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THE ROLE OF LABOR IN MEDIATING THE EFFECT OF WAGES, INVESTMENT, EDUCATION AND HEALTH ON GROSS REGIONAL DOMESTIC PRODUCT IN INDONESIA

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Abstract

Equitable and sustainable economic growth has become an important agenda in Indonesia's development, especially through the strengthening of the Gross Regional Domestic Product (GRDP). Labor is a main production factor that is suspected to play a mediating role in channeling the influence of various economic determinants on regional performance. This study aims to analyze the role of labor (LFPR) in mediating the influence of wages, domestic investment (PMDN), education, and health on GRDP in 34 provinces in Indonesia during the 2014–2023 period. The analysis was carried out using panel data with a path analysis approach and mediation testing using the Sobel Test. The results of the study show that directly wages, education, health, and investment have a significant effect on GRDP, while the influence of these variables on LFPR shows variations in significance. Indirectly, only wages and education are proven to have a significant effect on GRDP through LFPR as a mediating variable, while investment and health do not show significant mediation effects. These findings emphasize that improving the quality and involvement of labor is an important channel in transmitting the economic impact of wage and education improvements, while the influence of investment and health works more dominantly through direct mechanisms on economic output. This study contributes to strengthening the literature on human-capital-based development and provides more directed policy guidance in encouraging inclusive and sustainable regional economic growth.

Keywords: Labor, Wages, Investment, GRDP, Mediation

INTRODUCTION

The Indonesian national development agenda prioritizes inclusive and sustainable economic growth, prominently highlighted through the use of Gross Regional Domestic Product (GRDP) as an evaluative metric of regional economic performance and societal welfare. Recent data indicate a notable correlation between labor dynamics and economic output, as the labor force remains a primary production factor crucial for enhancing the nation's economic productivity. Although the agricultural sector's contribution to GRDP has diminished, it still employs approximately 40% of the national labor force, particularly in rural locales, illuminating the ongoing dependency on labor-intensive sectors that are sensitive to labor policies and fluctuations in workforce productivity (Prabowo et al., 2022), (Kasidi & Fitri, 2024). The imperative to bolster GRDP not only aims to boost growth figures but also to alleviate regional inequalities and enhance access to quality employment opportunities. Disparities in minimum wages, investment realization, educational attainment, and healthcare access manifest as critical challenges that ultimately affect regional labor productivity and GRDP performance. This reality necessitates that the Indonesian government craft policies that harmonize labor protection with competitive business practices. Observations from global organizations, such as the World Economic Forum, emphasize the necessity for upskilling and enhancing labor productivity to equip developing nations like Indonesia for economic transformation amid evolving global labor dynamics (Prabowo et al., 2022). Within the structural determinants of economic performance, several issues warrant attention. First, wage policies present a persistent challenge; competitive wages may enhance labor participation, but increases in minimum wages that outstrip business financial capacities can lead to labor reductions, disrupting economic equilibrium (Kasidi & Fitri, 2024). Second, domestic investments, particularly within processing industries, can augment production capacities and generate employment opportunities, as exemplified by research examining the tempe processing industry in Palangka Raya,

which underscores critical local economic contributions (Satriawan et al., 2025). Nonetheless, these investments are often inequitably distributed across regions, engendering disparities in economic benefits. Education is a pivotal factor in fortifying human resources; however, a skills mismatch exists between graduates' competencies and market demands, hindering the labor force's effective contribution to broader economic contexts (Putra & Mustika, 2025). Furthermore, healthcare access remains a fundamental determinant of workforce productivity. Research indicates that healthier individuals tend to be more productive and better equipped to engage in economic activities; hence, improving healthcare services is crucial for labor readiness and sustainability in supporting regional economic growth (Rahmayani, 2024).

The interconnectedness of wages, investment, education, and health creates an ecosystem that significantly influences GRDP. Scientific inquiry has largely concentrated on the direct impacts of these factors on economic growth, often neglecting the mediating role of labor within these dynamics. Recognizing labor as a crucial transmission agent through which economic policies influence regional output highlights an empirical gap this research aims to address. The forthcoming study intends to analyze the mediating role of the Labor Force Participation Rate (LFPR) within the interactions between wages, domestic investment, education, and health in relation to GRDP across 34 Indonesian provinces from 2014 to 2023. Utilizing panel-data analysis through path regression and the Sobel Test for mediation, the study aims to elucidate direct and indirect relationships among these variables, thereby enhancing the understanding of optimizing labor policies to foster more inclusive and sustainable economic growth.

