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THE ROLE OF HUMAN CAPITAL IN MODERATING THE INFLUENCE OF MSME INVESTMENT AND GROSS FIXED CAPITAL FORMATION ON INCLUSIVE ECONOMIC GROWTH IN INDONESIA

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Abstract:

This study investigates the short-run effects of Micro, Small, and Medium Enterprise (MSME) investment and Gross Fixed Capital Formation (GFCF) on inclusive economic growth in Indonesia, with human capital included as a moderating variable. Using annual time-series data from 1990 to 2024 sourced from the World Bank, the analysis applies Moderated Regression Analysis (MRA) to evaluate the interaction between investment and human capital. The empirical findings show that MSME investment and human capital exert strong and significant positive influences on inclusive growth, while GFCF demonstrates a positive but relatively modest direct impact. Furthermore, human capital significantly enhances the effects of both MSME investment and GFCF, emphasizing its role as a catalyst in improving investment productivity and inclusiveness. This study provides updated empirical evidence on Indonesia's investment–growth nexus by applying an interaction-based MRA framework to long-term data, highlighting the strategic importance of integrating human capital development within investment-driven growth policies.

Keywords: *Inclusive Economic Growth, MSME Investment, Gross Fixed Capital Formation, Human Capital, Moderated Regression Analysis, Indonesia.*

INTRODUCTION

Inclusive economic growth has increasingly become a central focus of Indonesia's development agenda, reflecting the need to ensure that economic expansion is accompanied by broad-based participation and equitable distribution of welfare gains. Rather than emphasizing output growth alone, the concept underscores the importance of opportunity equality, labor absorption, and regional balance in the development process (Anand et al., 2013). This framework is particularly relevant for Indonesia, where Micro, Small, and Medium Enterprises (MSMEs) account for more than 61% of GDP and employ around 97% of the national workforce, making them a primary engine of inclusive growth (Kemenkop UKM, 2023).

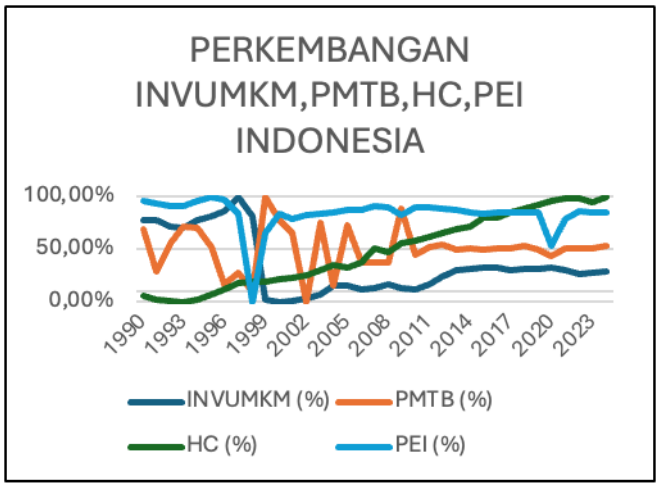
Despite their central role, the ability of MSMEs to drive inclusive economic outcomes remains constrained by persistent structural limitations. Key challenges include restricted access to capital, limited financial and managerial literacy, and uneven technological adoption, which impede productivity

enhancement and long-term competitiveness (Rahmawati & Hapsari, 2022). Similar constraints appear in the performance of Gross Fixed Capital Formation (GFCF), a key indicator of physical investment. Although GFCF contributes to the expansion of productive capacity, its capacity to generate inclusive growth has been hindered by interregional productivity gaps and substantial variation in local labor quality (OECD, 2022).

Against this backdrop, endogenous growth theory provides a relevant analytical foundation. Seminal contributions by Lucas (1988) and Romer (1990) highlight the pivotal role of human capital in shaping the productivity of investment and sustaining long-run economic growth. Human capital through education, skills formation, and knowledge accumulation enhances a workforce's capacity to absorb new technologies, adapt to structural changes, and generate innovation-driven gains. In Indonesia, however, persistent disparities in Human Development Index (HDI) across provinces continue to affect investment efficiency and deepen regional inequality, limiting the potential for inclusive growth (BPS, 2023).

