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Do globalization, foreign direct investment, and inflation drive income inequality? Evidence from Somalia within the Kuznets curve hypothesis

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ABSTRACT

Understanding the dynamics of income inequality in Somalia is essential for diagnosing the structural barriers that impede inclusive economic growth and development. Recognizing these disparities can lead to more effective policies that foster equitable and sustainable progress. Therefore, this study explores the determinants of income inequality in Somalia from 1990 to 2020, utilizing the Dickey-Fuller test for stationarity and the ARDL approach for analysis. The bounds-testing approach validated the long-run cointegration relationship between economic growth, globalization, foreign direct investment (FDI), institutional quality, unemployment, inflation, and income inequality. The findings indicate that GDP per capita initially increases income inequality, supporting the Kuznets curve hypothesis, but this effect diminishes as the economy matures. Globalization consistently exacerbates income inequality in the long- and short-run. Conversely, FDI and institutional quality are significantly linked to reductions in income inequality only in the short-run. Higher unemployment rates and inflation significantly increase income inequality in Somalia across both time frames. Robustness analysis via KRLS confirms the reliability of the ARDL outcomes. Furthermore, the Granger causality tests reveal bidirectional causality between GDP per capita and income inequality, as well as between globalization and income inequality. At the same time, FDI, institutional quality, unemployment, and inflation exhibit unidirectional influences. Drawing on these findings, the study suggests the adoption of inclusive growth frameworks, sustained investments in education and infrastructure, strategic trade and investment reforms, comprehensive employment programs, and prudent monetary policies to mitigate income inequality in Somalia.

1. Introduction

Income inequality has been a persistent feature of human societies, deeply intertwined with political, social, and economic structures. In recent decades, the forces of globalization have fundamentally reshaped the global economy, characterized by greater openness to international markets and substantial flows of foreign capital (Abdi, Warsame, et al., 2024). For instance, global foreign direct investment (FDI) inflows reached a record $1.8 trillion in 2021 (United Nations Conference on Trade and Development, 2022), while the global trade-to-GDP ratio rose from 39 % in 1990 to 58 % in 2021 (World Bank, 2023). These shifts have accelerated economic integration and growth across many regions. However, they have also exacerbated inequalities both within and between countries, which raises critical concerns about the distributional impacts of globalization and economic expansion. Despite overall gains in global wealth, the benefits have not been evenly distributed, which fuelled disparities that undermined social justice and inclusive development (Abounoori & Zivari Masoud, 2015). Globalization—understood as the increased interdependence of national economies through trade, investment, and financial integration—has thus become a double-edged phenomenon: fostering growth while simultaneously intensifying income inequality (Yusuf & Oluwaseun, 2022; Hui & Bhaumik, 2023a). Understanding the mechanisms through which globalization and economic growth influence income distribution is therefore essential for

Abbreviations: ARDL, Autoregressive Distributed Lag; CPI, Consumer Price Index; ECT, Error Correction Term; JB, Jarque-Bera (Normality Test); KRLS, Kernel-based Regularized Least Squares; LM Test, Lagrange Multiplier Test; OLS, Ordinary Least Squares; SSA, Sub-Saharan Africa; UNCTAD, United Nations Conference on Trade and Development; VIF, Variance Inflation Factor; WIID, World Income Inequality Database.

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devising strategies aimed at promoting equitable and sustainable development.

While economic growth is conventionally associated with improved living standards, many developing countries across Africa, Asia, and Latin America have experienced rising poverty and widening income disparities despite sustained economic expansion (Mohamed & Abdi, 2024). This paradox reflects the reality that growth alone does not guarantee broad-based prosperity. Without effective redistributive mechanisms, the gains from growth tend to accrue disproportionately to already affluent segments of society, thereby deepening socioeconomic divisions (Estes, 2019). Elevated levels of income inequality can undermine long-term economic performance by constraining aggregate demand, which limits investment in human capital, and fosters social instability (Arifin, 2024). However, the relationship between economic growth and income inequality is not uniformly negative. As posited by Kuznets (1955), the dynamic follows an inverted U-shaped trajectory, whereby inequality initially rises during the early stages of development and subsequently declines as societies reach higher levels of economic maturity. This framework, widely supported in empirical studies (Mdingi & Ho, 2021), suggests that the effects of growth on income distribution are contingent on structural transformations and policy interventions. Consequently, the global debate over economic inequality is increasingly centered not only on the pace of growth but also on its quality and inclusiveness.

