

Human Capital and Income Inequality in China: An ARDL Analysis

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ABSTRACT

This paper examines the dynamic relationship between human capital and income inequality in China over the period 1990–2023 using an ARDL–ECM framework. Income inequality (GINI) is modeled as a function of human capital, economic growth, trade openness, financial development, and governance quality. Bounds testing confirms a stable long-run cointegrating relationship across the full sample period. The long-run estimates show that human capital has a strong inequality-reducing effect, whereas trade openness and financial development significantly increase inequality; growth and governance have no robust direct impact once structural factors are controlled for. Short-run results indicate that positive shocks to human capital can temporarily widen inequality, while about 59% of any deviation from the long-run equilibrium is corrected within one period. These findings fill a gap in single-country long-time series evidence and highlight the need to coordinate human-capital policies with trade, financial, and governance reforms under China’s high-quality development and common prosperity agenda.

Keywords: human capital, income inequality, China, ARDL–ECM, cointegration

INTRODUCTION

Income inequality has become a central issue in global economics and public policy. Since the 1980s, many advanced and emerging economies have witnessed rising wealth concentration and growing income polarization. Without efficient taxation and redistributive measures, the long-term high rate of returns on capital in comparison with the economic growth cannot contribute to the sustainability of long-term growth and erodes social cohesion (Piketty, 2014; Atkinson, 2015; Milanovic, 2016). Empirical cross-country research also shows that extreme inequality may not only disincentivize investments in human capital, but also that lower- and middle-income Arab populations have less purchasing power, become financially fragile, and poverty is ultimately hindered and inclusive growth is not promoted (OECD, 2011; IMF, 2017). It is with this background of developments, along with the influence of the United Nations Sustainable Development Goals, or SDG 10, on inequality reduction and plans to reform domestic income distribution, that a dynamic balance between efficiency and equity has come into a set of global governance challenges.

The distribution of income inequality is also a multifaceted problem in the Chinese context. Findings identified from household surveys and administrative data repeatedly point to similar conclusions: since the reform and opening-up, China has experienced an evolutionary process of rapid growth in inequality to a high plateau and moderate decrease but is still significantly at a high level. The Gini coefficient was moderately low in the late 1980s, surged rapidly in the 1990s, reached high levels in the mid-to-late 2000s, and has declined slightly in recent years. Nevertheless, significant income disparities persist across urban-rural divides, regions, and industries (Jain-Chandra et al., 2018; Gradín, 2020; Zhang, 2016). Existing research generally agrees that urban-rural income disparities and inter-regional income gaps are the main sources of China's overall inequality. Against the backdrop of high-quality development and common prosperity being established as long-term strategic goals, income distribution patterns relate not only to 'expanding the middle-income group' and 'unleashing the potential of domestic demand', but also impact intergenerational mobility and social stability. Systematically identifying the determinants and evolutionary mechanisms of income inequality has significant theoretical and policy implications.

Among the many determinants of income disparity, human capital is widely regarded as a key factor shaping the structure of income distribution and patterns of social mobility (Castelló-Climent, 2014; Castelló-Climent & Doménech, 2021). On the one hand, educational attainment and skills accumulation directly influence workers' wage levels and employment opportunities (De Gregorio & Lee, 2002; Alali, 2022). On the other hand, an unequal distribution of human capital can entrench class divisions through mechanisms such as the "education gap" and the "digital divide" (Kim, 2013; van de Werfhorst, 2022; Sanders, 2021). International evidence shows that higher educational attainment and more equal access to education generally help narrow income gaps (De Gregorio & Lee, 2002; Ning, 2010; IMF, 2017). Nevertheless, at certain times and in country-specific circumstances, the growth of education can have a nonlinear pattern of short-run amplification and long-run convergence (causing, in the strangely short run, an increase in the inequality) (Makhlouf et al., 2023; Hu et

al., 2023; Vo et al., 2024). This highlights the analytical and policy value of investigating income inequality through the human capital lens.