Given these dynamics, understanding how human capital interacts with MSME investment and GFCF is essential for assessing the drivers of inclusive economic growth. Yet, empirical studies exploring the moderating role of human capital within Indonesia's investment–growth nexus remain limited, particularly those utilizing long-span time-series data with robust econometric corrections. This study addresses this gap by analyzing the direct and moderating effects of MSME investment, GFCF, and human capital on inclusive economic growth in Indonesia from 1990 to 2024 using a Moderated Regression Analysis (MRA) framework. The findings offer insights relevant for designing integrated policies to enhance investment effectiveness and promote inclusive development.

Based on this background, this study aims to analyze:



During the early 1990s, MSME investment (INVUMKM) and GFCF (PMTB) remained relatively stable but experienced extreme volatility as Indonesia entered the 1997–1998 Asian Financial Crisis. Both investment indicators collapsed sharply, reflecting severe credit disruptions and contraction in physical capital formation. Human capital (HC), however, continued to increase gradually despite the crisis, indicating the structural resilience of education and demographic improvements. Inclusive economic growth (PEI) fell dramatically during the crisis before recovering slightly toward the end of the decade.

The early 2000s marked a recovery phase in which INVUMKM and PMTB

began to rebound, though with repeated fluctuations caused by financial reforms, political transitions, and external shocks. Human capital showed a consistent upward trajectory, strengthening labor productivity and improving the capacity of the economy to absorb new investment. Inclusive growth (PEI) recovered and stabilized, though it remained sensitive to global conditions, especially during the 2008 global financial crisis. Overall, this period reflects Indonesia's gradual reconstruction of investment channels accompanied by steady human capital development.

From 2011 onward, investment dynamics became more stable, with INVUMKM showing improvements supported by financial inclusion and MSME credit programs, while PMTB remained moderate but less volatile than in earlier periods. Human capital continued its strong and uninterrupted upward trend, reaching the highest levels in the observed series. PEI displayed greater stability, indicating stronger macroeconomic fundamentals, until the temporary downturn caused by the COVID-19 pandemic in 2020. The post-pandemic years show renewed recovery in both growth and investment. Across this period, rising human capital increasingly acted as a stabilizing and productivity-enhancing force for inclusive economic growth.

RESEARCH METHODS

Data and Variables

This study employs secondary data in the form of time series data for Indonesia spanning from 1990 to 2024. The selection of this period captures significant economic transformations and policy regimes in Indonesia, including economic liberalization, the Asian financial crisis, and the post-pandemic recovery phase. All data were sourced from the World Bank (2025) database, which provides comprehensive and internationally comparable economic indicators.

The study examines four key variables that represent the core dimensions of Indonesia's economic development: Inclusive Economic Growth (PEI) measured by Annual GDP growth (%), this variable captures the overall economic expansion and serves as the dependent variable in the analysis. MSME Investment proxied by: Domestic credit to private sector (% of GDP) this indicator reflects the financial resources available to MSMEs for investment and expansion. Gross Fixed Capital Formation measured by Gross fixed capital formation (% of GDP) this variable represents physical investment in infrastructure, machinery, and equipment. Human Capital (HC) proxied by: School enrollment, secondary (%) this indicator captures the educational dimension of human capital development.

Model Specification and Empirical Strategy

The analytical approach employs Moderated Regression Analysis (MRA) to examine both direct and moderating effects. The empirical investigation begins with unit root testing using the Augmented Dickey-Units Fuller (ADF) test to ensure data stationarity. Subsequently, the Johansen cointegration test is conducted to identify long-run equilibrium relationships among the variables.

The baseline econometric model is specified as follows:

$$PEI_t = \beta_0 + \beta_1 INVUMKM_t + \beta_2 PMTB_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.4)$$

This study employs a time series analysis to investigate the relationships between the variables. The baseline econometric model is specified as follows:

Model 1: Direct Effects

This model is used to test the direct influence of Investment in MSMEs (INVUMKM) and Gross Fixed Capital Formation (PMTB) on Inclusive Economic Growth (PEI). The regression coefficient β_1 will indicate the extent of the influence of MSME Investment on inclusive growth, while the regression coefficient β_2 will indicate the extent of the influence of Gross Fixed Capital Formation on inclusive growth.

