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INEQUALITY DYNAMICS IN INDONESIA: THE LONG-RUN ROLES OF HUMAN CAPITAL DEVELOPMENT AND INVESTMENT

UDC / UDK: 330.564.2:331.101.262:330.322(594)
JEL classification / JEL klasifikacija: D31, I25, I31, O15, E22
https://doi.org/10.17818/EMIP/2026/31
Original scientific paper / Izvorni znanstveni rad
Received / Primljeno: February 2, 2026 / 2. veljače 2026.
Accepted / Prihvaćeno: June 10, 2026 / 10. lipnja 2026.

Abstract

Income inequality remains a major challenge in both developed and developing economies and is typically more pronounced in urban areas. This study examines the relationship between income inequality, human capital development, and investment in Tangerang Municipality in both the short and long term. Using annual data from 1995 to 2025, the study employs the ARDL–ECM and Toda–Yamamoto causality methods. The results confirm a stable long-term equilibrium relationship among the variables. Human capital development significantly reduces income inequality in both the short and long term, underscoring its role in promoting a more equitable distribution of income and supporting sustained social progress. In contrast, investment significantly increases income inequality over both periods, indicating that the benefits of capital accumulation are not evenly

shared. The Toda–Yamamoto causality analysis reveals one-way causality from human capital development and investment to income inequality. These findings support policies that combine investment promotion with broader access to education and skills development for all income groups.

Keywords: ARDL, human capital, income inequality, investment

1. INTRODUCTION

Income inequality has long been an essential issue in global economic development. Although it has been incorporated into the Sustainable Development Goals (SDGs) agenda since 2015, the global distribution of income remains highly unequal. Recent data indicated that the richest 10% of the world's population controlled approximately 53% of total global income in 2025, an increase of one percentage point compared to 2022, while the bottom 50% received only about 8.5%, a decrease of around 5 percentage points (Chancel, Gómez-Carrera, Moshrif, & Piketty, 2026; World Economic Forum, 2022). The condition explains that inequality continues to widen and wealth is controlled by a small global elite. Meanwhile, the income of the bottom class continues to experience a slowdown. Additionally, the COVID-19 pandemic has also aggravated global income inequality (World Bank, 2024). High levels of income inequality not only hinder economic growth but also exacerbate poverty, constrain social mobility, and increase the risks of social and political instability (Alvaredo, Cogneau, & Piketty, 2021; Assouad, 2023; Blau, 2018).

Indonesia, as a developing country, exhibits dynamic economic conditions in which relatively stable economic growth coexists with a trend of increasing income inequality, particularly in urban areas. In context, Ahmed et al. (2023) demonstrate that Indonesia is a country with high wealth inequality, where the four richest people have assets exceeding the poorest 100 million people. Although the national Gini ratio fluctuated from 2010 to 2025, it tended to decline to 0.363 in 2025 (Badan Pusat Statistik, 2026). Its rate slowed after the pandemic, indicating a blockage in the economic mobility of the lower classes. Some literature has emphasized on globalization and industrialization that is not inclusive (Kanbur, 2015), inequality of access to education (Chongvilaivan & Kim, 2016), investment bias (Xu, Chen, Chen, & Id, 2023), as well as the limitations of basic infrastructure (Khusaini, Sentosa, & Putro, 2023) is a factor that forms inequality in developing countries.

Tangerang Municipality is a strategic part of the Greater Jakarta metropolitan area and serves as a major hub for manufacturing, logistics, and service industries. The inflow of both domestic and foreign investment stimulates local economic growth while simultaneously generating social pressures in the form of income polarization. As one of the main growth centers in Banten Province, Tangerang Municipality exhibits relatively low yet fluctuating income inequality dynamics. BPS Banten Province (2025) reports that income inequality in Tangerang Municipality is volatile: relatively low in 2020–2021, between 0.339–

0.343, jumped in 2022 to 0.383, then decreased again to 0.295 in 2025. The pattern explains that the advantages of post-pandemic recovery and development have not been evenly distributed. Given its character as an investment-intensive industrial city, income inequality dynamics in Tangerang Municipality are largely shaped by the local human capital quality and the nature of investment flows, both foreign and domestic.

Theoretically, human capital is the key to inclusive development. Education and health increase productivity, expand access to employment, and encourage social mobility across generations (Becker, 1964; Hanushek & Woessmann, 2012; Rosen, 1989). From a macro perspective, human capital accumulation has the potential to narrow inequality through the expansion of employment opportunities and more equitable wages (Barro & Lee, 2013; Hanushek, 2013; Lee & Lee, 2018). In addition, human capital development through education, health, and the economy also has an impact on reducing inequality (Goh, 2025; Goh, Law, & Trinugroho, 2022; Moyo, Mishi, & Ncwadi, 2022; SenGupta, 2024). However, these benefits are not always automatic. Chani, Jan, Pervaiz, & Chaudhary (2014) and Xu et al. (2023) find that educational expansion in the early stages can actually widen inequality because it is enjoyed by the upper middle class first. Other researchers also emphasized the role of education in narrowing inequality (Khusaini et al., 2025; Wicaksono, Amir, & Nugroho, 2017). Therefore, the effect of human capital is highly dependent on equitable access, public services quality, and the suitability of skills with the structure of the local labour market (Goh et al., 2022; Vo, Vo, & Ho, 2024).

On the other hand, investment is the main engine of Asia's urban economic growth. Investment encourages industrialization, expansion of the modern service sector, and modernization of infrastructure (Chancel, Piketty, Saez, & Zucman, 2022; World Bank, 2019), however, contemporary investments tend to be capital and technology-intensive. Jaumotte, Lall, & Papageorgiou (2013) emphasizing that globalization and technological progress boost the demand for skilled labor faster than unskilled labor, thus triggering skill-biased technological change and wage polarization. Makhlouf & Lalley (2023) and Pham, Lang, Ho, & Vo, (2024) show that investment is pro-growth but not necessarily pro-equity if it is not balanced with the development of local labor skills. Prior researchs have emphasized the role of governments and foreign investors in reducing inequality (Lian, Pei, & Li, 2024; Yuldashev et al., 2023). Other literature has even found that foreign investment has no impact on reducing inequality (Fazaalloh, 2019; Hekmatpour, 2024; Rezk, Amer, Fathi, & Sun, 2022).

The recent literature on inequality in developing countries, particularly in Asia, generally converges around three main strands: the correlation between economic growth and inequality, the human capital role, and investment impact. Studies such as Jaumotte et al. (2013), Lee & Lee (2018) and Vo et al. (2024) suggest the structural transformations in Asia are often accompanied by increased income polarization. Meanwhile, SenGupta (2024) and Tsitouras & Papapanagos (2025) emphasize the role of education as a long-term equalizing mechanism. However, most existing studies rely on national-level data or cross-country panel

analyses, which limits their ability to capture distributional dynamics in urban areas that function as centers of capital and labor accumulation, such as Tangerang Municipality. In addition, investment is often treated merely as a control variable rather than as a primary distributive mechanism that directly shapes the city's income structure. Additionally, empirical studies on income inequality in Tangerang Municipality are still dominated by static time-series or panel data approaches, which fail to fully capture long-term relationships and the dynamics of structural adjustments.