Human capital vis-a-vis income inequality is one of the most sought-after researches in the Chinese context. The available studies on the rate of return of education and the interaction between education inequality and income inequalities prove that enhancing educational attainment and access to education are significant methods of alleviating permanent income inequality. Nevertheless, there are still considerable differences in access to education based on geographical regions and city-countryside distinctions, as well as social classes (Zhou, 2016; Kim, 2010). On the contrary, more recent research studies have used longer time series and nonlinear econometric approaches to provide a more subtle account of the changing relationship between human capital and inequality. In fact, Xu et al. (2023) built a non-linear ARDL model that utilizes the Chinese data between 1975 and 2020. They discovered that increases in positive shocks of secondary and tertiary education had a considerable impact on reducing income inequality on a long-term basis, but decreases in income inequality are noticed when the shock is negative. This shows a strong short-run/long-run asymmetry effect. Regarding human capital distribution at a regional level, Yu and Xu (2023) find that human capital agglomeration and mobility indirectly influence interregional income inequities through productivity and industrial structure. More to the point, with the scramble of digitalization of the economy, recent studies have found that digital competence combined with traditional human capital has the potential to create new amplifying or convergent effects on disparities in urban-rural, regional, and group incomes, which blends and combines the digital divide with the education divide (Zhang et al., 2025). Thus, redefining income inequality in China with the view of human capital can not only contribute to the global literature but also offer a significant direction for responding to the current common prosperity policy of China.

However, current studies have various weaknesses. To begin with, there is abundant literature where cross-country or regional panel data is used to test the relationship between education, human capital, and income inequality in a comparative manner. It is not systematic in the presentation of the long-term/short-term dynamics in an individual economy across a long period of time. This makes it difficult to reveal the distinctive pathways of a super-large economy such as China's during institutional transitions and developmental stage shifts. Secondly, empirical studies in China often treat human capital variables as control variables or indirect channels. Relatively little research centers on the 'human capital-income inequality' relationship as the primary analytical focus, integrating key structural factors such as economic growth, trade openness, financial development, and governance quality into a unified time-series framework. This makes it difficult to compare the relative importance of different structural factors on income disparities and their interactions. Thirdly, existing time-series studies predominantly end their sample periods in the mid-to-late 2010s. This means they fail to capture the new phase that began in 2020, which has been marked by pandemic shocks, accelerated digital economy development, and the comprehensive advancement of the common prosperity strategy. Furthermore, few studies explicitly link empirical analyses of income inequality with the development goals outlined in the 14th Five-Year Plan.

Building on the above research gaps, this paper uses annual macro data for China over the period 1990–2023 and estimates an ARDL model with income inequality (GINI) as the dependent variable and human capital (HC), economic growth (GDP), trade openness (TO), financial development (FD), and governance quality (GOV) as the key regressors to examine systematically the long-run equilibrium relationship and short-run adjustment dynamics between human capital and income inequality in China. The main objectives are threefold: (1) to identify, conditional on economic growth, trade openness, financial development and governance, the long-run direction and elasticity of the impact of human capital on income inequality in China; (2) to analyse the short-run, stage-specific effects of shocks to human capital on income disparities and the speed at which the system returns to its long-run equilibrium; and (3) to discuss, in light of China’s development stages since 1990 and the objectives of the forthcoming Fifteenth Five-Year Plan, how human capital policies can be coordinated with financial, trade and governance reforms within the broader agenda of high-quality development and common prosperity to reduce income inequality more effectively.

Accordingly, the theoretical contributions of this paper primarily lie in systematically characterizing the long-term and short-term dynamic relationship between human capital and income inequality within a single-country framework using extended time-series data, while integrating financial development, trade openness, and governance quality into a unified structural model. This enriches the empirical evidence on the “human capital-inequality relationship” in large developing economies. At the policy level, this study provides data support and quantitative evidence for understanding how China, during the 15th Five-Year Plan period, advanced common prosperity through education and human capital policies while coordinating financial and openness policies to prevent the gap from widening in the opposite direction.

LITERATURE REVIEW

Human Capital and Income Inequality from an International Perspective

In international literature, research on income inequality typically focuses on three key areas: Firstly, how to measure and describe its evolution across countries and over time. Secondly, identifying the determinants of inequality in terms of factors such as economic growth, trade openness, financial development, technological progress, human capital, and institutional quality. And thirdly, evaluating the impact of inequality on growth, social mobility, and political stability (Atkinson, 2015; Milanovic, 2016; OECD, 2011). Within this framework, the concept of human capital has evolved from being a "control variable" to becoming one of the core ways of explaining income distribution structures and intergenerational mobility (Lee, 2018).