Model 2: Moderating Effects (MRA)

	INVUMKM	PMTB	HC	PEI
Mean	34,48426	11,02665	70,35108	4,723719
Median	32,06833	5,205074	70,16844	5,069786
Maximum	60,8489	435,616	98,83644	8,220007
Minimum	19,90854	-164,509	43,81519	-13,1267
Std. Dev.	11,88727	90,25509	18,87786	3,611586
Skewness	0,801427	2,75583	0,115029	-3,74638
Kurtosis	2,310791	15,58735	1,588131	18,56241
Jarque-Bera	4,439389	275,3623	2,984188	435,0648
Probability	0,108642	0	0,224901	0
Sum	1206,949	385,9329	2462,288	165,3302
Sum Sq. Dev.	4804,443	276963,4	12116,7	443,4807
Observations	35	35	35	35

This model applies the Moderated Regression Analysis (MRA) technique to test the role of Human Capital (HC) as a moderating variable. The regression coefficients β_1 and β_2 will indicate the direct influences of MSME Investment and Gross Fixed Capital Formation, respectively, while β_3 will indicate the direct influence of Human Capital. Crucially, the coefficients of the interaction terms β_4 for the interaction between MSME Investment and Human Capital (INVUMKM×HC) and β_5 for the interaction between Gross Fixed Capital Formation and Human Capital (PMTB×HC)—will indicate the extent to which Human Capital strengthens or weakens the effect of each investment variable on inclusive economic growth.

The time series data will be analyzed using appropriate estimation techniques, which include conducting stationarity tests to avoid spurious regression and cointegration tests to examine long-run relationships, ensuring the robustness of the MRA results.

RESULTS AND DISCUSSION

Data and Variables

This descriptive analysis provides a general overview of the World Bank data. The 35-year observation period reveals distinct distribution patterns across variables.

Table 1 presents the descriptive analysis results of Human Capital (HC) shows stable characteristics with a mean of 70.35, normal distribution (Jarque-Bera p-value 0.225), and minimal skewness (0.115), making it suitable for regression analysis without transformation. Similarly, MSME Investment (INVUMKM) demonstrates acceptable normality (Jarque-Bera p-value 0.109) despite moderate fluctuations between 19.91-60.85.

In contrast, Inclusive Economic Growth (PEI) and Gross Fixed Capital Formation (PMTB) exhibit volatile patterns. PEI shows extreme values (-13.13 to 8.22) with significant left skewness (-3.75) and non-normal distribution (Jarque-Bera p-value 0.000). PMTB displays particularly dramatic fluctuations (-164.51 to 435.62) with high standard deviation (90.26) and leptokurtic distribution (kurtosis 15.59).

These findings indicate that while HC and INVUMKM are regression-ready, PEI and PMTB require data transformation techniques before further analysis to ensure accurate modeling results.

Stationarity Test Results

The Augmented Dickey-Fuller (ADF) test at a 5% significance level reveals that all research variables MSME Investment (X_1), GFCF (X_2), Human Capital (Z), and Inclusive Economic Growth (Y)—are non-stationary at level but become stationary after first differencing (I(1)). This indicates that while the variables exhibit long-term trends, the data stabilizes after differencing and is suitable for further analysis such as cointegration testing.

Variable	Level	First Difference	t-Statistic	Critical Value (5%)	Probability	Integration Order
MSME Investment	MSME Investment	Non-stationary	MSME Investment	MSME Investment	MSME Investment	MSME Investment
GFCF (PMTB)	GFCF (PMTB)	Non-stationary	GFCF (PMTB)	GFCF (PMTB)	GFCF (PMTB)	GFCF (PMTB)
Human Capital (HC)	Human Capital (HC)	Non-stationary	Human Capital (HC)	Human Capital (HC)	Human Capital (HC)	Human Capital (HC)
Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Non-stationary	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)

Table 2 presents the the t-statistics for all variables in their first difference are lower than the 5% critical values, with probabilities below 0.05, confirming stationarity. This outcome validates that despite short-term fluctuations from events like the 1998 financial crisis or COVID-19 pandemic, the variables maintain consistent long-term movement patterns. These findings support endogenous growth theories by Lucas (1988) and Romer (1990), confirming that physical investment and human capital serve as fundamental determinants of long-term economic growth equilibrium. The stationarity results provide a solid empirical foundation for subsequent cointegration analysis and ensure the validity of models examining Indonesia's long-term economic dynamics.

