

FORMAL EMPLOYMENT AND THE HUMAN DEVELOPMENT INDEX: A PANEL ANALYSIS OF 14 PROVINCES IN INDONESIA (2015–2024)

Picesco Andika Tulus¹, Cicih Ratnasih², Syaiful³

¹⁻³) Universitas Borobudur, Indonesia

E-mail: ¹) picesco@gmail.com, ²) cicih_ratnasih@borobudur.ac.id, ³) syaiful@borobudur.ac.id

Submitted:
02 August 2026

Revised:
02 Sept 2026

Accepted:
15 Sept 2026

Abstract

This study examines the effects of investment, provincial minimum wage, population growth, ICT index, and manufacturing GRDP growth on formal employment absorption, and its implications for the Human Development Index (HDI) in Indonesia. Using balanced panel data from 14 provinces selected as Indonesia's principal industrial and investment hubs with complete data coverage, over 2015–2024, estimated with Panel EGLS Random Effects and GLS Period SUR weighting, the results show that all independent variables jointly significantly affect formal employment absorption ($F=196.58$; $p=0.0000$). Investment, ICT index, and manufacturing growth have positive significant effects, highlighting structural transformation and digitalization. Minimum wage and population growth are also positive, while the COVID-19 pandemic in 2020 has a significant negative impact. In the second stage, formal employment absorption has a positive but insignificant effect on HDI after controlling for average years of schooling, poverty rate, and regional education-health expenditure. The pandemic in 2020–2021 significantly suppressed HDI. These findings suggest that formal employment is important but not yet sufficient to boost HDI due to job quality, productivity, and redistributive policy constraints. Integrated policies linking labor markets, industrialization, and digitalization are essential for resilient and sustainable human development.

Keywords: *formal employment absorption; investment; provincial minimum wage; ICT index; Human Development Index; manufacturing GRDP growth*

1. INTRODUCTION

Fundamental changes in the global economy are characterized by accelerating digitalization, shifting investment dynamics, and the need to enhance the quality of human development. For Indonesia, its large demographic base presents both challenges and opportunities in leveraging these macroeconomic factors to create high-quality formal sector jobs (BPS, 2024). Formal sector labor absorption is not merely a benchmark for economic policy effectiveness but a primary foundation influencing regional Human Development Index (HDI) outcomes.

This study focuses on a balanced panel of 14 provinces selected through purposive sampling: provinces with consistently complete annual data for every study variable across 2015–2024, and which together account for a substantial share of Indonesia's manufacturing GRDP, realized investment, and formal employment, spanning Java, Sumatra, Kalimantan,

and Sulawesi to represent the archipelago's principal industrial corridors, based on national manufacturing and investment statistics.

The dynamics of formal labor absorption in Indonesia are driven by several key factors. Capital allocation, both PMDN and PMA, is a driver of national production capacity. Rini and Septriani (2025) and Pramusinto and Daerobi (2021) confirm that investment penetration in the manufacturing sector contributes significantly to increased labor absorption. Meanwhile, Provincial Minimum Wage (UMP) regulations serve as a key variable influencing labor market flexibility and industrial competitiveness. Regional UMP adjustments have been shown to determine the formal sector's attractiveness, as demonstrated by Pratama et al. (2020) in the Sumatra region.

Demographic factors and technological acceleration are also reshaping the employment landscape. Population growth rates determine the size of the workforce, while the workforce's education and health levels are determinants of long-term productivity (Hanushek & Woessmann, 2019; Sari & Hidayat, 2020). The penetration of information and communication technology (ICT) presents a dual disruption: creating new digital-based job opportunities while simultaneously threatening routine jobs through automation (Frey & Osborne, 2017; Sahut et al., 2022; Ifan & Sulistyaningrum, 2023). In this context, growth in the manufacturing sector's Gross Regional Domestic Product (GRDP) continues to play a crucial role as a primary driver of value creation and labor absorption, owing to strong inter-sectoral linkages (Pramusinto & Daerobi, 2021).