Based on the research gap, the current study positions Tangerang Municipality as a focal case for examining the distributive mechanisms of urban development in Asia. The main contributions of an article are threefold: (i) employing city-level time-series data to capture the dynamic evolution of income inequality in urban investment hubs; (ii) reconceptualizing investment as a core distributive engine rather than merely a control variable; and (iii) applying a combination of ARDL-ECM and Toda-Yamamoto dynamic causality to identify long-run relationships and adjustment dynamics. Accordingly, this study contributes to the development and regional economics literature by adopting a mechanism-based perspective that supports the formulation of inclusive municipal investment policies in Tangerang Municipality and other developing municipal areas.

2. LITERATURE REVIEW

2.1. Income inequality in municipal economy

The development economics literature has discussed variations in income distribution due to urbanization and industrialization. This supports Kuznets' theory that inequality appears to rise during the early phases of development before declining as development progresses (Kuznets, 1955). Various empirical evidence shows that income inequality continues to widen, particularly in developing countries in Asia. Persistent inequality is caused by globalization, market liberalization, and a technological skills bias (Assouad, 2023; Jaumotte et al., 2013; Kanbur, 2015). The accelerated structural transformation from traditional sectors to modern manufacturing and service industries has not significantly reduced inequality. The situation has instead created a dualism in the labor market, namely, between formal employment activities with high wages. Income inequality tends to widen due to limited cross-sectoral mobility, resulting in gaps in skills, access to education, spatial segmentation, and urbanization (Blau, 2018; Chongvilaivan & Kim, 2016; Vo et al., 2024). Asian cities are undergoing rapid structural transformation from traditional sectors to modern manufacturing and service industries, generating labor market dualism between high-wage formal employment and low-wage informal activities.

Inequality dynamics also have become increasingly salient alongside the structural shift toward technology-based industries and services in Indonesia. The World Bank reports that the growth of the economy in Indonesia's municipal regions is heavily concentrated in areas with high investment attractiveness, while

local economies and the informal sector remain relatively weak (World Bank, 2019, 2022). Consequently, the gains from growth are disproportionately captured by skilled workers and capital owners, leaving low-educated workers marginalized. Prior empirical studies found that disparities in educational attainment, infrastructure access, and regional fiscal policies play a critical role in shaping inequality both across regions and among social groups in Indonesia (Goh et al., 2022; Khusaini et al., 2023).

Tangerang Municipality is a model for urban economic development in Indonesia due to the rapid development of the manufacturing, logistics, and modern service sectors. This municipality benefits from investment inflows and urbanization, however simultaneously faces the challenge of unequal income distribution. The expansion of industrial estates, the construction of modern housing, and service centers in Tangerang Municipality has proven to create high-paying job opportunities for skilled workers. Conversely, the local workforce remains concentrated in informal and semi-skilled jobs. Furthermore, unequal access to quality education for local residents, vocational training, and spatial connectivity across urban areas also contribute to inequality.

2.2. Human capital

The theory of human capital stated that investment in education and health increased individual productivity and income (Becker, 1964; Rosen, 1989). At the macroeconomic level, the accumulation of human capital promotes economic growth while simultaneously shaping income distribution (Hanushek, 2013; Hanushek & Woessmann, 2012). A substantial body of empirical literature has demonstrated a negative correlation between education and inequality. Previous studies find that equitable distribution of educational attainment fosters intergenerational social mobility and contributes to more equal income distribution (Barro & Lee, 2013). Lee & Lee (2018) and Goh (2025) find that long-term reductions in inequality are significantly influenced by enhancements in the quality of human capital in Asian economies. However, this relationship is not always linear. Empirical evidence finds that in the early stages of development, educational expansion can increase inequality, as higher-income groups are better able to take advantage of educational opportunities (Chani et al., 2014; Xu et al., 2023). Subsequently, inequality declines as a result of expanded educational access.

Furthermore, the impact of human capital on inequality depends heavily on the alignment between acquired skills and local industrial structures, rather than merely on mean years of schooling (Goh et al., 2022; Vo et al., 2024). Other empirical findings suggest that, in the long run, human capital development significantly alleviates inequality (Khusaini et al., 2025; Mengesha & Singh, 2023). In contrast, Owolabi, Omeire, Okwudire, & Bolujoko (2024) and Nunoo, Taale, Ofori, Mwinlaaru, & Adama (2024) report that human capital accumulation may exacerbate income disparities. Moniruzzaman & Emran (2021) further argue that the net impact of education on inequality depends on individuals' ability to sustain educational investment amid economic fluctuations. Current studies also find that

human capital contributes significantly on income distribution (SenGupta, 2024). While these studies have emphasized the human capital role in influencing income inequality, empirical evidence still shows mixed and non-linear results, depending on the context of the region, industrial structure, and stage of development at the national or cross-country level.

2.3. Investment

Investment plays an essential role in the municipal economy by boosting production capacity, efficiency, and technology diffusion. Investment, both domestic and foreign direct investment (FDI), serves as a lever for structural transformation. Empirical literature finds that technology investment increases the demand for skilled labor and reduces opportunities for unskilled labor, thus creating wage polarization (Jaumotte et al., 2013; Makhlouf & Lalley, 2023). Other empirical evidence from Asia also supports this argument like in Vietnam and China (Pham et al., 2024; Tien & Lien, 2025; Xu et al., 2023). FDI magnifies inequality through the concentration of modern sectors and the limited absorption capacity of local labor in Asia (Yuldashev et al., 2023) and in Egypt (Rezk et al., 2022). Another study by Tsitouras & Papapanagos (2025) shows that investment promotes inclusive growth in the long-run in Greece, however exacerbates inequality in the short-run. Studies in various developing countries note that investment tends to increase inequality. In addition, Hekmatpour (2024) and Lian et al. (2024) suggest that concentrated investment in the modern services sector and developed regions creates growth enclaves that are not fully integrated with the local economy, thereby deepening economic segregation.

Fazaalloh (2019) shows that FDI does not automatically reduce inequality due to the weak integration of local labor into the value-added formal sector in Indonesia. This pattern is consistent with the global literature that emphasizes that the distributional effect of investment is conditional and highly dependent on the quality of human capital, labor market structure, and poverty levels (Burzynski, Deuster, & Docquier, 2020; Dodig, Hein, & Detzer, 2015; World Bank, 2019, 2022). In Asian municipal areas, investment is often concentrated in specific industrial areas, creating growth enclaves that are less connected to low-income settlements, so economic modernization deepens social and spatial polarization. Previous literature has limited empirical evidence at the industrial municipal (district) level and there is still a lack of analysis that distinguishes short- and long-run dynamics in the context of municipalities in Indonesia.