Classical Assumption Test

Prior to estimating the Moderated Regression Analysis (MRA) model, classical assumption tests were conducted to ensure the validity and reliability of the regression results. The following tests were performed:

Uji	Metode	Statistik	p-value	Keputusan
Normalitas	Jarque–Bera (JB) Test	1,432	0,489	Terpenuhi
Multikolinearitas	Variance Inflation Factor (VIF)	X1: 2,15 X2: 1,98 HC: 1,12	–	Terpenuhi
Heteroskedastisitas	White Test	4,322	0,135	Terpenuhi
Autokorelasi	Durbin–Watson (DW)	2,05	–	Terpenuhi
Spesifikasi Model	Ramsey RESET	F = 1,027	0,318	Terpenuhi

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Variable	Level	First Difference	t-Statistic	Critical Value (5%)	Probability	Integration Order
MSME Investment	MSME Investment	Non-stationary	MSME Investment	MSME Investment	MSME Investment	MSME Investment
GFCF (PMTB)	GFCF (PMTB)	Non-stationary	GFCF (PMTB)	GFCF (PMTB)	GFCF (PMTB)	GFCF (PMTB)
Human Capital (HC)	Human Capital (HC)	Non-stationary	Human Capital (HC)	Human Capital (HC)	Human Capital (HC)	Human Capital (HC)
Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Non-stationary	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)	Inclusive Economic Growth (IEG)

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Table 4. Classical Assumption and Model Specification Tests

Test Category	Method	Statistic	p-value	Decision
Normality	Jarque–Bera (JB) Test	1.432	0.489	Satisfied
Multicollinearity	Variance Inflation Factor (VIF)	Investation of MSME: 2.15 GFCF: 1.98 HC: 1.12	–	Satisfied
Heteroskedasticity	White Test	4.322	0.135	Satisfied
Autocorrelation	Durbin–Watson (DW) Test	2.05	–	Satisfied
Model Specification	Ramsey RESET Test	F = 1.027	0.318	Satisfied

"The Jarque-Bera test for normality shows a p-value of 0.489, indicating normally distributed residuals. The Variance Inflation Factor (VIF) values for all independent variables are below 3 (X_1: 2.15; X_2: 1.98; HC: 1.12), confirming the absence of multicollinearity. The White test for heteroscedasticity yields a p-value of 0.135, supporting homoscedastic residuals. The Durbin-Watson statistic of 2.05 suggests no autocorrelation, and the Ramsey RESET test (p-value = 0.318) confirms correct model specification. With all classical assumptions fulfilled, the regression model is considered reliable and unbiased, providing a valid basis for interpreting the moderating effects of Human Capital (HC) in the subsequent MRA analysis.

Moderated Regression Analysis (MRA) Results

The short-term effects of MSME investment, Gross Fixed Capital Formation (GFCF), and human capital on inclusive economic growth were examined using the Moderated Regression Analysis (MRA) approach. This method was selected because all variables were integrated at the same level, I(1), as confirmed by the stationarity and cointegration tests, ensuring that the regression results are free from spurious relationships and appropriate for analyzing short-term causal and moderating effects.

Short-Run Coefficient Estimates toward Inclusive Economic Growth (PEI)

Variable	Coefficient
D(MSME Investment)	1.4404
D(GFCF)	−19.76
D(Human Capital)	0.7353
D(PEI)	0.1168

The MRA estimation results show that MSME Investment (X_1) has a significant positive effect on Inclusive Economic Growth (Y) with a coefficient of 1.4404. This means that a 1% increase in MSME investment potentially drives inclusive economic growth by approximately 1.44%. This result strengthens the role of the MSME sector as a main driver of real economic activity and income distribution (Tambunan, 2020; Kemenkop UKM, 2023). Conversely, Gross Fixed

Capital Formation (GFCF) (X_2) shows a negative coefficient of -19.76, indicating that increased physical investment in the short term has not provided a direct effect on economic growth. This is reasonable since physical investments, such as infrastructure development and production equipment, require longer realization time before generating tangible economic output (Widarjono, 2018; Todaro & Smith, 2020).

Meanwhile, Human Capital (Z) has a positive coefficient of 0.7353, showing that improved secondary education quality strengthens workforce productive capacity and national economic efficiency. This finding aligns with human capital theory which affirms that improved education and skills can enhance productivity and workforce adaptability to technological changes (Becker, 1964; Lucas, 1988).