LITERATURE REVIEW

Theoretical Foundations

Economic growth at the regional level can indeed be analyzed through the lenses of capital, labor, and human resources quality, as posited in the Economic Growth Theory. The neoclassical perspective, represented by the Solow-Swan model, supports this view by positing that regional output (Y) is a function of capital (K), labor (L), and technological efficiency (A) expressed as $Y = K^{\alpha}(A)^{(1-\alpha)}$. This model highlights that investments in capital not only expand production capacity but that the quality of labor, influenced by education and health, is crucial for enhancing productivity and linking these factors to Gross Regional Domestic Product (GRDP) performance (Vikia, 2023; Giombini et al., 2022). The role of labor is particularly significant; it acts as a mediator that channels the effects of wages, investment, education, and health into economic outputs.

Furthermore, the endogenous growth theory emphasizes the long-term contributions of education, health, and innovation as essential elements for sustained productivity growth. Studies illustrate that human capital directly influences regional economic outcomes and plays a mediating role in the relationship between investment and economic growth (Li et al., 2023; Wang & XiaoweiZhou, 2024). For instance, investments in health and education are recognized as key drivers of economic productivity, enhancing labor quality and further contributing to GRDP growth (Villanueva, 2021). From a Keynesian perspective, the dynamics of consumption (C) can be expressed as $C = a + bYd$, where increased disposable income (Yd), a factor heavily influenced by wages, propels consumption. Higher wages elevate consumption levels, thereby stimulating demand and furthering regional economic output through enhanced labor absorption (Ekeocha et al., 2023). This alignment underscores the theory's assertion that increases in income fuel consumption, which subsequently stimulates broader economic activities and employment opportunities.

The Harrod-Domar model similarly aligns with this framework, proposing that investment is the primary engine driving economic growth. This model emphasizes that effective investment not only boosts output but simultaneously establishes new labor opportunities, thereby reinforcing the link between capital investment and labor dynamics that influence economic growth rates (Ramly et al., 2023). In summary, different economic theories converge on a central message: wages, investments, and the quality of human capital are critical determinants of labor dynamics and regional GRDP performance. The interrelationships among these factors are essential for understanding and addressing regional economic growth, signaling the importance of developing targeted policies that enhance education, health, and employment opportunities in a cohesive manner (Puaschunder, 2020).

Empirical Review

Previous empirical studies reveal mixed evidence concerning the influence of economic factors on labor outcomes and Gross Regional Domestic Product (GRDP). For instance, Priambodo et al. found a significant positive impact of labor on regional economic growth in Central Java, suggesting that employment absorption

evidently stimulates growth (Nairobi & Respitasari, 2021). Conversely, Wicaksono et al. indicated that economic growth and investment are negatively correlated with educated unemployment in the region, highlighting contrasting dynamics in labor absorption (Wicaksono et al., 2024). Regarding wages, research indicates variable impacts: While Qurniawan and Jasmina noted that higher school quality could enhance labor market outcomes when coupled with effective educational frameworks (Qurniawan & Jasmina, 2021), other studies suggest increasing minimum wage levels might negatively affect industrial labor absorption (Purba et al., 2023). This inconsistency highlights the complex interplay between wage regulations and economic performance.

In contrast, studies on education and health consistently show that these factors positively influence labor productivity, with Bahtia et al. asserting significant effects of education and health levels on economic outcomes (Bahtia et al., 2025). Additionally, research by Kusumawardhani demonstrates that higher education and improved health substantially bolster labor competitiveness and contribute positively to GRDP (Kusumawardhani, 2025). The overall findings suggest the interactions among economic variables and GRDP are multifaceted, necessitating a comprehensive model that examines both direct and indirect influences, including the mediating role of labor.

Conceptual Framework

Grounded in growth theory, aggregate demand theory, and human capital theory, wages, investment, education, and health are assumed to influence GRDP both directly and indirectly through labor as a mediating variable. Labor acts as a transmission channel through which these economic factors affect regional output. The conceptual framework of this study captures direct and indirect causal relationships as illustrated in Figure 1.