Early cross-country studies generally find that higher levels of education and a more equal distribution of schooling help to alleviate income inequality. De Gregorio and Lee (2002), using panel data for 1960–1990, show that increases in average years of schooling and a more even distribution of education both significantly reduce the Gini coefficient, and they also confirm a Kuznets-type inverted U-shaped relationship between income and inequality.

Kim (2013), using a larger cross-country sample, further finds a significant positive and nonlinear relationship between educational inequality and income inequality, with equalizing access to education being particularly important in developing countries. Subsequently, Castelló-Climent and Doménech (2014) construct a human capital inequality database covering many countries over 1950–2010 and show that, even when average education levels rise, highly concentrated educational opportunities—and thus human capital inequality—still tend to push income inequality higher.

Recent literature has further emphasized the non-linear and threshold characteristics of the relationship between human capital and inequality. Vo et al. (2024) used ARDL and threshold models to analyze data from ASEAN countries, concluding that human capital reduces income inequality in the short term for most nations. However, in the long term, when educational expansion is not aligned with labor market demand, diminishing returns or even counterproductive effects may emerge, revealing an inverted U-shaped relationship. Goh et al. (2025) found that positive shocks to education and human capital significantly reduce inequality in the long term using NARDL methods. Conversely, educational contraction or slowing investment in education markedly amplifies inequality, with this asymmetric effect being influenced by trade openness and macroeconomic stability. Meanwhile, some studies have adopted a reverse causality approach, arguing that high income inequality restricts human capital investment through credit restrictions and disparities in educational opportunity, creating a vicious cycle of 'inequality-human capital-inequality' (SenGupta, 2024; Khan et al., 2025).

In summary, the international literature broadly converges on two points. First, educational expansion and equalization of educational opportunities yield a 'human capital–equality effect' in the long term. Second, human capital and income inequality exhibit widespread nonlinear, stage-dependent, and bidirectional causality. This implies that, within specific national contexts, the interactive mechanisms between human capital and income inequality must be systematically examined within a framework that balances long-term cointegration and short-term dynamic adjustments.

Research Progress on Income Inequality and Human Capital in the Chinese Context

Recent literature has further emphasized the nonlinear and threshold characteristics of the human capital-inequality relationship. Vo et al. (2024) employed ARDL and threshold models across ASEAN countries, finding that human capital contributes to reducing income inequality in the short term for most nations. However, in the long run, when educational expansion misaligns with labor market demand, diminishing returns or even counterproductive effects may emerge, revealing an inverted U-shaped relationship. Goh et al. (2025), employing NARDL methods, found that positive shocks to education and human capital significantly reduce inequality over the long term. Conversely, the contraction of or reduction in educational investment has a significant impact on inequality, and such an asymmetric change depends on how open the trade is as well as the macroeconomic stability. At the same time, other studies have presented a reverse causality study, which states that income inequality limits the investment of human capital by restricting their credit access and educational opportunity

inequality, forming an infinite loop of inequality-human capital-inequality (SenGupta, 2024; Khan et al., 2025).

Overall, it is clear that the international literature widely agrees that, in the long run, educational expansion and equalization of educational opportunities bring about a human capital-equality effect and that human capital and income inequality display stage-dependent, nonlinear, and bi-directional causal relationships. This implies that within specific national contexts, it is necessary to systematically examine the interactive mechanisms between human capital and income inequality within a framework that balances long-term cointegration and short-term dynamic adjustments.

In the Chinese context, research on human capital and its distribution has increased markedly over the past five years. On the one hand, studies taking overall educational development as a starting point show that education expansion has played an important role in the recent easing of inequality. Using household data, Hu, Wan, and Zuo (2025) find that education accounts for a large share of wage inequality in China, and that a substantial part of the decline in inequality between 2010 and 2018 can be attributed to improved educational opportunities and a reduction in the college wage premium. Drawing on data for 1975–2020, Xu et al. (2023) employed an NARDL model and showed that positive shocks to secondary and higher education significantly reduce the Gini coefficient in the long run, whereas negative shocks to education widen inequality, revealing a clear short-run–long-run asymmetry. On the other hand, studies focusing on educational inequality and the spatial allocation of human capital indicate that the concentration of high-quality human capital in first-tier cities and high-end services exacerbates regional disparities through capital–skilled complementarity (Yu & Xu, 2023). Lin & Liu (2024) using an education Gini index and CFPS data, finds that unequal educational resources not only increase income gaps but also significantly reduce subjective well-being, while a provincial-level study by the Asian Development Bank (ADB, 2025) further identifies educational attainment and educational inequality as key variables explaining inter-provincial income differences.