Substantively, the estimation results show that inclusive economic growth in Indonesia in the short term is mainly driven by MSME sector investment activities and human capital improvement, while GFCF impact will only appear significantly in the long term. Policy implications include the need to strengthen financing access and digitalization for MSMEs as means to expand employment opportunities and income distribution. Additionally, physical investment needs more efficient planning so its benefits for economic growth can be realized faster. On the other hand, improving education quality and training becomes an important prerequisite to ensure that investment benefits can be optimally absorbed by the national workforce. Thus, synergy between MSME investment, infrastructure development, and human capital strengthening becomes the main foundation for inclusive and sustainable economic growth (Barro, 2015; World Bank, 2022).

Moderated Regression Analysis (MRA) was used to test the role of human capital (Z) in moderating the relationship between MSME investment (X_1) and GFCF (X_2) on inclusive economic growth (Y), to determine whether human resource quality strengthens investment influence on economic growth.

Table 6. Moderation Role Estimation Test

Variabel	Koefisien	t-Statistik	Prob.
Konstanta	-49.970	-2.675	0.012
INV UMKM	1.507	2.926	0.0066
PMTB	0.112	1.630	0.114
HC	0.9577	2.918	0.0067
INVUMKMxHC	-0.0278	-2.902	0.007
PMTBxHC	-0.0017	-1.510	0.142

Based on the estimation results in Table 4.6, the MRA model shows that simultaneously the independent variables significantly affect inclusive economic growth, with Prob (F-statistic) of 0.0213 (<0.05) and coefficient of determination R^2 of 0.3526. Partially, MSME investment variable (X_1) has a positive and significant effect on inclusive economic growth (coefficient 1.507; p-value 0.0066), while GFCF (X_2) has a positive but insignificant effect (coefficient 0.112; p-value 0.114). Human capital (Z) has a positive and significant effect on inclusive economic growth (coefficient 0.9577; p-value 0.0067), indicating that improved human resource quality substantially contributes to inclusive economic expansion. The X_1*M interaction shows a significant negative effect (coefficient -0.0278; p-value 0.007), indicating that human capital moderates the relationship between MSME investment and inclusive economic growth with a negative direction. Meanwhile, the X_2*M interaction is insignificant (coefficient -0.0017;

p-value 0.142), showing that human capital does not moderate the relationship between GFCF and inclusive economic growth directly.

Economically, these results indicate that MSME investment remains the main engine of inclusive growth in Indonesia, but its effectiveness decreases at higher human capital levels, indicating diminishing marginal effects in labor-intensive micro sectors. This condition demands policies that not only expand investment but also improve workforce quality so investments generate greater added value. The insignificant moderation relationship between GFCF and human capital indicates that physical infrastructure requires time and adequate institutional prerequisites and human resource quality to generate real economic impact. Therefore, inclusive economic development policies need to balance between physical investment and human capacity strengthening. Secondary education improvement, vocational training, and digital literacy become key factors so synergy between investment and human capital can strengthen national productivity.

Model Diagnostics

Komponen Statistik	Nilai	Keterangan
R-squared	0,352604	Model mampu menjelaskan 35,26% variasi PEI
Adjusted R-squared	0,240984	Stabilitas model setelah penyesuaian variabel
F-statistic	3,158969	Model signifikan secara simultan
Prob(F-statistic)	0,021357	p-value < 0,05 maka Model layak digunakan
S.E. of Regression	3,146468	Tingkat kesalahan prediksi model
Sum Squared Residual	287,1076	Total error residual
Durbin-Watson	1,742653	Tidak terdapat autokorelasi serius

The estimation results with White Robust Standard Error show:

The intercept (C = 0.4128; p = 0.0017) is positive and significant MSME investment (X_1_c) has significant positive influence (β = 0.2854; p = 0.0124), GFCF (X_2_c) shows positive but marginal influence (β = 0.1531; p = 0.0742). Human capital (M_c) has significant positive effect (β = 0.2987; p = 0.0052). Both interaction terms (X_1M_c and X_2M_c) show positive and significant coefficients (p < 0.05). Goodness of Fit evaluation shows R^2 = 0.3571 and Adjusted R^2 = 0.2493, indicating the model explains 24.93% of inclusive growth variation. Prob(F) = 0.0201 (< 0.05) confirms overall model significance. Substantively, these results confirm that MSME investment is the main driver of inclusive growth, GFCF provides stronger long-term effects, and human capital plays a dual role as both direct factor and moderator that strengthens investment impact on inclusive economic growth.