3. DATA AND METHODOLOGY

3.1. Data and sources

This study investigated a correlation between human capital, investment, and income inequality in the short- and long-run. Researchers applied the

Autoregressive Distributed Lag (ARDL) estimation and the Bounds cointegration test to obtain the long-term correlation with possible differentially charged integration variables [I(0) and I(1)] (Pesaran, Shin, & Smith, 2001). The data used is an annual time series for Tangerang Municipality, period 1995–2025 (31 observations). The data is sourced from official agencies such as Central Bureau of Statistics of Banten Province and Tangerang Municipality, national and international databases such as the Ministry of Investment, and the World Bank.

3.2. Variables description and measurement

This study utilized income inequality (Gini coefficient = LNGC) as the dependent variable. The main explanatory variables included the Human Development Index (LNHDI), which represented the dimensions of human development and the quality of human capital. Researchers also utilized investment (INV) as an explanatory variable. To account for broader economic and social influences, poverty (LNPOV) and government size (GS) were included as control variables. Each variable was operationally defined, measured using pre-defined indicators, and associated with the expected direction of influence on income inequality, as summarized below.

Table 1 Variable description

Variable	Description	Unit	Sign	Source
Dependent variable:				
Gini coefficient (LNGC) (Goh et al., 2022; Khusaini et al., 2023; Vo et al., 2024; Xu et al., 2023)	It represents the distribution of income in a municipality. The value ranges from 1–100. This is proxied by the natural logarithm.	Ratio		Central Bureau of Statistics, World Bank
Independent variable:				
Human Development Index (LNHDI) (Scripcar & Ciobanu, 2021; Taresh, Sari, & Purwono, 2021; Vo et al., 2024)	It measured the human capital, which includes dimensions: longevity & health, knowledge, and decent living standards. The value ranges 1-100. This variable is proxied by the natural logarithm. This variable is proxied by the natural logarithm.	Ratio	(-)	Central Bureau of Statistic, World Bank
Investment (INV) (Fazaalloh, 2019; Hekmatpour, 2024; Rezk et al., 2022; Tsitouras & Papapanagos, 2025; Yuldashev et al., 2023)	The ratio of domestic and foreign direct investment to investment to GRDP.	Ratio	(-)	Central Bureau of Statistics, Ministry of Investment
Control variables:				
Poverty (LNPOV) (Khusaini et al., 2023; Mohd, Hamat, Idris, & Kasim, 2014; Moyo et al., 2022; Wilson, Jayanthakumaran, & Verma, 2022)	The percentage of the population living below the poverty line. This variable is proxied by the natural logarithm.	Ratio	(-)	Central Bureau of Statistics, World Bank
Government Size (GS) (Asimakopoulos & Karavias, 2016; Goerl & Seiferling, 2014; Stojcic & Tolic, 2019);	The ratio of expenditure realization to GRDP.	Ratio	(-)	Central Bureau of Statistics, World Bank

Source: Authors

3.2. Empirical specifications

The model specification was formulated to examine the influence of human capital, investment, and control variables on inequality in Tangerang Municipality as follows:

$$GC_t = \alpha_0 + \alpha_1 HDI_t + \alpha_2 INV_t + \alpha_3 POV_t + \alpha_4 GS_1 + \varepsilon_t \quad (1)$$

where $LNGC_t$ denotes income inequality, proxied by the Gini coefficient. $LNHDI_t$ denotes human capital, measured using the Human Development Index. INV_t refers to the ratio of realized investment (foreign and domestic investment) to real GRDP, capturing the intensity of capital accumulation at the city level. $LNPOV_t$ refers to the poverty rate and serves as a distributional control variable. GS_t refers to government size, reflecting the extent of regional economic and social policy intervention. The parameter (α_0) is a constant. α_i (i = 1, 2, 3, 4) is the estimated coefficient. ε_t and is an error component.

To distinguish between short- and long-run correlation, these estimates were estimated using the ARDL–ECM approach. In general, the ARDL specification can be written as:(p, q_1, q_2, q_3, q_4)

$$\begin{aligned} \Delta LNGC_t = \quad & \phi_0 + \sum_{i=1}^{p} \phi_i \, \Delta LNGC_{t-i} + \sum_{j=0}^{q_1} \theta_j \, \Delta LNHDI_{t-j} + \sum_{k=0}^{q_2} \gamma_k \, \Delta INV_{t-k} \\ & + \sum_{l=0}^{q_3} \delta_l \, \Delta \mathrm{LN}POV_{t-l} + \sum_{m=0}^{q_4} \psi_m \, \Delta GS_{t-m} \\ & + \lambda_1 LNGC_{t-1} + \lambda_2 LNHDI_{t-1} + \lambda_3 INV_{t-1} + \lambda_4 LNPOV_{t-1} + \lambda_5 GS_{t-1} + u_t \end{aligned} \quad (1)$$

where the operator declares the first difference. The coefficients on variables in the level capture the long-run equilibrium correlation, while the coefficients on variables in the form of differences reflect short-term dynamics $\Delta(\lambda_1, \dots, \lambda_5)$

The consistency of long-run correlation was assessed utilizing the ARDL Bounds testing to cointegration. If cointegration is confirmed, then the model can be represented in the form of an error correction model (ECM) as follows:

$$\begin{aligned} \Delta LNGC_t = \quad & \omega_0 + \sum_{i=1}^{p} \omega_i \, \Delta LNGC_{t-i} + \sum_{j=0}^{q_1} \eta_j \, \Delta LNHDI_{t-j} + \sum_{k=0}^{q_2} \rho_k \, \Delta INV_{t-k} \\ & + \sum_{l=0}^{q_3} \xi_l \, \Delta LNPOV_{t-l} + \sum_{m=0}^{q_4} \kappa_m \, \Delta GS_{t-m} + \varphi \, ECT_{t-1} + e_t \end{aligned} \quad (2)$$

where ECT_{t-1} is an error correction term. The coefficient of ECT_{t-1} is expected to be negatively significant, meaning the adjustment speed of income inequality towards long-run equilibrium after a short-run shock (φ).

The ARDL–ECM approach was chosen because it has several methodological advantages: (i) it can be used when the variable has a mixed order of integration I(0) and I(1); (ii) appropriate for sample sizes limited to municipal-level timeline data; and (iii) allow simultaneous estimation of long-term effects and short-term adjustment dynamics. This study is able to interpret whether human capital and investment affect inequality in Tangerang Municipality, as well as how and how quickly the income distribution system adapts to structural changes in municipal economic development.

3.3. Estimation procedure

The estimation stage is carried out systematically to ensure the validity of the long-run correlation and the short-run dynamics between variables. First, a unit

root test was carried out utilizing an Augmented Dickey–Fuller (ADF) to identify the degree of integration of each variable and ensure that there were no variables integrated in order two, I(2) (Dickey & Fuller, 1979), because the ARDL approach is only valid for variables that are I(0) or I(1) (Pesaran et al., 2001). To complement the test, the researchers applied the Phillips-Perron and Kwiatkowski-Philips-Schmidt-Shin (KPSS) tests (Kwiatkowski, Phillips, Schmidt, & Shin, 1992; Phillips & Perron, 1988) for further validation. The procedure is important to avoid spurious regression in the analysis of time sequences. Second, the optimal lag length is determined utilizing information criteria such as the SIC (Schwarz, 1978) in order to be able to capture the dynamics of system adjustment efficiently and parsimoniously (Lütkepohl, 2005). Although the Akaike Information Criterion (AIC) was initially considered, the final lag selection was based on the Schwarz Criterion (SC) because it provides a more parsimonious model specification and produces theoretically more stable error correction dynamics. The approach is important because the use of AIC produces ECT coefficients outside the theoretical stability range. The selection of the right lag allows the analysis model to be able to more accurately represent the dynamic correlation between inequality, human capital, investment, and poverty.