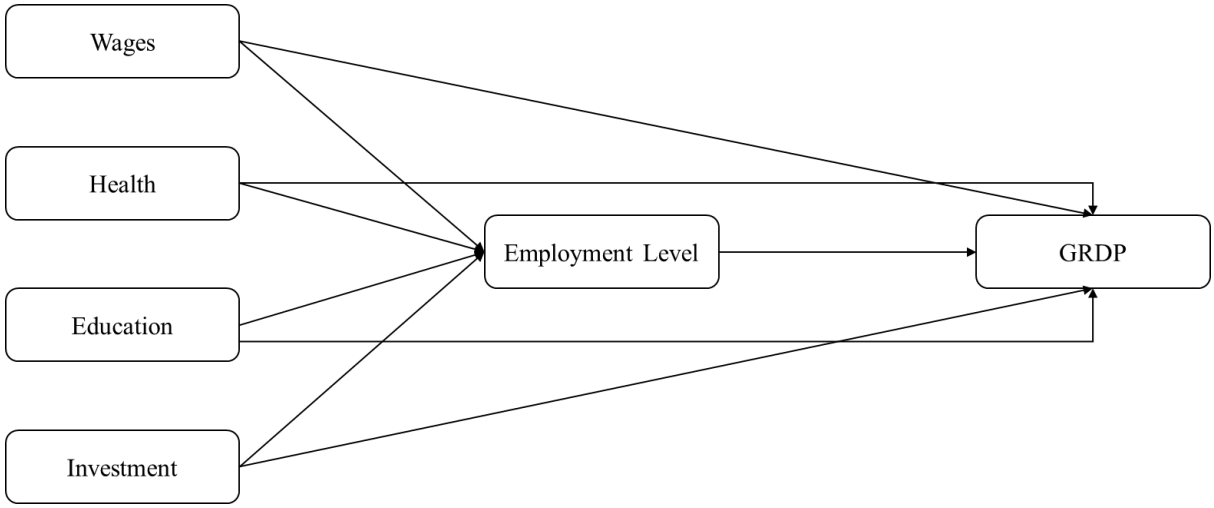

Figure 1. Conceptual Framework

Based on the theoretical foundations, empirical evidence, and the conceptual framework presented above, the following hypotheses are proposed:

H1: Wages have a positive effect on labor in Indonesia.
H2: Investment has a positive effect on labor in Indonesia.
H3: Education has a positive effect on labor in Indonesia.
H4: Health has a positive effect on labor in Indonesia.
H5: Wages have a positive effect on GRDP in Indonesia.
H6: Investment has a positive effect on GRDP in Indonesia.
H7: Education has a positive effect on GRDP in Indonesia.
H8: Health has a positive effect on GRDP in Indonesia.
H9: Labor has a positive effect on GRDP in Indonesia.
H10: Wages have a positive effect on GRDP through labor in Indonesia.
H11: Investment has a positive effect on GRDP through labor in Indonesia.
H12: Education has a positive effect on GRDP through labor in Indonesia.
H13: Health has a positive effect on GRDP through labor in Indonesia.

METHOD

Research Approach

This study applies a quantitative explanatory approach designed to examine causal relationships among wages, investment, education, health, labor, and regional economic performance (GRDP). The explanatory design is appropriate because the study aims not only to describe macroeconomic conditions but also to test how these variables influence one another through direct and indirect channels. Labor is positioned as a mediating variable, allowing the analysis to capture transmission mechanisms that link human capital, wage incentives, and investment capacity to regional economic output. By using panel data covering all provinces in Indonesia over a ten-year period, the research design provides a strong empirical basis for identifying consistent patterns, temporal dynamics, and cross-regional variations in Indonesia's economic development.

Data Collected

The study relies on secondary data collected from official national institutions, ensuring reliability, consistency, and comparability across provinces. Data on provincial minimum wages, labor force participation rates, and GRDP are obtained from the Badan Pusat Statistik (BPS). Domestic investment data are sourced from the Indonesia Investment Coordinating Board (BKPM). Indicators of education, represented by tertiary gross enrollment rates, are obtained from the Ministry of Education, while health indicators such as life expectancy are sourced from the Ministry of Health. All data cover the period from 2014 to 2023 and include complete observations for all 34 provinces, forming a balanced panel dataset. This structure makes it possible to analyze how changes in economic and human capital indicators correspond with changes in labor participation and economic growth over time.