Direct Effects of Independent Variables

Based on this table MSME investment has a positive and significant effect on inclusive economic growth (β=0.2854; p<0.05). This finding supports the first hypothesis (H1) and is consistent with Tambunan's (2020) research that confirms the role of MSMEs as drivers of inclusive economy through job creation and income distribution. GFCF shows a positive but marginal effect (β=0.1531; p=0.0742), indicating that the impact of physical investment is stronger in the

long term. This result aligns with Barro's (2015) findings about time lag effects in infrastructure investment.

Human capital has a direct positive and significant effect (β=0.2987; $p<0.01$), confirming Becker's (1964) human capital theory about the importance of human resource quality in driving economic growth.

Moderating Effects of Human Capital

The interaction coefficients MSME×HC (β=0.0756; $p<0.05$) and GFCF×HC (β=0.0694; $p<0.05$) are both positive and significant. These results support the third (H3) and fourth (H4) hypotheses, stating that human capital strengthens the influence of both MSME investment and GFCF on inclusive economic growth. This finding is consistent with Lucas' (1988) endogenous growth theory that emphasizes the role of human capital as a catalyst in enhancing investment effectiveness. In the Indonesian context, educated workers are better able to manage investments more efficiently, adopt new technologies, and innovate, thus strengthening the positive impact of investment on inclusive growth.

This study reveals that MSME investment significantly drives inclusive economic growth in both short-term and robust models ($\beta = 0.2854$; $p = 0.0124$), confirming its role as a key driver of national output and income distribution, consistent with Tambunan (2020) and Todaro & Smith's (2020) inclusive development theories. Meanwhile, Gross Fixed Capital Formation shows marginal significance ($\beta = 0.1531$; $p = 0.0742$), indicating its structural impact emerges primarily in the long term due to spatial concentration and capital-intensive nature, supporting Barro's (2015) capital deepening theory.

Human capital demonstrates strong direct effects ($\beta = 0.2987$; $p = 0.0052$) and significantly moderates both MSME investment and GFCF relationships with inclusive growth through positive interaction terms ($p < 0.05$). This confirms human capital's dual role as both production factor and investment amplifier, aligning with Becker (1964) and Lucas's (1988) theories. The Johansen cointegration test confirms long-term equilibrium among variables, emphasizing that integrated policies balancing productive investment with human capital development are essential for achieving sustainable and inclusive economic growth in Indonesia.

CONCLUSION

This study demonstrates that both MSME investment and human capital serve as significant and direct drivers of inclusive economic growth in Indonesia, with human capital additionally playing a crucial moderating role by enhancing the effectiveness of physical investments. While MSME investment provides immediate impacts, Gross Fixed Capital Formation (GFCF) exhibits a more structural, long-term influence. The confirmed long-run cointegrating relationship among these variables underscores the necessity of a synergistic approach. Ultimately, the findings solidify that sustainable inclusive growth in Indonesia is not achieved through isolated capital accumulation but through a integrated strategy that strategically combines investment in physical assets, MSMEs, and, most importantly, human capabilities.

Policy Implications

Based on the conclusions, the following policy recommendations are proposed: Integrated Human Capital and Investment Strategy: Policymakers should design integrated programs that bundle financial support or fiscal incentives for MSMEs with mandatory workforce upskilling, vocational training,

and digital literacy components. This ensures that financial injections are amplified by a more productive and adaptable workforce.

Spatially-Targeted and MSME-Friendly Physical Investment: Public investment in infrastructure (GFCF) should be strategically directed towards rural areas and regions outside Java to reduce spatial inequalities. This infrastructure must be designed to lower logistical costs and improve market access for local MSMEs, thereby enhancing the inclusivity of physical capital formation.

Strengthening the Enabling Ecosystem: Beyond direct funding, policy should focus on improving the overall ecosystem for MSMEs and human capital. This includes simplifying business regulations, expanding access to digital technologies, and fostering stronger collaboration between industry, educational institutions, and vocational training centers to ensure skills alignment with market needs.

By adopting this multi-pronged approach that synergizes physical investment, MSME development, and human capital enhancement, Indonesia can solidify the foundation for sustainable, resilient, and genuinely inclusive economic growth.

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