Furthermore, cointegration testing was carried out using the ARDL bounds testing approach to identify the existence of a long-run equilibrium correlation between variables despite having different levels of integration between I(0) and I(1) (Pesaran et al., 2001). If the F-value of the statistics exceeds the critical upper limit, then the hypothesis of zero non-cointegration is rejected. Once cointegration is confirmed, the long-term coefficient is estimated from the selected ARDL specification. Then, the model is transformed into an ECM to capture the short-term adjustment mechanism towards long-term equilibrium. The coefficient of ECT is expected to be negatively significant (Banerjee, Dolado, & Mestre, 1998; Engle & Granger, 1987).

In addition, researchers assert the diagnostic test to ensure the model is valid and reliable. The researcher utilized an autocorrelation test using the Breusch–Godfrey LM test, a heteroscedasticity test using the Breusch–Pagan test, a multicollinearity test using variance inflation factor (VIF), and a residual normality test using the Jarque–Bera test. Researchers also employ a parameter stability test using CUSUM and CUSUMSQ (Brown, Durbin, & Evans, 1975). These tests are important to produce unbiased and stable estimates throughout the observation period.

3.4. Toda-Yamamoto causality test

After examining the long-term relationship between variables using the ARDL method, the researcher applied the Toda-Yamamoto causality test based on the Vector Autoregressive (VAR) framework. The conventional approach to testing causality relationships was proposed by Granger (1969); however, this approach is limited because it can produce biased results if the variables are non-stationary or cointegrated (Granger & Newbold, 1974). The main advantage of the Toda-Yamamoto approach lies in its ability to ignore the traditional cointegration prerequisites and be friendly to variables with mixed degrees of integration, both

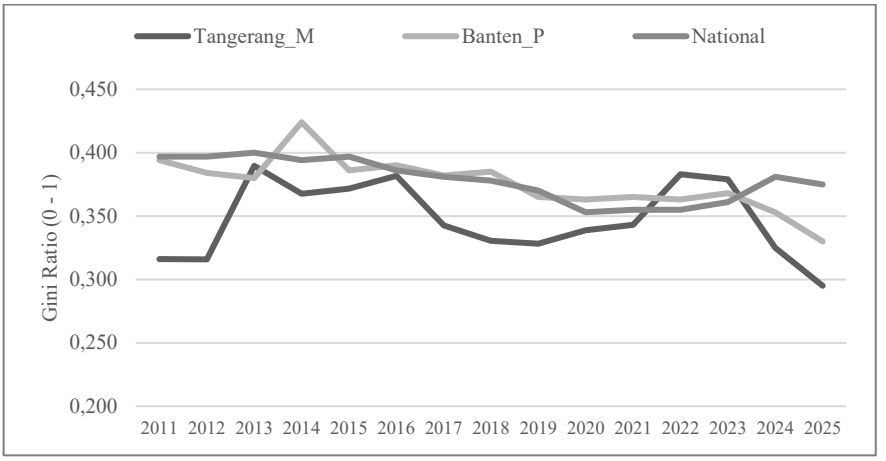
I(0) and I(1), as long as there are no stationary variables at degree I(2) (Toda & Yamamoto, 1995). The Toda-Yamamoto causality test is implemented in stages with the following steps: First, adjust the VAR equation with the optimal number of lags (*k*) based on different information criteria, AIC or SC; similarly, the maximum integration order (d_{max}) is known at this step. The second step is adding the maximum integration degree of the variables with two values (k and d_{max}), where the new VAR with order ($k+d_{max}$) is adjusted. Due to the addition of lag in the augmented VAR specification, the effective number of observations in the Toda–Yamamoto estimation decreased from 31 to 28 observations. To understand the existence of a causal relationship, a modified Wald test was applied. The resulting parameters have an asymptotic Chi-Squared (χ^2) distribution, which is important for inference.

4. EMPIRICAL RESULTS

4.1. Dynamics of income inequality in Tangerang Municipality

Figure 1 illustrates the evolution of the Gini ratio over the period 2011–2025, showing a moderate downward trend at both the national and Banten Province levels, as reflected by the declining linear trend lines. At the national level, inequality decreased from approximately 0.39 to 0.36 by the end of the period. Banten Province exhibited a similar pattern but with higher volatility, including a noticeable surge in the mid-2010s followed by a subsequent decline. This overall trend suggests a gradual improvement in income distribution, although structural inequality, particularly in urban areas, remains persistent.

Figure 1 Development of Gini ratio in Tangerang Municipality, Banten Province, and National, 2011-2025

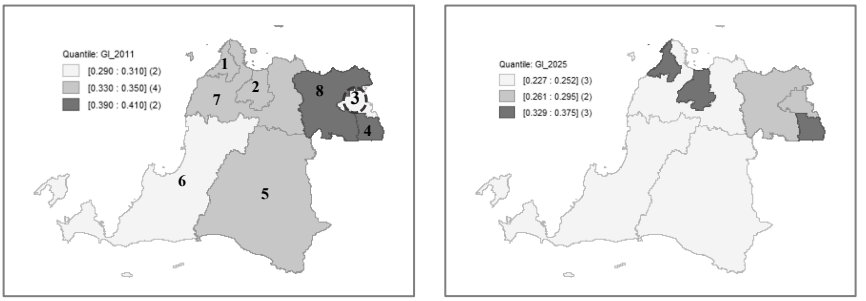


Note: M = Municipality, P = Province

Source: Authors calculation

Tangerang Municipality exhibits more volatile inequality dynamics than both provincial and national aggregates. Inequality rose sharply during 2013–2014, declined over the period 2016–2019, increased again during the post-pandemic recovery phase, and then fell markedly in 2024–2025 (see Figure 1). This pronounced sensitivity suggests that income inequality is strongly shaped by investment cycles and labor market segmentation. Consequently, an in-depth analysis is required to identify the underlying distributional channels of development and to underscore the importance of aligning investment strategies with human capital development in order to achieve more inclusive growth.

Figure 2 Comparison of the distribution of income inequality (Gini ratio) of regencies/municipalities in Banten Province, 2011 and 2025



Note: (1) Cilegon Municipality; (2) Serang Municipality; (3) Tangerang Municipality; (4) South Tangerang Municipality; (5) Lebak Regency; (6) Pandeglang Regency; (7) Serang Regency; (8) Tangerang Regency

Source: Geoda application version 1.22 (2026)

Figure 2 illustrates an overall improvement in income distribution with varying spatial dynamics, particularly in Tangerang Municipality (5). In 2011, it experienced a decline in inequality from 0.310 (first quantile) to 0.295 (second quantile) by 2025. It indicates that income tends to be distributed more evenly. However, Tangerang Municipality's relative position has shifted toward the middle class, as inequality in other regions has declined more rapidly. Income distribution pressures persist due to the agglomeration of economic activities and labor market segmentation.