More recent work has turned to the interaction between human capital and the digital economy. Zhang et al. (2025) argue that the digital economy, on the one hand, can help narrow urban–rural income gaps by raising the returns to human capital and creating new types of jobs; on the other hand, where digital skills and educational foundations are highly uneven, digital transformation tends to increase skill premia and weaken the bargaining power of low-skilled workers, leading the “education gap,” the “digital divide,” and the “income gap” to reinforce one another (Liang, 2024; Zhang et al., 2025). From a dual perspective of “quantity” and “price” of human capital, Butaeva et al. (2025) find that both the level of education and its rate of return jointly shape the pattern of inter-provincial wealth inequality, underscoring the structural role of human capital in explaining regional disparities.

Overall, relevant research in China has shifted from single-indicator approaches to multidimensional characterizations and from static comparisons to dynamic analysis. There has also been a progressive incorporation of human capital into a core explanatory framework alongside trade openness, financial development, and the digital economy. However, research that systematically identifies the short- and long-term effects of human capital on inequality,

using income inequality as the dependent variable and incorporating human capital, economic growth, trade openness, financial development, and governance quality into a unified time-series model, remains limited. Furthermore, the majority of studies have a data cut-off period in the mid-to-late 2010s. A systematic quantitative analysis based on the latest data from the new phase since 2020, marked by pandemic shock, accelerated digital economic development, and comprehensive advancement of the common prosperity strategy, is lacking, providing scope for future research.

METHODOLOGY

This study primarily employed the ARDL model because it can handle variables with mixed integration orders of $I(0)$ and $I(1)$. This allows it to identify short-term dynamics and long-term equilibrium relationships simultaneously under small sample conditions. Compared to methods such as VECM and FMOLS, which require uniform integration orders or larger sample sizes, the ARDL model is more applicable (Pesaran & Shin, 1999; Pesaran et al., 2001; Narayan, 2005). The sample period is 1990–2023 because data on China's income inequality, economic growth, trade openness, financial development, governance levels, and human capital only became relatively complete and consistent in measurement and internationally comparable from 1990 onwards. The existing data prior to 1990 have large gaps and measurement errors. It is also known as a time of China's major economic transition steps, such as the accession to the WTO, the development of high-tech and digital economies, and the introduction of new plans, such as the so-called dual circulation and common prosperity plans. This gives a strong basis for the analysis concerning the dynamic relationship between human capital and income inequality at various stages of development. The strong results of the ARDL model in representing dynamic socioeconomic relations within small sample sizes, as well as structural change, also support the choice of the model and sample period.

The theoretical framework of the benchmark model is based on the relationship between economic development, globalization, institutional factors, and income distribution. It is based on the Kuznets hypothesis (1955), which indicates that income inequality changes in relation to the growth of the economy and structural change. The current theory of world globalization examines the operation of the conflict between foreign direct investment (FDI) and trade openness and inequality through relationships such as technology transfer, skills premiums, and regional investment concentration (Alderson and Nielsen, 1999; Goldberg and Pavcnik, 2007). Financial development theory can demonstrate the relationship between access to credit, asset accumulation, and income disparities (Greenwood and Jovanovic, 1990), as well as the relationship between the quality of governance, human capital, and the distribution of economic opportunities (Rodrik, 1999; Psacharopoulos and Patrinos, 2018).

Based on this framework, income inequality is modeled as a function of economic growth, trade, financial development, governance, and human capital, resulting in the linear specification in Equation (1).

$$\text{GINI}_t = \delta_0 + \beta_1 \text{GDP}_t + \beta_2 \text{TO}_t + \beta_3 \text{FD}_t + \beta_4 \text{GOV}_t + \beta_5 \text{HC}_t + \varepsilon \quad (1)$$

This specification provides an initial assessment of the direction and magnitude of relationships before incorporating transformations and dynamic adjustments.