National economic growth data for the 2012–2024 period recorded sharp fluctuations, particularly when the contraction reached -2.07% in 2020 due to the COVID-19 pandemic, before finally recovering to around 5.03% in 2024. However, economic recovery does not automatically result in equitable prosperity if it is not accompanied by an expansion of formal employment opportunities that can support the community's standard of living, health, and access to education.

Research Gap and Novelty

Most existing literature examines the relationships among investment, wages, digitalization, and the Human Development Index (HDI) in a partial or isolated manner. For instance, Sari and Hidayat (2020) investigated the impact of the provincial minimum wage (UMP) and investment on employment opportunities without incorporating ICT or HDI dimensions. Putra and Rachmawati (2020) positioned HDI as a driver of economic growth but overlooked the role of formal labor absorption as an intervening variable. Meanwhile, Yuliana and Prasetyo (2019) limited their scope to regional investment and HDI, failing to integrate the dynamics of digital transformation.

This study addresses these gaps in the literature through three primary contributions. First, conceptually, it integrates investment, UMP, population growth, the ICT index, and manufacturing Gross Regional Domestic Product (GRDP) into a unified simultaneous

analysis framework. Second, it positions formal labor absorption as a transmission (mediating) variable to examine the extent to which improvements in the employment structure can transform economic growth into enhanced human capacity (HDI). Third, the use of 10-year panel data (2015–2024) covering the phases before, during, and after the COVID-19 pandemic is estimated using the GLS Period SUR method to precisely control heteroscedasticity and cross-regional dependencies.

2. LITERATURE REVIEW

2.1 Theoretical Framework

This study's analytical framework rests on four key theoretical pillars. Solow's (1956) Neoclassical Growth Theory posits that physical capital accumulation and labor force growth are primary drivers of output, with investment facilitating capital deepening to enhance production capacity. Endogenous Growth Theory (Romer, 1986; Lucas, 1988) expands on this perspective by identifying technology, innovation, and human capital as internal factors that generate long-term productivity spillovers.

Furthermore, Human Capital Theory (Becker, 1964) asserts that investments in education and health directly enhance individual capabilities, thereby driving higher labor productivity and improving standards of living. This concept intersects with the Capability Approach (Sen, 1999), which views development as a process of expanding human freedoms and substantive capabilities. Formal employment provides not only income but also social security and stability, thereby broadening people's capabilities.

2.2. Empirical Synthesis

Global empirical studies confirm that foreign direct investment (FDI) drives the expansion of employment opportunities and technology transfer in developing countries (Borensztein et al., 1998; Nguyen et al., 2024). Conversely, the adoption of digital technology boosts productivity in the manufacturing sector, albeit with the potential to displace routine labor (Frey & Osborne, 2017; Kristyanto & Jamil, 2023).

In the domestic context, research in East Java indicates that a combination of Gross Regional Domestic Product (GRDP), education levels, and the provincial minimum wage determines the regional labor market's absorption capacity (Putri & Pratomo, 2025). However, a study by Rahman (2025) in West Nusa Tenggara (NTB) warns that digital penetration does not automatically lead to labor absorption without corresponding skill adjustments. It aligns with the perspective of Hanushek and Woessmann (2020), who identify human capital investment through education as a key determinant in seizing opportunities for economic transformation.

3. RESEARCH METHOD

3.1. Variable and Data Design

A quantitative approach using panel data regression analysis was applied to 14 provinces in Indonesia over the 2015–2024 period. Secondary data were sourced from Statistics Indonesia (BPS), the Ministry of Investment/BKPM, and the Ministry of Communication and Digital Affairs., and the Ministry of Finance (Kementerian Keuangan, 2024) for regional government expenditure data

The 14 provinces were selected through purposive sampling based on three criteria: (1) completeness and consistency of annual data for all study variables across the full 2015–2024 panel; (2) their status as Indonesia’s principal manufacturing, investment, and formal-employment hubs, together accounting for a substantial share of national manufacturing GRDP and realized investment, based on national manufacturing and investment statistics; and (3) geographic coverage spanning Java, Sumatra, Kalimantan, and Sulawesi to capture cross-regional heterogeneity. While this purposive design maximizes data quality and economic relevance, it may limit generalizability to smaller or less industrialized provinces, a limitation addressed in Section 5.2 through the recommendation to expand coverage to all 38 provinces.