4.2. Statistical summary

Table 2 demonstrates that the average Gini coefficient value is 3.464. There is moderate (31.9) variability across observations, indicating that income inequality in Tangerang Municipality tends to decrease and reflect a more relatively equitable income distribution. The mean years of schooling is 2.178 (equivalent to 8.83 years), suggesting that the average population aged above 15 years attained nearly nine years of formal education. It implies that disparities in educational attainment may significantly influence human capital accumulation. Meanwhile,

the LNHDI records an average of 4.312 with a small standard deviation, indicating relatively high (74.6%) and stable human development performance throughout the observation period.

Table 2 Statistical summary

Variable, n = 31	Mean	Std. Dev.	Max.	Min.
Gini Coefficient (LNGC)	3.464	0.139	3.663	3.038
Human Development Index (LNHDI)	4.312	0.052	4.412	4.212
Investment (INV)	0.024	0.035	0.113	0.001
Poverty (LNPOV)	1.681	0.164	2.086	1.433
Government Size (GS)	0.226	0.088	0.349	0.043

Source: Authors' calculation

Table 2 also describes that economic variables show different dynamics. The average value of investment is 0.024. There is relatively high volatility, indicating that there are fluctuations in investment flows (foreign and domestic investment) in Tangerang Municipality. The average poverty rate is 1.681 (5.37%), indicating that the poverty rate is relatively low and stable. Meanwhile, government size has considerable variation, reflecting changes in the fiscal role of local governments over time. These findings indicate that during the study period, inequality remained at a moderate level, human development was stable and steadily increasing, poverty was controlled, and investment and municipal government size continued to fluctuate in Tangerang Municipality.

4.3. Unit root test results

Table 3 demonstrates unit root test results with the ADF, PP, and KPSS test approaches. The test result revealed stationary data on the mixed integration order of "level" I(0) and "first difference" I(1) with the ADF test. However, for the variable data on the INV, neither "*level*" I(0) nor "*first difference*" I(1) was stationary. Meanwhile, the unit root test with PP and KPPS reveals that the research variables have mixed integration order characteristics, where some variables are stationary at the level and others become stationary after the first differentiation. Therefore, all research variables have been stationary, making the application of the ARDL model feasible and reliable for long-term relationship analysis.

Table 3 The unit root test results

Variable	ADF			PP			KPSS [critical value=0.463]		
	I(0)	I(1)	Decision	I(0)	I(1)	Decision	I(0)	I(1)	Decision
lngc	-3.567**	-7.308***	I(0), I(1)	-3.594**	-12.896***	I(0), I(1)	0.499	0.343	I(1)
lnhdi	-0.673	-5.361***	I(1)	-0.586	-5.349***	I(1)	0.709	0.089	I(1)
lnv	2.607	1.034	No	1.381	-9.085***	I(1)	0.584	0.441	I(1)
lnpov	-3.879**	-6.601***	I(0), I(1)	-3.349**	-6.647***	I(0), I(1)	0.088	0.087	I(0), I(1)
gs	-1.881	-4.778***	I(1)	-1.875	-4.774***	I(1)	0.483	0.399	I(1)

Note: *p < 0.1, **p < 0.05, ***p < 0.01

Source: Authors' calculation

4.4. Bounds cointegration test results

The researchers tested the cointegration of the ARDL model using the Bounds test. The test criterion is as follow: if the F-statistic value is bigger than the first difference of the F-table, or I(1), at the 5% significance value limit, then cointegration is present (see Table 4). The test results showed that the F-statistical value of 5.773 > a critical limit of 4.01 [I(1)]. From this result, it can be stated that there is cointegration in the ARDL, making it suitable for use as an analysis method.

Table 4 ARDL Bounds test results

F-Bounds test		H_0: No levels relationships		
Test statistics	Value	Sig.	I(0)	I(1)
F-stat	5.773	10%	2.45	3.52
K	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06

Source: Authors' calculation

In addition, researchers set the optimal lag length. The maximum lag order refers to standard econometric recommendations and information criteria (Narayan, 2005; Pesaran & Shin, 1999; Pesaran et al., 2001), specifically time series data. Researchers set SC as the basis for selecting the final lag to ensure model parsimony, dynamic stability, and stronger econometric validity. The lag length of the suspended and independent variables is 2. Thus, the results of the optimal lag sequence of the ARDL model (1, 0, 0, 0, 0) with the Schwarz criterion value = -1.452. The boundary test (ARDL) also recorded a statistical value of F of 33.675 and a p-value = 0.000<0.05. These results indicate that the hypothesis of zero absence of cointegration between dynamic variables in the model is rejected. It implies that there is a significant long-run equilibrium correlation between inequality (LNGC) and its dynamic predictor variables (LNHDI, INV, LNPOV, and GS) in the income inequality model of Tangerang Municipality.

4.5. Diagnostic and stability test results

The researchers employed a series of diagnostic tests to investigate whether the ARDL-ECM was valid, robust, efficient, and consistent. These tests included the normality, heteroskedasticity, and serial correlation tests. As reported in Table 5, the diagnostic test results show that the ARDL model satisfies standard econometric assumptions, confirming that the estimated model is statistically valid and reliable.

Table 5 The results of diagnostic test

Test	F-stat.	Sig.	Conclusion
Normality (JB test)	1.949	0.376	Normally distributed
Breusch-Godfrey Serial Correlation LM test	2.247	0.325	No autocorrelation
Breusch-Pagan-Godfrey Heteroscedasticity test	3.387	0.289	Homoscedasticity
Ramsey RESET test	0.027	0.872	Failed to reject H_0

Source: Authors' calculation

Additionally, the researchers reported individual Variance Inflation Factor (VIF) values and bivariate correlations to detect violations of the multicollinearity assumption. Table 6 demonstrates that the values were generally <10, and the bivariate correlation between the independent variables was <0.80. These results indicate that the analysis model was free from violations of the multicollinearity assumption.

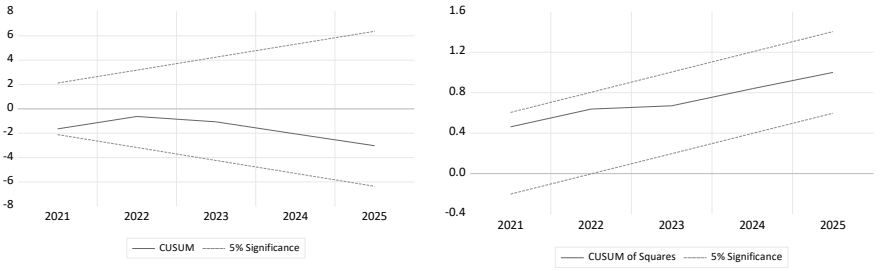
Table 6 The results of multicollinearity test

Variable	VIF	LNHDI	INV	LNPOV	GS
LNHDI	8.161	1.000	-	-	-
INV	3.860	0.739	1.000	-	-
LNPOV	1.012	-0.006	0.001	1.000	
GS	3.987	0.746	0.258	-0.063	1.000

Source: Authors' calculation

Researchers applied the stability test of the ARDL model with CUSUM and CUSUMSQ tests. The plot of the CUSUM test demonstrated that the blue line was consistently within the 5% significance threshold (between the dotted lines) during the study period. It indicated that the praised parameters have stabilized (see Figure 3). Similarly, the plot of CUSUM of Squares showed that the residual squares remain below the critical limit. The ARDL-ECM model confirmed that it is enable of identifying adjustments in relationships between variables in both the short- and long-run.

