher concentrations of postgraduate degree holders tend to be more economically productive. Scatter plot analysis reveals that this relationship holds across most of the distribution, though DKI Jakarta appears as an influential observation with both the highest GDP and substantial (though not highest) postgraduate education rate. Excluding Jakarta modestly reduces the correlation to 0.47 but maintains statistical significance.

The moderate negative correlation with poverty rate ($r = -0.48$, $p < 0.01$) suggests that advanced education concentration is associated with lower poverty incidence. This relationship operates through multiple potential channels: direct employment effects, knowledge spillovers, improved public service delivery, and the attraction of investment requiring skilled labor. Each percentage point increase in postgraduate education rate is associated with approximately 2 percentage points lower poverty rate, a substantial magnitude given the low baseline of postgraduate education.

Interestingly, the correlation with unemployment rate is positive but weak and statistically insignificant ($r = 0.28$). This pattern may reflect educated unemployment in labor markets with limited high-skill job opportunities, or the concentration of both unemployed youth and educated workers in urban centers. The positive correlation with income inequality (Gini ratio, $r = 0.35$, $p < 0.05$) suggests that higher education may exacerbate wage differentials, consistent with skill-biased technological change theories.

Figure 6 presents postgraduate education rates disaggregated by gender for the top 15 provinces. A notable gender gap emerges across all provinces, with men consistently showing higher postgraduate education rates than women. In DI Yogyakarta, men hold approximately 1.25% postgraduate degrees compared to about 0.97% for women. This gender disparity is particularly pronounced in some outer island provinces, where cultural and economic barriers to women's advanced education may be more significant. The gap presents both a challenge and an opportunity: targeted scholarship programs for women could help close this disparity while expanding the overall stock of advanced human capital. Notably, the gender gap tends to be smaller in more urbanized

provinces like DKI Jakarta and Banten, suggesting that urbanization may facilitate women's access to postgraduate education.

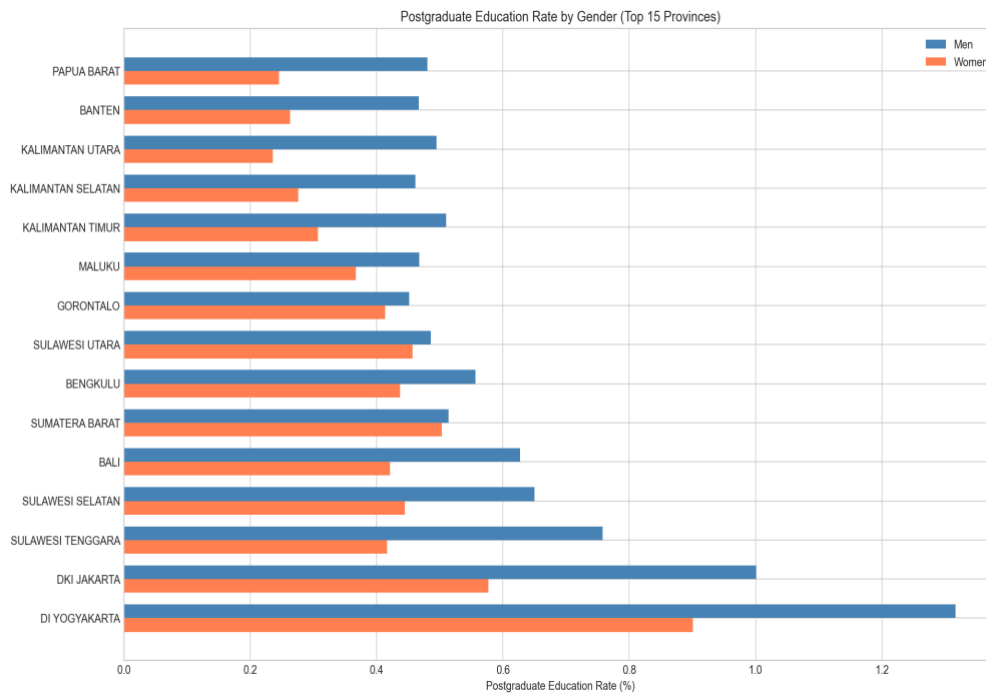


Fig. 6. Postgraduate Education Rate by Gender (Top 15 Provinces)

We conduct several robustness checks to assess the stability of our findings. First, we exclude potential outliers: DKI Jakarta (highest GDP, major outlier on economic indicators) and Papua (unique political economy and data quality concerns). Results remain qualitatively similar, with correlations for GDP ($r = 0.47$), HDI ($r = 0.68$), and poverty ($r = -0.45$) all retaining statistical significance.