Data and Sources

The key variables examined in this study represent major components of regional economic development. Wages reflect provincial minimum wage levels that influence workers' incentives to participate in the labor market. Investment describes the realization of domestic investment (PMDN) that contributes to capital accumulation and regional production capacity. Education is represented by tertiary enrollment rates, capturing the level of human capital formation in each province. Health is measured using life expectancy, which reflects population well-being and long-term productivity potential. Labor is represented by the labor force participation rate (TPAK), indicating the proportion of the population engaged or willing to engage in economic activity. GRDP serves as the primary indicator of regional economic output. All variables are measured annually and aligned across provinces to maintain consistency and facilitate meaningful panel-data analysis.

Data Analysis Techniques

Data analysis begins with descriptive statistics to explore the general distribution, patterns, and trends across provinces. After the descriptive phase, panel-data regression is applied to estimate direct relationships among variables. The selection of the most suitable model—whether fixed effects, random effects, or pooled OLS—is determined through the Chow and Hausman tests. Once the appropriate model is identified, path analysis is used to decompose direct and indirect effects in accordance with the conceptual framework. This method allows the study to evaluate how wages, investment, education, and health influence GRDP not only individually but also through their impact on labor. To test the mediating role of labor, the Sobel test is employed to determine whether the indirect effects are statistically significant. The coefficient of determination (R^2) is then used to assess how well the overall model explains variations in labor and GRDP. Together, these analytical procedures provide a comprehensive picture of how human capital, economic inputs, and labor dynamics shape regional economic performance in Indonesia.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1. Descriptive Statistics Results

Statistik	LOG_PDRB	TPAK	LOG_UPAH	LOG_PMDN	PENDIDIKAN	KESEHATAN
Mean	8.3155	70.5646	6.3503	3.5896	32.4201	70.3259
Median	8.3329	68.6358	6.3522	3.6654	31.1050	70.1900
Maximum	9.9098	98.2458	7.5040	5.1818	75.5900	78.9100
Minimum	6.9272	60.0000	5.9590	0.5563	10.8300	64.0900
Std. Dev.	0.5169	7.6966	0.1509	0.7574	10.6900	2.7322
Observations	340	340	340	340	340	340

Table1 reports the descriptive statistics for all variables over 34 provinces in Indonesia during 2014–2023. The average value of logged GRDP (LOG_PDRB) is 8.3155 with a standard deviation of 0.5169, indicating substantial disparity in regional economic capacity, as reflected by the gap between the minimum (6.9272) and maximum (9.9098). This pattern suggests that economic output and productivity remain highly uneven across provinces. Provincial minimum wages (LOG_UPAH) have a mean of 6.3503, with values ranging from 5.9590 to 7.5040 and a relatively small standard deviation (0.1509) in logarithmic terms. Although dispersion appears moderate in log scale, the underlying differences in nominal wages imply meaningful variation in purchasing power and welfare standards among provinces.

Domestic investment (LOG_PMDN) exhibits a mean of 3.5896 and a higher dispersion (standard deviation 0.7574), with a very low minimum (0.5563) compared to a maximum of 5.1818. This confirms sharp inequality in investment distribution, where a few provinces attract disproportionately large investment flows while others lag behind. Education, proxied by tertiary gross enrollment, has an average of 32.42% and a relatively high standard deviation of 10.69, with values ranging from 10.83% to 75.59%. This wide gap reflects serious inequality in access to higher education across regions. Health, measured by life expectancy, shows a mean of 70.33 years with a standard deviation of 2.73, and values between 64.09 and 78.91 years, indicating persistent differences in health outcomes and service quality among provinces.

The labor force participation rate (TPAK) averages 70.56% with a standard deviation of 7.70, suggesting that although aggregate participation is relatively stable, some provinces experience lower engagement in the labor market due to structural and sectoral characteristics. Overall, the descriptive statistics highlight structural disparities in wages, investment, human capital, labor participation, and economic performance, providing an initial indication of differentiated growth capacity across Indonesian regions.