Figure 3 The CUSUM and CUSUMSQ statistic of the ARDL(1, 0, 0, 0, 0)



Source: Authors' calculation (Eviews 12 version)

4.6. Short- and long-run analysis

Table 7 demonstrates that the ARDL-ECM estimation obtains the coefficient for the error correction term (CointEq(−1)), which is negative and very significant (−0.978; $p < 0.01$). These results confirm the existence of a strong mean-reverting mechanism in the dynamics of income inequality. It suggests that any short-term deviations from the long-term equilibrium are quickly corrected, with approximately 97.85% of the imbalances readjusting within a single period (see Table 7). The income distribution system in Tangerang Municipality tends to be stable and has a high capacity for adjustment to economic shocks. Human capital development (LNHDI) has a negative and significant effect (-3.143; $p < 0.05$) on short-term income inequality. It exhibits that improving human quality contributes directly to narrowing income inequality. Conversely, investment (INV) has a significant positive effect (3.721; $p < 0.05$), indicating that short-term investment expansion is not yet fully inclusive. The control variable, local government size (GS), has a significant positive effect, indicating that short-term regional fiscal expansion is not yet fully inclusive. Conversely, poverty is insignificant in reducing inequality in the short run. It indicates that the impact of poverty is more structural.

Table 7 The results of the ARDL short- and long-run estimations

Variable	Short-run estimation				Variable	Long-run estimation			
	Coeff.	Std. Error	t-stat.	Sig.		Coeff.	Std. Error	t-stat.	Sig.
LNGC(-1)	-0.978	0.191	-5.126	0.007	LNHDI	-3.212	1.257	-2.555	0.017
LNHDI	-3.143	1.269	-2.477	0.020	INV	3.803	1.252	3.038	0.005
INV	3.721	1.384	2.689	0.012	LNPOV	0.036	0.136	0.267	0.792
LNPOV	0.035	0.133	0.266	0.792	GS	1.729	0.509	3.393	0.002
GS	1.692	0.525	3.223	0.004					
Constant	16.411	5.563	2.950	0.007					
CointEq(-1)*	-0.978	0.169	-5.803	0.000					
R^2	0.546								
Adjusted R^2	0.529								
F-stat	33.675								
Prob(F-stat)	0.000								

Source: Authors' calculation

Table 7 also explains that the cointegration test results indicate a stable long-run correlation between human capital, investment, poverty, municipal government size, and inequality. The human development index has a negative and significant impact on inequality (−3.212; $p<0.05$), confirming the role of human development as a long-term equity mechanism. Investment has a positive and significant impact on inequality in the long-run (3.803; $p < 0.01$). It shows that long-term capital accumulation tends to be skill-biased and not fully inclusive in Tangerang Municipality. Meanwhile, the control variable, local government size, also exhibits a positive and statistically significant impact. It means that increasing the expenditure-to-GRDP ratio has not yet resulted in income redistribution. The poverty variable does not significantly decrease inequality in the long-run.

5. DISCUSSION

5.1. Dynamics of inequality in Tangerang Municipality

The estimation results showed a stable long-run correlation between variables, which was characterized by a negative and significant ECT coefficient. The finding indicates that income inequality in Tangerang Municipality is mean-reverting. Mean-reverting means that any short-term shocks due to changes in investment, human capital, poverty, and government size will quickly return to a long-run equilibrium. This result of the ARDL cointegration test is consistent because the dynamic adjustment mechanisms are able to explain the structural relationship (Pesaran & Shin, 1999; Pesaran et al., 2001) between predictor variables and income inequality. In the context of municipalities, the relatively high speed of adjustment reflects strong labor mobility, market flexibility, and dense sectoral linkages. Municipal areas typically experience faster transmission of economic shocks than non-municipal areas due to integrated labor markets, migration flows, and the concentration of value-added production activities (Kanbur, 2015; World Bank, 2019).

As a center for modern manufacturing, logistics, and service industries, Tangerang Municipality operates within a metropolitan economic ecosystem connected to the nation's capital (Jakarta Province) and its surroundings. This position impacts changes in investment flows and rapid improvements in labor quality, resulting in a more favorable wage structure in the formal sector and an adequate income distribution pattern. This situation suggests that inequality is dynamic and susceptible to economic cycles and development policies. These findings reinforce the view that municipal inequality dynamics are influenced by local economic structures and institutional conditions, particularly in regulating access to productive opportunities (Goh, 2025; Goh et al., 2022; Lee & Lee, 2018). The long-term adjustment mechanisms analyzed using the ARDL–ECM model provide a strong analytical foundation for designing development strategies to reduce inequality in Tangerang Municipality.

5.2. Human capital and inequality

The ARDL-ECM estimator reveals that human capital has a negatively significant impact on inequality. Equitable distribution and improvements in the quality of education, health, and living standards demonstrate a strong redistributive capacity in industrial municipalities. These results show that human development in Tangerang Municipality has led to an increase in average welfare, thus reducing inequality. Income inequality exhibits short-term dynamics but has a relatively high speed of adjustment. In other words, income distribution is more manageable within a long-run economic framework. These findings indicate that human capital development not only serves as a long-term structural redistribution instrument but also has a significant short-term inequality-reducing effect. The significance of the short-term coefficients indicates that improvements in the

quality of education, health, and living standards broaden low-income groups' access to productive economic opportunities. Investment in human development in Tangerang Municipality serves as a short-term corrective mechanism for income distribution disparities and a foundation for long-term distributive transformation.

These test results also demonstrate that human capital has the power to act as a balancing force in an agglomeration-based urban economy. In Tangerang Municipality, improvements in education and health not only raise individual productivity but also expand access for low-income groups to formal-sector employment in modern manufacturing and service industries integrated into the Greater Jakarta metropolitan system. Human capital operates through several regional channels. First, upskilling reduces labor market segmentation by facilitating cross-sector and cross-firm mobility, thereby narrowing wage differentials across skill groups. Second, improved local capabilities mitigate spatial mismatch between residential areas and employment centers. Third, education strengthens workers' bargaining power within the municipal industrial value chain so that agglomeration benefits can be shared.

The significant long-run effects of human capital development indicate that productivity-based equity is more sustainable than short-term redistribution policies. However, the effectiveness of human capital critically depends on the alignment between skills development and the local economic structure. Education and training providers periodically adjust their curricula to respond to the needs of modern manufacturing, logistics, and service industries. Improving human capital quality will result in long-term structural income redistribution. Human capital is not only a trigger of growth but also plays a role in decreasing income inequality in Tangerang Municipality in the long-run. In addition, educational institutions and governments should eliminate obstacles, excessive administrative burdens and inertia (Štimac & Tanasić, 2023).