To enhance data stability, reduce potential heteroskedasticity, and allow elasticity-based interpretation of coefficients, all variables are transformed into natural logarithms. Following Gujarati & Porter (2009) and Wooldridge (2013), the logarithmic form is expressed as:

$$\text{LNGINI}_t = \delta_0 + \beta_1 \text{LNGDP}_t + \beta_2 \text{LN TO}_t + \beta_3 \text{LN FD}_t + \beta_4 \text{LNGOV}_t + \beta_5 \text{HC}_t + \varepsilon \quad (2)$$

The log-linear model also allows for comparison with previous empirical studies on inequality and foreign direct investment (FDI).

To capture both long-run equilibrium and short-run adjustment processes, the study employs the ARDL approach. The general ARDL-error correction representation of the log model is formulated as follows:

$$\begin{aligned} \Delta \text{LNGINI}_t = & \beta_0 + \theta_1 \text{LNGDP}_{t-1} + \theta_2 \text{LNTO}_{t-1} + \theta_3 \text{LNFD}_{t-1} + \theta_4 \text{LNGOV}_{t-1} + \theta_5 \text{LNHC}_{t-1} \\ & + \sum_{i=1}^a \beta_i \Delta \text{LNGDP}_{t-i} + \sum_{i=1}^a \mu_i \Delta \text{LNTO}_{t-i} + \sum_{i=1}^a \pi_i \Delta \text{LNFD}_{t-i} \\ & + \sum_{i=1}^a \rho_i \Delta \text{LNGOV}_{t-i} + \sum_{i=1}^a \varrho_i \Delta \text{LNHC}_{t-i} + \vartheta_t \end{aligned} \quad (3)$$

where:

- GINI: Income inequality (Gini coefficient);
- GDP: Real GDP per capita (constant 2015 USD);
- TO: Trade Openness (Trade/GDP);
- FD: Credit to Private Sector (% of GDP);
- GOV: Corruption Perception Index (CPI);
- HC: Secondary School Enrollment (%).

The specific annual data are derived from the macroeconomic time series for China compiled by the researchers for the period 1990–2023, consistent with the World Bank's World Development Indicators (WDI), Transparency International's Corruption Perceptions Index (CPI) data, and domestic statistical yearbooks.

The estimation strategy follows a systematic and robust econometric procedure. First, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests are used to determine the order of integration of all variables. Then, the ARDL bounds testing approach (Pesaran et al., 2001) is applied to examine long-run cointegration, with critical values taken from Narayan (2005). Once cointegration is confirmed, short-run dynamics and long-run elasticities are estimated within the ARDL framework. The error correction model (ECM) then provides the speed of adjustment, where the error-correction term is expected to be negative and sizable. Finally, serial correlation, heteroskedasticity, and specification diagnostics, together with CUSUM and CUSUMSQ stability tests and additional robustness checks (e.g., alternative controls or sample periods; Handayani et al., 2022b), ensure the reliability of the results.

FINDINGS AND DISCUSSIONS

Unit Root Test

The findings reveal the stationarity characteristics of the variables under investigation. Thus, supporting the use of the ARDL model.

ARDL Bound Test

To investigate whether Human Capital (HC) and other factors have a long-run equilibrium relationship with income inequality in China, this study employed the ARDL Bounds Testing Approach proposed by Pesaran et al. (2001). The null hypothesis of the bounds test is that there is no long-run relationship between the variables, while the alternative hypothesis is that there is such a relationship.

Table 1. Bound test

F-statistic	7.528***	
Critical value	Lower bound	Upper bound
10%	2.08	3.35
5%	2.62	3.79
1%	3.41	4.68

Note: *** denotes significance at 1%.

The bounds test result shows that the F-statistic (7.528) is well above the 1% upper critical value (4.68), so the null hypothesis of no long-run relationship is decisively rejected. This indicates a stable long-run cointegrating relationship between income inequality (GINI), human capital, and the other macroeconomic variables, justifying the use of the ARDL–ECM framework for subsequent long- and short-run analysis.

ARDL Short-run and Long-run Estimation

As shown in Table 2, in the long run, INHC displays a large negative and highly significant coefficient, confirming a strong long-run inequality-reducing effect of human capital. This result is fully consistent with international evidence that higher and more equally distributed education lowers the Gini coefficient over time (De Gregorio & Lee, 2002; Kim, 2013; Castelló-Climent & Doménech, 2014), and recent Chinese studies show that education expansion and improved access are key drivers of the recent easing of inequality (Xu et al., 2023; Hu et al., 2025; Yu & Xu, 2023), thereby empirically validating the central hypothesis that human capital is a core structural lever for narrowing income gaps in China.