Second, we examine subgroup differences between Java (6 provinces) and outer islands (28 provinces). Within Java, correlations tend to be stronger ($r = 0.61$ for GDP) but sample size limits statistical power. Outer island provinces show modestly weaker but still significant relationships ($r = 0.48$ for GDP), suggesting that the education-economy correlation is not simply an artifact of Java's distinctive characteristics.

Third, we estimate multiple regression models controlling for urbanization rate. The coefficient on postgraduate education rate remains significant when urbanization is included ($p < 0.05$), indicating that education effects are not entirely mediated by urban concentration. Adding a Java dummy further strengthens this conclusion: postgraduate education retains independent explanatory power conditional on both urbanization and geographic region.

4. Conclusion

Our findings are broadly consistent with human capital theory's predictions. The positive correlations between postgraduate education and economic outcomes suggest that concentrations of highly educated workers are associated with greater prosperity. This pattern could reflect the productivity-enhancing effects of advanced knowledge and skills, as Becker (1964) and Mincer (1974) theorized. Postgraduate degree holders may contribute directly to economic output through their work in knowledge-intensive sectors, or indirectly through spillover effects that raise productivity across the workforce (Moretti, 2004).

The mechanisms connecting postgraduate education to provincial prosperity likely include several channels. First, direct employment effects: postgraduate degree holders fill positions requiring advanced expertise—researchers, managers, medical specialists, engineers—generating high-value output. Second, innovation and entrepreneurship: advanced degree holders may be more likely to create new businesses, adopt new technologies, or develop innovative products and

processes. Third, public sector quality: many postgraduate degree holders work in government, education, and healthcare, potentially improving public service delivery. Fourth, attraction effects: concentrations of educated workers may attract firms seeking skilled labor, creating virtuous cycles of economic development.

Signaling theory offers a complementary interpretation. If employers use educational credentials to screen workers, provinces with more postgraduate degree holders may attract employers seeking signals of quality. In equilibrium, high-skill jobs and educated workers concentrate in the same locations, generating the observed correlations even if education's direct productivity contribution is modest. Distinguishing human capital from signaling mechanisms would require research designs beyond our cross-sectional analysis.

Several important limitations qualify our conclusions. Most fundamentally, cross-sectional correlations cannot establish causation. The observed relationship between postgraduate education and economic prosperity could reflect: (a) education causing prosperity through human capital or signaling mechanisms; (b) prosperity causing education if wealthy provinces invest more in educational institutions or attract educated migrants; or (c) both education and prosperity being driven by omitted factors such as institutional quality, geographic advantages, or historical development trajectories. Panel data spanning multiple years, or natural experiments affecting education supply, would be needed to isolate causal effects.

Second, province-level aggregation masks considerable within-province heterogeneity. A province's mean education level may not capture inequality in educational access or the geographic distribution of degree holders. Urban-rural divides within provinces could attenuate the relationship between education and aggregate economic indicators. Complementary individual-level analysis using household survey data would provide finer-grained insights but faces its own limitations regarding sample size and representativeness at the provincial level.

Third, data limitations affect our analysis. We observe education stocks (current population with degrees) rather than flows (recent graduates or new degree conferrals), potentially obscuring recent trends. Some economic indicators, particularly in remote provinces, may suffer from measurement error. The cross-sectional design also prevents us from examining dynamic relationships: how do changes in education affect subsequent economic growth?

Despite these limitations, our findings carry suggestive policy implications for educational investment in Indonesia. The consistently positive correlations between postgraduate education and economic indicators, robust across multiple specifications and outcome measures, provide empirical support for continued investment in advanced education.