This result is in line with the general theory of human capital which states that the higher the quality of human capital in education and health, the productivity increases because education and health degrees are more evenly distributed (Becker, 1964; Rosen, 1989), thus narrowing inequality. In addition, these findings are consistent and reinforce the literature that places education as the primary channel of equity. Educational expansion will boost population productivity and it has been proven to increase social mobility, thereby reducing inequality (Barro & Lee, 2013; Hanushek & Woessmann, 2012). Recent studies such as SenGupta (2024) and Vo et al. (2024) affirms that skill upgrading is the key to containing income polarization in an economy that is undergoing structural transformation. These results also confirm the findings by Goh (2025), which show that improving the quality of human resources significantly reduces inequality. However, the impact of human capital depends on the structure of the labor market and access to education. This research contributes to strengthening the argument about the role of human capital as an individual factor and a local capability in leveraging the spatial and social distribution of agglomeration.

5.3. Investment and inequality

The results of testing the effect of investment on reducing inequality show a different result than for human capital. The estimation results explains that investment has a positive and significant impact on inequality in the short- and long-term. It means that investment expansion has not been distributionally inclusive. Investment tends to generate income premiums for high-capacity groups (highly educated and skilled workers), while low-capacity workers earn increasingly lower incomes. This finding implies that income inequality in Tangerang Municipality has been shaped by the structure of capital accumulation, thus exacerbating inequality.

The findings of this study reveal pressure on income inequality in Tangerang Municipality despite investment expansion, thus creating a mechanism for the reproduction of structurally widening inequality. In the short term, investment flows tend to drive demand for skilled labor and high-capacity groups, thereby providing economic benefits to certain segments. Meanwhile, investment patterns concentrated in capital-intensive sectors, technology, and leading economic regions have the potential to strengthen labor market segmentation, spatial inequality, and the unequal distribution of economic opportunities in the long term. These findings emphasize that without policies to strengthen local capabilities, spatial equity, and expand economic access, investment can function as both an engine of growth and a driver of inequality. Therefore, investment in agglomeration areas such as Tangerang Municipality requires a more inclusive policy framework so that economic transformation increases output and broadens the distribution of development benefits.

Increased investment at the municipal level means capital accumulation that is skill-oriented, capital-intensive, and spatially selective. Tangerang Municipality is attractive for investment in modern manufacturing, logistics, industrial estates, and medium- to high-tech services. These sectors increase productivity and demand for skilled labor, thus positively impacting development. This dynamic generates labor market polarization, whereby skilled workers capture income premiums, whereas informal and semi-skilled workers remain concentrated in low-wage segments. In addition, investment appears to reinforce existing income disparities rather than functioning as an inclusive distributive mechanism. This condition will occur if the focus on improving the local human capital quality and productive capabilities is neglected. From a spatial perspective, investment is also concentrated in industrial corridors, airport zones, and logistics hubs, thereby intensifying disparities in economic opportunities across districts and within the city.

These findings are relevant with the literature on skill-biased technological change, where capital- and technology-based modernization tends to increase productivity as well as inequality (Jaumotte et al., 2013). Recent studies by Makhlouf & Lalley (2023) and Pham et al. (2024) found that modern investment often widens the distribution of income when it is not accompanied by capability policies. In contrast, cross-country studies have found the redistributive function

of public spending (e.g., Lian et al., 2024; Yuldashev et al., 2023). The results of an empirical study in Tangerang Municipality indicate that in the context of an agglomerative city, local fiscal policy has not automatically become an equalize. It underscores the importance of spatial and sectoral approaches in investment and public spending policies, as emphasized in the literature development and regional studies about place-based development and territorial cohesion.

5.4. Toda-Yamamoto causality test results

After ARDL-ECM estimation, the researchers applied the Toda-Yamamoto causality test. The analysis aims to strengthen the direction of the relationship between variables from the previous estimator. The results of the lag selection test showed that AIC and FPE produced lag 2, while SC and HQ chose lag 1. The researchers concluded that the maximum lag was at order 2. Employing the Toda-Yamamoto VAR(2) structure, the maximum integration was d_{max}=1 and k=2; the VAR(3) structure obtained was $(k+d_{max})=(2+1)=3$. Table 8 demonstrates that the Toda–Yamamoto causality test yields income inequality as the variable most dynamically influenced by changes in the regional economic structure in Tangerang Municipality. Table 8 explains that the Toda–Yamamoto results strengthen the ARDL-ECM findings that inequality in Tangerang Municipality is a consequence of the interaction between human capital quality, investment, poverty, and regional fiscal orientation. In addition, the municipal government development agenda needs to shift from an investment-led growth paradigm to human capital-embedded and territorially inclusive development by strengthening local capabilities and optimizing government spending as an instrument of socio-spatial equality.

Tabel 8 The Toda-Yamamoto causality test results

Dependent Variable	Independent Variable	Chi-sq.	Prob.	Causality Direction	Interpretation
LNGC	LNHDI	24.748	0.000	LNHDI → LNGC	Significant
LNGC	INV	27.614	0.000	INV → LNGC	Significant
LNGC	LNPOV	10.105	0.018	LNPOV → LNGC	Significant
LNGC	GS	8.734	0.033	GS → LNGC	Significant
LNHDI	LNGC	3.646	0.302	No causality	Not significant
LNHDI	INV	1.622	0.654	No causality	Not significant
LNHDI	LNPOV	1.136	0.769	No causality	Not significant
LHDI	GS	2.341	0.505	No causality	Not significant
INV	LNGC	2.204	0.531	No causality	Not significant
INV	LNHDI	2.535	0.469	No causality	Not significant
INV	LNPOV	4.042	0.257	No causality	Not significant
INV	GS	3.691	0.297	No causality	Not significant
LNPOV	LNGC	2.829	0.419	No causality	Not significant
LNPOV	LNHDI	0.616	0.893	No causality	Not significant
LNPOV	INV	0.240	0.971	No causality	Not significant
LNPOV	GS	4.578	0.205	No causality	Not significant
GS	LNGC	11.240	0.011	LNGC → GS	Significant
GS	LNHDI	8.651	0.034	LNHDI → GS	Significant
GS	INV	8.901	0.031	INV → GS	Significant
GS	LNPOV	0.351	0.950	No causality	Not significant

Source: Authors' calculation;

Table 8 demonstrates that the Toda–Yamamoto causality test produces a significant bidirectional causal relationship between local government size and income inequality [(GS→LNGC; p=0.000) and (LNGC→GS; p=0.011)]. This further confirms that increased regional government spending is still focused on economic infrastructure development and investment support, rather than inclusive social redistribution. However, boosting inequality has resulted in regional governments becoming more active in fiscal interventions under socio-economic pressures. This implies that regional fiscal policy tends to be reactive and has not been optimal in sustainably reducing socio-spatial disparities (Lian et al., 2024; Yuldashev et al., 2023). The unidirectional causal relationship between human capital and government size (LNHDI→GS; p=0.034) reveals that increasing quality of education and health tends to increase the need for public services, social infrastructure, and development governance. Human development places demand on local governments to improve the effectiveness of their spending and the quality of their public services. The finding is consistent with empirical studies that it was found that improving human capital has a positive impact on fiscal capacity and quality of local government institutions (Kim, Wu, & Lin, 2018).