The primary variables were evaluated at two equation levels:

- Formal Sector Employment (Y): Percentage of workers in the formal sector.
- Human Development Index (Z): A continuous composite index (0–100) covering dimensions of health, education, and a decent standard of living.
- Explanatory Variables: Domestic/Foreign Direct Investment (Ln X1), Provincial Minimum Wage (Ln X2), Population Growth Rate (X3 in %), ICT Index (X4 on a 0–10 scale), and Manufacturing GRDP Growth (X5 in %).
- Control Variables (HDI Model): Mean Years of Schooling (RLS), Poverty Rate (%), following the multidimensional poverty framework of Alkire & Foster, 2011), and Regional Government Expenditure on Education & Health (Ln Expenditure).

3.2. Econometric Model Specification

Equation 1 analyzes the determinants of formal labor absorption:

$$Y_{it} = \alpha + \beta_1 X_{1it}^{(s)} + \beta_2 X_{2it}^{(s)} + \beta_3 X_{3it}^{(s)} + \beta_4 X_{4it}^{(s)} + \beta_5 X_{5it}^{(s)} + \gamma Dt + u_{it}$$

Note: Variables with the superscript (s) denote variables adjusted based on stationarity test results (levels for I(0) or first differences for I(1)). Dt is a dummy variable for the 2020 COVID-19 pandemic.

Equation 2 examines the implications of formal sector employment absorption for the Human Development Index (HDI), using the following control variables:

$$Z_{it} = \alpha + \beta_1 \hat{Y}_{it}^{(s)} + \beta_2 RLS_{it} + \beta_3 Poverty_{it} + \beta_4 RegionalExpenditure_{it} + \gamma Dt + u_{it}$$

where $RLSit$ represents the mean years of schooling (years), $Kemiskinanit$ is the percentage of the poor population (%), $Belanja Daerahit$ is the natural logarithm of total provincial government expenditure on education and health functions (rupiah), and Dt is a dummy variable for the COVID-19 pandemic years (2020 and 2021).

The inclusion of these control variables aims to isolate the pure effect of formal labor absorption on the HDI from other public policy factors and socio-economic conditions that theoretically influence human development outcomes (Becker, 1964; Sen, 1999).

Stationarity testing employs the Pesaran CIPS test to account for cross-sectional dependence. Parameter estimation utilizes a Panel EGLS Random Effects model with GLS Period SUR weighting.

It should be noted that Equation 2 treats formal labor absorption ($\hat{Y}$) as a predetermined regressor for HDI, which assumes a one-directional transmission from employment to human development. In practice, however, HDI improvements for instance, a healthier and better-educated workforce, may simultaneously feed back into labor absorption, raising a potential simultaneity bias between formality and HDI. The two-equation recursive design used here, in which the fitted $\hat{Y}$ from Equation 1 enters Equation 2, partially mitigates this concern by construction but does not fully substitute for a joint estimator. Future extensions of this study are therefore encouraged to apply Two-Stage Least Squares (2SLS) or System GMM, using lagged values of the endogenous regressors or external instruments (e.g., regional fiscal transfers or geographic proximity to industrial centers), to formally test and control for this simultaneity.

4. RESULTS AND DISCUSSION

4.1. Data Dynamics and Statistical Description

Between 2015 and 2024, the average formal employment rate across the 14 sample provinces rose from 39.2% to 47.8%, despite a dip to 40.1% during the 2020 pandemic. In contrast, the Human Development Index (HDI) showed a more stable upward trend, climbing from 70.2 to 75.1. Realized investment surged from IDR 412 trillion to IDR 1,214 trillion, while the ICT Index rose significantly from 3.8 to 7.2. The manufacturing sector experienced sharp fluctuations, hitting a low of -4.2% in 2020 before recovering to 5.1% in 2024. A province-by-province recapitulation of the 14 sample provinces and the 2015–2024 average of each key variable is presented in Appendix 4.