By contrast, INGDP is positive but insignificant, suggesting that once structural factors are controlled for, economic growth per se has no robust direct effect on inequality, which is consistent with the mixed, stage-dependent growth–inequality findings in the literature (De Gregorio & Lee, 2002; Li, 2016; Lin, 2024). LNT0 is positive and highly significant, indicating that trade openness tends to raise inequality in China, echoing the “double-edged sword” view of openness in emerging economies (Nam, 2024; Pleninger et al., 2022; Saci, 2024). INFD is also positive and significant, implying that financial development has a long-run pro-inequality bias when it predominantly serves high-income groups, in line with recent evidence on finance and inequality (Li, 2025; Akpa et al., 2024; Shen et al., 2025). Finally,

INGOV is slightly negative but insignificant, suggesting that governance—as proxied by CPI—does not exert a strong direct long-run effect on inequality in this specification, and is more likely to operate through indirect channels, which is broadly consistent with cross-country work emphasizing the role of corruption control and welfare institutions (Lee, 2018; Castillo et al., 2025).

Table 2: Long-run ARDL estimation results

Variables	Coefficient	t-stat	Prob
INGDP	0.226	1.464	0.1709
LNT0	0.186***	3.169	0.0089
INFD	1.596**	2.323	0.0403
INGOV	-0.006	-0.222	0.8282
INHC	-6.612***	-3.112	0.0099
C	18.980	3.348	0.0065

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively

As shown in Table 3, in the short run, human capital (HC) shows a clearly asymmetric pattern. The contemporaneous change in human capital is small and insignificant, whereas its first lag, $D(INHC_{(-1)})$, is large, positive, and highly significant. This implies that an increase in human capital initially tends to raise income inequality before its long-run equalizing effect dominates. In other words, education expansion in China appears to benefit better-educated and higher-income groups first, generating a temporary widening of gaps, while the longer-run dynamics—captured by the negative long-run coefficient—are inequality-reducing. This time profile is highly consistent with international and Chinese evidence that education and human capital accumulation often have short-run inequality-widening but long-run inequality-reducing effects, especially in developing and emerging economies (Kim, 2013; Castelló-Climent & Doménech, 2014; Xu et al., 2023; Hu et al., 2025; Vo et al., 2024; Yu & Xu, 2023).

The positive, significant INGINI confirms short-run persistence in inequality changes, while the error-correction term $CointEq_{(-1)} = -0.585$ implies that about 59% of any disequilibrium is corrected within one period, signaling a stable adjustment towards the long-run path on which HC plays a strongly inequality-reducing role. For the control variables, the alternating signs on the GDP differences suggest no clear monotonic short-run growth–inequality effect. In contrast, the significantly negative coefficients on LNT0 and INFD indicate that past increases in trade openness and financial development have transitory equalizing effects before the longer-run, inequality-increasing impacts identified in the long-run ARDL emerge (Nam, 2024; Li, 2025; Akpa et al., 2024; Shen et al., 2025), while short-run changes in governance (CPI) remain insignificant, consistent with governance working mainly through slower institutional channels (Lee, 2018).

Table 3. Short-run estimation results

Variables	Coefficient	t-stat	Prob
$D(INGINI_{(-1)})$	0.436**	2.748	0.0189

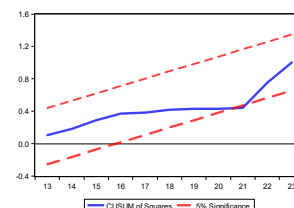
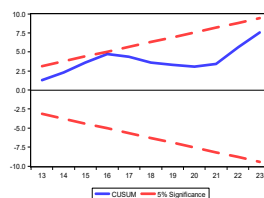
D(INGDP)	-1.030	-1.559	0.1472
D(INGDP(-1))	1.558*	1.853	0.0907
D(INGDP(-2))	-3.654***	-3.326	0.0068
D(INGDP(-3))	3.328***	3.489	0.0051
D(LNTO)	-0.011	-0.423	0.6804
D(LNTO(-1))	-0.117***	-5.637	0.0002
D(INFD)	-0.213	-0.915	0.3793
D(INFD(-1))	-0.879***	-3.847	0.0027
D(INFD(-2))	-0.177	-1.379	0.1953
D(INGOV)	-0.003	-0.222	0.8283
D(INHC)	0.084	0.181	0.8590
D(INHC(-1))	2.437***	4.888	0.0005
CointEq(-1)	-0.585***	-3.789	0.0030