Model Selection

Table 2. Chow Test Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	13.2928	33,301	0.0000
Cross-section Chi-square	305.6888	33	0.0000

The Chow test (Table 2) yields a Cross-section F value of 13.2928 and a Cross-section Chi-square of 305.6888, both with p-values of 0.0000, well below the 5% significance level. This indicates that the fixed effect model (FEM) is preferred over the pooled OLS model, confirming the presence of significant heterogeneity across provinces.

Table 3. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	36.6940	5	0.0000

The Hausman test (Table 3) reports a Chi-square statistic of 36.6940 with 5 degrees of freedom and a p-value of 0.0000, implying that the fixed effect estimator is also superior to the random effect estimator. These results jointly justify the use of a Fixed Effect Model in this study, allowing province-specific unobserved characteristics to be controlled in estimating the relationships between wages, investment, education, health, labor, and GRDP.

Direct Effects

Table 4. Direct Effect Estimation Results

Hyp	Variable	Coefficient	Std. Error	t-Statistic	Prob.
H1	Wages → Labor (TPAK)	15.1746	4.6938	3.2329	0.0014
H2	Investment → Labor (TPAK)	1.0168	1.0431	0.9748	0.3304
H3	Education → Labor (TPAK)	0.3671	0.1652	2.2215	0.0271
H4	Health → Labor (TPAK)	0.7492	0.5538	1.3528	0.1771
H5	Wages → GRDP	0.5667	0.0863	6.5694	0.0000
H6	Investment → GRDP	0.3206	0.0189	16.9811	0.0000
H7	Education → GRDP	0.0172	0.0030	5.7072	0.0000
H8	Health → GRDP	0.0274	0.0100	2.7264	0.0068
H9	Labor (TPAK) → GRDP	0.0021	0.0010	2.0605	0.0402

The direct effect estimates are summarized in Table 4 On the labor equation, wages have a positive and statistically significant effect on labor force participation (H1 supported), with a coefficient of 15.1746 and a p-value of 0.0014. This suggests that higher provincial minimum wages act as an economic incentive that attracts more working-age individuals into the labor market, consistent with labor economics and Keynesian views on income and labor supply. Education also shows a positive and significant effect on TPAK (coefficient 0.3671; p = 0.0271), supporting H3 and confirming the role of education in strengthening human capital and employability. In contrast, domestic investment (PMDN) and health do not significantly affect labor force participation (H2 and H4 not supported). Although both coefficients are positive (1.0168 for PMDN and 0.7492 for health), their p-values (0.3304 and 0.1771, respectively) indicate that increases in investment and life expectancy have not translated into statistically detectable changes in provincial labor participation during the study period. These results may reflect the predominance of capital-intensive investments and the long-term nature of health improvements.

On the GRDP equation, all explanatory variables exert positive and statistically significant effects. Wages (coefficient 0.5667; p = 0.0000), investment (0.3206; p = 0.0000), education (0.0172; p = 0.0000), health (0.0274; p = 0.0068), and labor (0.0021; p = 0.0402) all significantly enhance GRDP, supporting H5–H9. These findings confirm that higher wage levels, greater domestic investment, better educational attainment, improved health, and higher labor participation collectively strengthen regional output. The strong effects of wages and investment are consistent with Keynesian and Harrod–Domar/Solow–Swan perspectives, while the significant roles of education and health align with Human Capital Theory.

Indirect Effects

Table 5. Indirect Effect (Sobel Test) Results

Hyp	Variable	t-Statistic	Prob.
H10	Wages → Labor (TPAK) → GRDP	2.3605	0.0391
H11	Investment → Labor (TPAK) → GRDP	0.8842	0.3766
H12	Education → Labor (TPAK) → GRDP	1.9997	0.0455
H13	Health → Labor (TPAK) → GRDP	1.1373	0.2554

The Sobel test results in Table 4.5 show that not all independent variables exert significant indirect effects on GRDP through labor as a mediator. Wages have a positive and statistically significant indirect effect on GRDP via TPAK (t = 2.3605; p = 0.0391), supporting H10. This indicates that higher wages not only increase GRDP directly but also indirectly through higher labor force participation. Education similarly exhibits a significant indirect effect on GRDP through labor (t = 1.9997; p = 0.0455), supporting H12 and confirming that education enhances both the quality and participation of the labor force, which subsequently raises regional output.