4.2. Model 1 Estimation: Formal Sector Employment Absorption

The results of the CIPS test (Appendix 1) confirm that some variables are stationary at level $I(0)$, while others are stationary at the first difference $I(1)$. The EGLS Period SUR estimation yields an excellent model fit ($R^2 = 0.8987$; $F = 196.58$; $p = 0.0000$).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant (C)	-31,2758	8,4357	-3,7075	0,0003
Investment (X1)	1,0778	0,1573	6,8534	0,0000
Minimum Wage (X2)	1,9225	0,6249	3,0766	0,0025
Population Growth Rate (X3)	0,5968	0,2271	2,6280	0,0096
ICT Index (X4)	0,4745	0,1830	2,5923	0,0106
Manufacturing GRDP (X5)	0,0852	0,0226	3,7769	0,0002
COVID-19 Dummy (2020)	-4,1908	0,2139	-19,5939	0,0000

Source: *Data Processed, 2026*

4.3. Discussion on the Determinants of Employment

Investment expansion proved to be the largest driver of formal labor absorption ($\beta = 1.0778$; $p = 0.0000$). The addition of physical capital expanded industrial scale and created a multiplier effect in the labor market, in line with the proposition of Solow (1956) and the findings of Nguyen et al. (2024) and Mustika and Khairani (2025).

In fact, an increase in the minimum wage (UMP) was positively correlated with formal labor absorption ($\beta = 1.9225$; $p = 0.0025$). This finding rejects the neoclassical assumption of wage rigidity and instead confirms the Efficiency Wage Theory (Akerlof & Yellen, 1990). A more adequate minimum wage boosts productivity, reduces turnover rates, and attracts educated workers to participate in the formal sector (Renaldi & Nurfaahmiyati, 2022; Iksan et al., 2024).

This mechanism operates through several channels consistent with the fair wage–effort hypothesis (Akerlof & Yellen, 1990): wages set above the market-clearing level reduce shirking and costly labor turnover, strengthen worker loyalty, and act as a screening device that draws higher-quality workers into the formal sector. In the Indonesian context, where labor-standard enforcement is uneven across regions, a credible minimum-wage floor also narrows the compensation gap between formal and informal work, encouraging voluntary transitions into formal employment rather than functioning merely as a cost burden on firms, as often assumed under the competitive wage-rigidity view.

Population growth ($\beta = 0.5968$; $p = 0.0096$) and ICT adoption ($\beta = 0.4745$; $p = 0.0106$) also contributed positively. ICT penetration creates a new digital-based business ecosystem (Romer, 1986; Hasanah et al., 2024). However, the moderate ICT coefficient suggests a digital divide and a scarcity of technical talent in various regions, as noted by Acemoglu and Restrepo (2020).

GDP growth in the manufacturing industry showed a significant positive impact ($\beta = 0.0852$; $p = 0.0002$), confirming Verdoorn's Law regarding manufacturing as an engine of growth (Haraguchi et al., 2017). The relatively small coefficient indicates a gradual shift toward more capital-intensive industries (Carbonero et al., 2018).

4.4. Model Estimation 2: Implications for the HDI

The second model tests whether the increase in the share of the formal workforce is directly transmitted to the quality of human development, by including fiscal and social control variables.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constanta (C)	0,5214	0,0287	18,1710	0,0000
Formal Labor Force ($\hat{Y}$)	0,0038	0,0035	1,0860	0,2793
Average Years of Schooling	0,0182	0,0041	4,4390	0,0000
Poverty Rate	-0,0094	0,0023	-4,0870	0,0001
Regional Spending (Ln)	0,0078	0,0039	2,0000	0,0472
Dummy COVID-19 2020	-0,5481	0,0352	-15,5710	0,0000
Dummy COVID-19 2021	-0,2897	0,0329	-8,8050	0,0000

Source: Data Processed, 2026

4.5. Discussion on Employment Transmission to the Human Development Index

Estimation results indicate that formal sector labor absorption has a positive coefficient, yet it is not statistically strong enough to influence the Human Development Index (HDI) ($\beta = 0.0038$; $p = 0.2793$). This finding offers a crucial critique: the mere quantity of formal labor absorption does not automatically improve the community's quality of life.