Diagnostic Test Results

Upon confirming the existence of long-run cointegration, a battery of diagnostic tests was applied to validate the ARDL model. As shown in Table 4, the Breusch–Godfrey serial correlation test ($p = 0.588$), RESET functional form test ($p = 0.951$), normality test ($p = 0.654$), and heteroskedasticity test ($p = 9.023$) all yield p-values above the 10% level, indicating no evidence of autocorrelation, misspecification, non-normality, or heteroskedasticity and thus supporting the statistical adequacy of the model for estimating short- and long-run coefficients. In addition, the CUSUM and CUSUMSQ statistics remain within the 5% critical bounds throughout the sample, confirming the structural stability of the estimated parameters over time. Taken together, these diagnostic and stability results provide a solid basis for interpreting the estimated elasticities and the dynamic adjustment process.

Table 4. Diagnostic test results

Test statistic	F-statistic	Probability
BG Serial Correlation LM	0.588	[0.575]
Ramsey RESET stability	0.951	[0.341]
Heteroscedasticity	0.654	[0.795]
Jarque-Bera	9.023	[0.787]
CUSUM and CUSUMSQ	Cusum	CusumSQ



CONCLUSION

Using 1990–2023 annual data for China and an ARDL–ECM framework, this paper identifies a clear and stable long-run cointegrating relationship between income inequality and its key structural drivers. First, conditional on economic growth, trade openness, financial development, and governance, human capital exerts a strong and statistically significant inequality-reducing effect in the long run, confirming that higher and more broadly shared education is a core mechanism for narrowing income gaps. Second, the short-run results reveal that positive shocks to human capital initially tend to widen inequality, while the error-correction term indicates that around 59% of any deviation from the long-run equilibrium is corrected within one period, implying that temporary distributional tensions are relatively quickly pulled back towards an equality-enhancing long-run path. Third, trade openness and financial development significantly raise inequality in the long run, whereas economic growth and the governance proxy (CPI) do not display robust direct effects once these structural factors are controlled for, suggesting that China’s inequality trajectory is shaped by the interaction between an equalizing human-capital channel and inequality-enhancing forces from openness and finance. Collectively, these findings address the research questions, fill the identified gap of a single-country long-time-series analysis with human capital at the analytical core, and provide an empirical basis for discussing how human-capital policy can be coordinated with trade, financial, and governance reforms under the agenda of high-quality development and common prosperity in the forthcoming Fifteenth Five-Year Plan period.

The empirical results suggest that, in the context of high-quality development and the forthcoming Fifteenth Five-Year Plan, human capital policy should be treated as the primary structural lever for reducing inequality, but its dynamic profile needs to be recognized: human-capital expansion can temporarily widen gaps before its long-run equalizing effect dominates. Therefore, education and training policies should be accompanied by targeted support for low-income and low-skilled groups (scholarships, remedial and vocational programs, and digital-skills training) to cushion short-run distributional pressures. At the same time, the inequality-raising long-run effects of trade openness and financial development indicate that future trade and financial reforms must be designed with an explicit distributional lens: trade policy should be complemented by active labor-market programs and regional support for lagging areas, while financial policy should shift from top-heavy deepening towards genuine financial inclusion, expanding credit and risk-management tools for SMEs, rural households, and human-capital investment. Although the governance indicator does not show a strong direct long-run effect in the estimates, the results are consistent with governance working through indirect channels—tax–benefit systems, social protection, intergovernmental transfers, and the regulation of finance—so strengthening these institutions is crucial to align openness and finance with an equality-enhancing human-capital strategy. Overall, the evidence points to a coordinated policy mix in which human-capital expansion, inclusive trade and finance, and supportive governance are jointly designed so that the long-run inequality-reducing role of human capital is not only identified, but also reinforced by China’s continued integration and financial development.

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