In contrast, the indirect effects of investment and health through labor are not statistically significant (H11 and H13 not supported). PMDN shows an indirect t-value of 0.8842 (p = 0.3766), while health records a t-value of 1.1373 (p = 0.2554). These results suggest that, although investment and health directly support GRDP, their channels of influence do not operate primarily through changes in labor force participation. Investment appears to work more through capital deepening and technology, whereas health improvements are more closely tied to productivity and efficiency than to the decision to participate in the labor market.

Model Fit

Table 6. Model Determination (Adjusted R^2) Results

Variabel	Adjusted R-Square
PDRB	0.9222
TPAK	0.9873

Table 4.6 reports adjusted R-square values of 0.9222 for the GRDP model and 0.9873 for the labor model. This implies that 92.22% of the variation in GRDP is explained by wages, investment, education, health, and labor, while 98.73% of the variation in TPAK is explained by wages, investment, education, and health. These high explanatory powers indicate that the specified models fit the data very well and that the chosen variables provide a strong empirical representation of the structural relationships between economic determinants, labor, and regional output in Indonesia.

The Effect of Wages on Labor in Indonesian Provinces

Wages exert a positive and statistically significant influence on labor force participation, as reflected by a coefficient of 15.1746, t-statistic 3.2329, and p-value 0.0014. These findings confirm that increases in the

provincial minimum wage provide stronger financial incentives for working-age individuals to enter the labor market. In labor economics and Keynesian theory, higher income reduces the opportunity cost of working and stimulates both labor supply and consumption. Additionally, wages may act as a signal of labor productivity consistent with Human Capital Theory, where higher compensation attracts more skilled and motivated workers. Empirically, this result aligns with Sasongko et al. (2020) who found that provincial minimum wages have significantly positive effects on female labor force participation rate. Similarly, Comola and de Mello (2011) documented that higher minimum wages encourage labor force participation by providing stronger financial incentives. Collectively, this suggests that wage policy remains a powerful tool for strengthening labor participation across Indonesian provinces.

The Effect of Investment on Labor in Indonesian Provinces

Investment displays a positive yet statistically insignificant relationship with labor participation, supported by a coefficient of 1.0168, t-statistic 0.9748, and p-value 0.3304. Although investment increases capital availability, it does not appear to directly influence the willingness or ability of individuals to enter the labor market. The insignificance likely stems from Indonesia's investment pattern, where PMDN frequently targets capital-intensive sectors such as mining, energy, or large-scale manufacturing. These industries rely more on technology and machinery than on additional labor, reducing the potential for immediate labor absorption. This outcome is consistent with the Solow–Swan and Harrod–Domar models, which emphasize that investment raises output primarily through capital deepening rather than increased employment. Empirically, Fatimah and Wiratmini (2024) similarly found that domestic investment (PMDN) does not always generate sufficient employment opportunities in the short term due to structural constraints. Sulistiawati (2012) noted that investment's labor impact depends heavily on sector type and technology intensity. Thus, investment's influence on labor participation remains structurally constrained.

The Effect of Education on Labor in Indonesian Provinces

Education significantly enhances labor force participation, indicated by a coefficient of 0.3671, t-statistic 2.2215, and p-value 0.0271. Higher educational attainment increases employability, strengthens individual capabilities, and improves readiness for labor market entry. According to Human Capital Theory, education enhances cognitive, technical, and adaptive skills, allowing individuals to access more productive and formal sectors. Provinces with higher tertiary enrollment rates tend to exhibit stronger labor market integration, as education reduces barriers to securing quality employment. Empirical support comes from Purnastuti and Suprayitno (2016), who demonstrated that education contributes significantly to the improvement of labor productivity. Similarly, Kusumawardhani (2025) found that higher education increases labor absorption and enhances regional economic competitiveness. These findings reinforce that expanding higher education access is crucial for encouraging productive labor participation across Indonesia.

The Effect of Health on Labor in Indonesian Provinces

Health exerts a positive but statistically insignificant effect on labor participation, with a coefficient of 0.7492, t-statistic 1.3528, and p-value 0.1771. While healthier populations tend to be more productive, the indicator used—life expectancy—captures long-term well-being rather than short-term functional health that directly affects labor force entry. In the context of labor economics, decisions to participate in the workforce are often influenced more by economic conditions (e.g., wages, job availability) than by broad health indicators. Empirically, Haryanto and Tenrini (2022) similarly found that life expectancy as a health indicator does not directly influence labor participation decisions but plays a stronger role in enhancing worker productivity. This suggests that health improvements contribute more toward labor quality rather than labor quantity. Thus, health remains important for economic efficiency, but its effect on labor participation decisions may manifest only in the long run or through more granular health indicators.