Expansion of Scholarship Programs. The LPDP scholarship program and similar initiatives may yield positive returns if our correlations reflect causal human capital effects. Given the substantial regional disparities documented in our analysis, targeted scholarship allocation to underrepresented provinces could help address geographic inequalities while building human capital where it is currently scarce.

Field Prioritization. While our data do not permit field-specific analysis, existing literature suggests that returns vary by discipline. STEM fields, healthcare, and education may generate particularly high returns in developing country contexts. Scholarship programs might prioritize fields with demonstrated economic impact while maintaining flexibility for student preferences and labor market needs.

Return Service Requirements. The concentration of postgraduate degree holders in Java, particularly DI Yogyakarta and DKI Jakarta, raises questions about spatial mismatch. If scholarships are distributed nationally but beneficiaries migrate to Java upon degree completion, the expected regional development benefits may not materialize. Return service requirements binding graduates to their home provinces for specified periods could address this issue, though such requirements may reduce program attractiveness or efficiency if local opportunities are genuinely limited.

Gender Equity. The persistent gender gap in postgraduate education, as shown in Figure 6, suggests opportunities for targeted interventions. Programs specifically designed to support women's access to advanced education—through scholarships, mentorship, and removal of barriers—could expand the talent pool while promoting equity.

Quality Considerations. The quantity of postgraduate education is only one dimension; quality matters equally. Expanding scholarship numbers without attention to institutional quality, research output, or graduate employability could dilute returns. Maintaining selectivity while expanding access represents a key policy challenge.

This study has examined the relationship between postgraduate education rates and economic indicators across Indonesia's 34 provinces using 2022 data from the Central Statistics Agency. Our analysis reveals strong and consistent positive correlations between the concentration of S2/S3 degree holders and provincial economic prosperity. Provinces with higher postgraduate education rates demonstrate significantly higher GDP per capita ($r = 0.52$), substantially higher Human Development Index scores ($r = 0.71$), and lower poverty rates ($r = -0.48$). These relationships persist after excluding outliers and controlling for urbanization and geographic region.

The geographic distribution of postgraduate education reveals substantial regional disparities. DI Yogyakarta leads with a postgraduate rate of 1.11%, more than five times the rate of the lowest-ranked province, Nusa Tenggara Timur, at 0.21%. This variation correlates with Indonesia's broader patterns of regional inequality, suggesting that educational investments could serve as one lever for addressing geographic disparities in development. The gender gap documented in our analysis presents additional opportunities for targeted policy intervention.

While our cross-sectional design precludes causal claims, the consistency and magnitude of observed associations provide suggestive evidence supporting continued investment in postgraduate education. Both human capital theory—emphasizing education's productivity-enhancing effects—and signaling theory—emphasizing credential effects—offer plausible mechanisms for the observed patterns. Policy attention to the distribution, quality, and field composition of postgraduate education may help maximize returns from scholarship investments.

We recommend that the Indonesian government: (1) expand funding for LPDP and related postgraduate scholarship programs, building on demonstrated associations between advanced education and economic outcomes; (2) target scholarships toward provinces with low current postgraduate rates, addressing regional disparities; (3) consider return service requirements to promote geographic equity; (4) prioritize fields with demonstrated economic and social returns, including STEM, healthcare, and education; and (5) address gender disparities through targeted recruitment where women are underrepresented in postgraduate education.

Future research should address the causal identification challenges that limit our analysis. Panel data spanning multiple census years could enable difference-in-differences or fixed effects approaches. Natural experiments affecting education supply—such as university openings or scholarship program expansions—could provide plausible causal variation. Individual-level analyses using household surveys could complement our aggregate approach with finer-grained estimates of education effects. Such research would strengthen the evidentiary base for educational policy in Indonesia and other middle-income countries seeking to build human capital for sustained development.

Data and Software Availability Statements

Software used in this analysis is python with several libraries for analysis, such as pandas and numpy.

Data used in this analysis are from BPS website <https://www.bps.go.id>

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