In addition, there exists a significant unidirectional causal relationship between investment and government size (INV→GS; p=0.031). Meaning, the increased investment tends to increase the government of Tangerang Municipality (see Table 8). In the regional economy context, local governments still tend to be reactive to investment expansion, so they don't have an effect on reducing inequality. These results confirm recent literature by (Martinez-Vazquez, Smoke, & Yilmaz, 2025), which found that increased investment in developing countries tends to be followed by an expansion of local government spending to support municipal economic transformation.

6. CONCLUSION, CONTRIBUTION, AND POLICY IMPLICATION

This study examines the effect of human capital, investment, and control variables on income inequality in Tangerang Municipality in the short- and long-run utilizing the ARDL–ECM and Toda-Yamamoto approaches. The estimation results show a stable long-run equilibrium correlation. Empirical testing reveals that human capital development has been proven to decrease inequality in the short- and long-run, confirming its dual role as an immediate distributive corrective mechanism and a long-term structural equalizer. In contrast, investment tends to exacerbate inequality in both the short- and long-run. This imbalance is due to a bias in technological skills for the local workforce. Municipal government size also contributes positively and significantly to inequality, while the Toda–Yamamoto results indicate a directional causal relationship between inequality and government size. It suggests that local fiscal policy still tends to be reactive and is not yet optimal as a redistribution instrument. Meanwhile, poverty appears to operate more as a structural socioeconomic condition than as a direct short-term

driver of inequality. The Toda–Yamamoto causality results strengthen and confirm the ARDL–ECM findings on the dynamic causal role of human capital, investment, poverty, and government size in shaping income inequality.

This study extends the literature on income inequality by proving that there is a long-run connection between human capital, investment, and income distribution, and that it is not static. The pattern of the correlation between these variables follows the adjustment channel of the ARDL cointegration framework. The evidence of mean reversion in inequality supports the argument that the metropolitan economic structure allows for effective policy intervention in the medium and long term. Empirically, this study contributes by providing municipality-level evidence from the context of Indonesian municipal areas. Meanwhile, improving human capital quality acts as a long-term equalizer. These findings imply that reducing inequality in Tangerang Municipality requires shifting from growth-oriented development toward inclusive capability-based development. In addition, investment policies should be directed toward inclusiveness to strengthen the linkages between industry and the local workforce. The mechanism can be implemented by increasing the variety of non-formal skills, retraining, and skills enhancement programs according to the needs of the modern manufacturing and service sectors. Human development policies also prioritize the equitable distribution of education and skill quality so that the benefits of economic growth can be enjoyed by all income groups.

7. LIMITATIONS AND FUTURE RESEARCH

This study still has limitations in terms of the data, proxy variables, and analytical approach used. First, this analysis has a relatively limited number of observations (even though $n > 30$), thereby increasing the sensitivity of the model specification because it relies on annual data. Second, the human capital variables proxied by the LNHDI may not adequately capture the dimensions of education quality, skills acquisition, and alignment with labor market needs. Third, aggregate investment measurements (without distinguishing between capital-intensive and labor-intensive investments) do not adequately capture its role in reducing inequality. Research has shown that both are sources of inequality in Tangerang Municipality. Fourth, the potential for a nonlinear relationship (asymmetry or threshold effect) between capital development and inequality is highly likely. However, the approach used in this study cannot adequately accommodate this. The study also did not include major shocks (the Asian Crisis, the GFC, and COVID-19), so their true impact is unknown. Finally, the Toda–Yamamoto approach can improve the robustness of causal inference under mixed integration orders, but it is still limited in capturing nonlinear and asymmetric transmission mechanisms. In addition, the ARDL–ECM and Toda–Yamamoto approaches mitigate several time-series estimation problems, potential endogeneity and omitted institutional dimensions may still impact the estimated relationships.

Based on these limitations, further research can be developed in several directions. First, the use of spatial panel data across sub-districts would allow for the identification of spillover effects and regional heterogeneity. Second, researchers should disaggregate investment proxies by foreign investment and domestic investment to identify their respective roles in reducing inequality. Furthermore, the inclusion of institutional variables, sectoral structure, technological factors, and labor market segmentation would complement the determinants of inequality and improve the quality of further research. Third, the application of nonlinear models such as NARDL, threshold panel models, or quantile regression could enrich our understanding of inequality responses at different levels of development. Finally, future studies could use ARDL or regime-switching breakpoint models to more explicitly capture these macroeconomic disruptions.

Author contributions: Conceptualization, K.K. and L.E.L.; Methodology, K.K. and B.M.; Software and Resources, K.K.; Validation, B.M. and L.E.L.; Formal analysis and writing – original draft, K.K.; Writing – review and editing, supervision, and data curation, BM and L.E.L.; Visualization, K.K.

Funding: The research presented in this manuscript did not receive any funding from external sources.

Conflict of interest: None.

Acknowledgement of the uses of AI: The authors utilized the ChatGPT application to assist in manuscript preparation to improve writing efficiency, productivity, and article quality, as well as to ensure originality. After utilizing the application, the authors reviewed, validated, discussed, and edited the content. The authors are fully responsible for the content of the published article.

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DINAMIKA NEJEDNAKOSTI U INDONEZIJI: DUGOROČNE ULOGE RAZVOJA I ULAGANJA U LJUDSKI KAPITAL

Sažetak

Nejednakost dohotka već je dugo jedno od ključnih društveno-ekonomskih pitanja u razvijenim zemljama i zemljama u razvoju, a osobito je izražena u urbanim područjima. Ova studija ispituje povezanost između nejednakosti dohotka, razvoja ljudskog kapitala i ulaganja u općini Tangerang u kratkoročnom i dugoročnom razdoblju. Na temelju godišnjih podataka za razdoblje od 1995. do 2025. godine primijenjeni su ARDL-ECM model i Toda-Yamamoto pristup analizi kauzalnosti. Rezultati potvrđuju postojanje stabilne dugoročne ravnotežne povezanosti među promatranim varijablama. Razvoj ljudskog kapitala značajno smanjuje nejednakost dohotka u oba promatrana razdoblja, dok ulaganja pridonose njezinu povećanju, što upućuje na nedovoljno uključiv karakter akumulacije kapitala. Analiza kauzalnosti pokazuje jednosmjernu vezu od ljudskog kapitala i ulaganja prema nejednakosti dohotka. Nalazi upućuju na potrebu usklađivanja investicijskih politika s pravednim razvojem ljudskog kapitala radi smanjenja nejednakosti i održivog povećanja blagostanja.

Ključne riječi: ARDL, ljudski kapital, nejednakost dohotka, investicije.

JEL klasifikacija: D31, I25, I31, O15, E22.