The Effect of Wages on GRDP in Indonesian Provinces

Wages have a strong, positive, and highly significant effect on GRDP, as shown by a coefficient of 0.5667, t-statistic 6.5694, and p-value 0.0000. Higher wages strengthen household consumption—the largest component of Indonesia's aggregate demand—which stimulates production across multiple sectors. This mechanism aligns with Keynesian multiplier theory, whereby income increases lead to higher consumption and broader economic activity. From the perspective of Human Capital Theory, higher wages also signal improved worker productivity, as regions with higher labor compensation tend to have more efficient and better-trained workers. Empirically, this finding is supported by Siregar et al. (2020), who documented that GRDP has a significant positive relationship with regional

minimum wages in Indonesian provinces. Similarly, Kasidi and Fitri (2024) found that minimum wages positively affect economic output across Central Java. This consistent evidence underscores the strategic importance of wage policy in driving regional economic growth.

The Effect of Investment on GRDP in Indonesian Provinces

Investment exerts a strong and highly significant effect on GRDP, reflected by a coefficient of 0.3206, t-statistic 16.9811, and p-value 0.0000. This confirms that PMDN functions as a major driver of regional economic growth through capital accumulation, infrastructure expansion, and technological upgrading. The magnitude of the effect aligns with predictions from the Harrod–Domar and Solow–Swan models, where sustained investment increases productive capacity and accelerates long-term output growth. Empirically, Fadhilah et al. (2024) and Ramly et al. (2023) also reported significant investment-driven growth across Indonesian provinces through capital accumulation. These findings highlight that although investment may not immediately absorb labor, it plays a fundamental role in enhancing productivity and expanding the economic base of regions, thereby boosting GRDP directly.

The Effect of Education on GRDP in Indonesian Provinces

Education has a positive and statistically significant effect on GRDP, as demonstrated by a coefficient of 0.0172, t-statistic 5.7072, and p-value 0.0000. Even though the coefficient value is relatively small, the significance indicates that higher educational attainment contributes meaningfully to economic growth over time. According to Human Capital Theory, education enhances skills, creativity, and adaptability, leading to higher productivity and innovation capacity. Empirical studies by Purnastuti and Suprayitno (2016) and Suripto et al. (2021) also show that education improves labor productivity, which ultimately contributes to regional economic expansion. These patterns suggest that education acts as a structural force that supports long-term economic development rather than producing immediate, large-scale output changes.

The Effect of Health on GRDP in Indonesian Provinces

Health significantly increases GRDP, with a coefficient of 0.0274, t-statistic 2.7264, and p-value 0.0068. A healthier population tends to be more productive, has lower absenteeism, and sustains longer working hours, all of which strengthen economic output. In the framework of Human Capital Theory, health is a core component of labor quality, enabling workers to perform tasks more effectively and consistently. Empirical evidence from Setyadi et al. (2023) supports this relationship, showing that life expectancy strongly correlates with GRDP per capita and improved economic outcomes in regional contexts. In Indonesia, disparities in health services among provinces mean that improvements in health outcomes can have particularly strong marginal effects on GRDP, highlighting the importance of health policies for economic development.

The Effect of Labor on GRDP in Indonesian Provinces

Labor participation significantly affects GRDP, with a coefficient of 0.0021, t-statistic 2.0605, and p-value 0.0402. Although the magnitude of the coefficient is small, its significance confirms that increasing the number of economically active individuals strengthens regional output. In Solow–Swan's production theory, labor is a fundamental production input, and growth in the active workforce increases productive capacity. Empirical support from Ramly et al. (2023) and Vikia (2023) suggest that labor availability remains essential in regions where formal and informal sectors rely heavily on labor-intensive processes. The finding indicates that while labor alone may not produce large jumps in GRDP, it remains a necessary component of sustained economic expansion.