Several arguments underpin this phenomenon.

First, the prevalence of the "working poor" phenomenon in the formal sector persists, where workers' incomes hover just above the provincial minimum wage. Such income levels suffice only for basic consumption needs, leaving no room for savings allocated to investments in family health and education (Dauphin, 2020; Fields, 2019). Second, there is evidence of diminishing returns regarding labor-intensive employment in the absence of adequate human capital enhancement (Gollin, 2018). Third, there is a time lag before the impact of increased formal sector wages can permanently transform health and education indicators.

These findings underscore that the success of human development cannot be measured solely by the level of workforce formalization. Formal sector workers earning minimum wages and lacking social security remain in the same zone of economic vulnerability as informal workers. Consequently, policies aimed at expanding formal employment opportunities must be accompanied by guarantees of real wage growth and assured social protection so that the shift in employment status genuinely impacts the community's quality of life.

Conversely, human capital indicators and public spending proved to be primary determinants of the HDI. Average years of schooling showed a strong positive effect ($\beta = 0.0182$; $p = 0.0000$), confirming Becker's theory (1964). Poverty exerted significant downward pressure on the HDI ($\beta = -0.0094$; $p = 0.0001$), while regional spending on education and health consistently drove HDI improvements ($\beta = 0.0078$; $p = 0.0472$). These findings reinforce the views of Sen (1999) and Pritchett and Viarengo (2021) that strengthening access to basic public services is far more decisive for human capabilities than mere administrative employment status.

Taken together, these results point to a wage-stagnation trap: nominal formal-sector wages that merely track the minimum wage fail to translate into real purchasing-power gains once inflation and regional cost-of-living differences are considered, so the "working poor" remain unable to accumulate the human-capital investments that raise the HDI (Dauphin, 2020; Fields, 2019). By contrast, regional government expenditure on education and health operates through a more direct channel, financing school facilities, teacher and health-worker deployment, and service access that translate more immediately into the HDI's education and health dimensions. This asymmetry suggests that, in the short run, fiscal instruments are a more effective lever for human development than labor-market formalization alone, reinforcing the case for pairing employment expansion with sustained, well-targeted social expenditure rather than treating the two as substitutes.

Discussion

4.6. Implications of Integrative Policy

To optimize the impact of employment on enhancing human capital quality, policy measures should focus on three key agendas:

Strengthening Job Quality and Social Protection

Labor market policies must shift their focus from merely expanding employment volume to improving job quality. This includes enforcing social security for workers (BPJS Employment/Health) and monitoring the wage scale structure to free workers from the working poverty trap.

Industrial Transformation and Digital Skills Alignment

Central and regional governments need to accelerate "link-and-match" mechanisms between vocational training and the needs of high-value-added manufacturing industries. The development of digital infrastructure outside Java must be prioritized to reduce the technological capability gap in the workforce.

Effectiveness of Public Spending in the Social Sector

Given the significant impact of regional spending on the Human Development Index (HDI), performance-based budgeting for education and health sectors must be tightened. Fiscal allocations should be directed specifically toward improving school facilities and expanding the reach of public health service.

5. CONCLUSION

Simultaneously, investment, the Provincial Minimum Wage (UMP), population growth, the ICT index, and manufacturing GRDP significantly influence formal sector employment absorption, with an F-statistic of 196.58, a p-value of 0.0000, and a model explanatory power of 89.87%. Individually, investment, the UMP, the ICT index, population growth, and manufacturing GRDP also exert a positive and significant influence on the proportion of formal sector workers. However, formal sector employment absorption has a positive but insignificant effect on the Human Development Index (HDI) when controlling for education, poverty, and regional government spending. These findings indicate that increasing job formalization does not automatically lead to a significant rise in the HDI unless accompanied by improvements in labor productivity, the provision of decent wages, and expanded public access to services.

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