The Indirect Effect of Wages on GRDP via Labor

The mediation of wages through labor is significant, indicated by a Sobel t-statistic of 2.3605 and p-value 0.0391. This shows that wages contribute to GRDP partly by stimulating labor force participation. Higher wages not only increase purchasing power but also motivate individuals to engage in productive economic activities, thereby increasing the effective labor supply. This dual mechanism is aligned with Keynesian income–employment theory, where rising wages increase both household consumption and labor participation. Empirically, this effect is consistent with Ekeocha et al. (2023), who showed that income increases through wage improvements reinforced labor engagement and strengthened consumption-driven economic output. The mediated pathway highlights the importance of wage-driven inclusivity in labor markets as part of regional growth strategies.

The Indirect Effect of Investment on GRDP via Labor

Investment does not significantly affect GRDP through labor, as reflected in a Sobel t-statistic of 0.8842 and a p-value of 0.3766. This suggests that investment flows during the study period were not labor-absorptive

enough to influence regional output through increased participation. Many investment projects in Indonesia are directed toward capital-intensive or technology-intensive sectors, which enhance productivity but do not require large expansions of the labor force. These findings mirror Ramly et al. (2023) and Silaban et al. (2024), who observed that investment influences GRDP primarily through capital accumulation rather than labor absorption. As such, investment's contribution to GRDP remains predominantly direct, rather than mediated through labor.

The Indirect Effect of Education on GRDP via Labor

Education significantly affects GRDP through labor participation, with a Sobel t-statistic of 1.9997 and p-value 0.0455. This indicates that education increases GRDP by improving worker productivity and increasing labor force participation. According to Human Capital Theory, educated individuals possess greater employability and adaptability, enabling them to enter the labor market more readily and contribute to productive output. Studies by Purnastuti and Suprayitno (2016) and Kusumawardhani (2025) confirm that education elevates both labor quality and participation through human capital development. Thus, the mediated effect illustrates how human capital formation expands both the size and efficiency of the workforce, driving regional economic growth.

The Indirect Effect of Health on GRDP via Labor

Health shows a positive but insignificant indirect effect on GRDP via labor, with a Sobel t-statistic of 1.1373 and a p-value of 0.2554. While healthier populations are more productive, life expectancy does not strongly influence decisions to participate in the labor market. This suggests that health contributes more through productivity improvements, such as better stamina and reduced absenteeism, rather than increasing the number of active workers. The finding is consistent with Haryanto and Tenrini (2022) and Setyadi et al. (2023), who found that health indicators relate more closely to productivity enhancement than labor participation decisions. Therefore, health strengthens GRDP primarily through quality-enhancing channels rather than through labor-mediated pathways.

CONCLUSION

This study examined the direct and indirect effects of wages, investment, education, and health on regional economic performance (GRDP) in Indonesia, using labor force participation (TPAK) as a mediating variable. Based on panel data from 34 provinces over the 2014–2023 period, the empirical results provide several important insights into the structural determinants of regional growth.

First, wages and education consistently demonstrate positive and significant effects on both labor participation and GRDP. Higher wages encourage greater workforce engagement and simultaneously stimulate aggregate demand, while education strengthens human capital quality and facilitates entry into productive employment. Labor mediates both relationships, indicating that these variables contribute to regional output through a dual mechanism of increased participation and enhanced productivity.

Second, investment shows a strong and highly significant direct effect on GRDP but does not significantly influence labor participation. This implies that investment-driven growth in Indonesia remains primarily capital-intensive, producing output gains through technological progress, capacity expansion, and structural shifts rather than through labor absorption. Health also contributes significantly to GRDP through productivity-enhancing channels but does not significantly affect labor participation, suggesting that improvements in population well-being enhance efficiency more than labor supply decisions.

Third, the mediating effect of labor is confirmed only for wages and education. The Sobel test indicates significant indirect effects for these variables, while investment and health do not exhibit mediation through TPAK. These findings reveal that Indonesia's labor participation is more sensitive to income incentives and educational attainment than to capital inflows or aggregate health improvements.

Overall, this study highlights two distinct pathways through which regional economic performance grows in Indonesia: a participation-driven pathway, dominated by wages and education, and a productivity-driven pathway, dominated by investment and health. Policymakers seeking inclusive regional growth should prioritize strategies that strengthen human capital and labor market inclusivity, while also ensuring that investment and health improvements translate into productivity gains. Future research may explore sector-specific heterogeneity, dynamic effects, and alternative health indicators to deepen the understanding of growth mechanisms across Indonesia's diverse regions.

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