FDI is often viewed as a major engine of economic development, which promotes capital formation, technology transfer, and employment generation (Magazzino and Mele, 2022). However, the entry of multinational corporations can exacerbate wage disparities within the host country. This is primarily because a substantial portion of the profits generated by these corporations is repatriated to their home countries rather than being reinvested locally (Indra, 2019). Additionally, the skill-intensive nature of FDI-driven employment opportunities tends to exclude large segments of the local population, particularly in developing economies where education and training systems remain underdeveloped (Borensztein et al., 1998). Moreover, trade openness plays a crucial role in influencing income inequality. Although trade openness can stimulate economic growth by expanding market access and enhancing efficiency, it often leads to uneven distributional outcomes. Advanced economies, characterized by superior technological capacity, diversified production bases, and robust institutions, are better positioned to capitalize on global trade than their developing counterparts (Abdi et al., 2023; Polpibulaya, 2015). Consequently, the terms of trade systematically favor developed countries, which further widens the gap between rich and poor nations. Nevertheless, under favorable conditions, FDI and trade openness can contribute to reducing income inequality by facilitating technology diffusion, expanding employment opportunities, and improving consumer welfare in developing economies (Abdi, Warsame, et al., 2024; Dollar & Kraay, 2004).

Inflation constitutes another critical channel through which income inequality is shaped, particularly in developing economies. By disproportionately eroding the real incomes of lower-income households, who allocate a larger share of their earnings to essential goods and services, inflation intensifies existing disparities (Abdi, Warsame, et al., 2024; Law & Soon, 2020). Furthermore, high inflation introduces macroeconomic instability, which discourages long-term investment and undermines prospects for sustained economic growth (Albanesi, 2007). These adverse effects are particularly pronounced in unstable countries, where economic vulnerabilities are compounded by weak institutional frameworks. In contrast, countries endowed with strong governance structures are better positioned to mitigate the distributional consequences of inflation through effective monetary policies and targeted social protection programs (Haini et al., 2023; Law & Soon, 2020). However, in sub-Saharan Africa (SSA), persistent institutional weaknesses—characterized by widespread corruption, political instability, and limited regulatory capacity—have severely constrained efforts to address income inequality and fully leverage the potential benefits of globalization (Adeleye, 2024). According to the United Nations Development Program (UNDP), 10 of the 19 most unequal countries globally are located in SSA. Therefore, strengthening governance frameworks and institutional resilience remains essential for promoting inclusive economic development and narrowing income gaps (Kunawotor et al., 2020).

Globalization, FDI, and inflation significantly shape income inequality dynamics across Africa and other developing economies. While globalization and rising FDI inflows have contributed to economic growth, they have also tended to exacerbate existing income disparities by disproportionately benefiting wealthier social segments with greater access to capital, education, and markets (Lustig, 2008; Mallick et al., 2020). As a result, the advantages of global economic integration often reinforce inequalities, particularly in politically unstable and institutionally weak environments. In Somalia, FDI has primarily flowed into sectors such as telecommunications and real estate, industries that are largely controlled by a small elite, further widening the income gap. Meanwhile, inflation has placed a disproportionate burden on lower-income households, who spend a larger share of their income on basic necessities and are thus more vulnerable to price increases (Abdi, Warsame, et al., 2024). Historical data further reflect the persistence of rising inequality in advanced economies. In the 1980s, the income of the richest 10 percent was approximately seven times higher than that of the poorest 10 percent (OECD, 2011), a ratio that has since expanded to nearly 9.5. Similarly, the Gini coefficient, which averaged 0.29 during the 1980s and rose to 0.32 by the late 2000s, has escalated to approximately 0.434 in recent years (Rodríguez, 2020). As shown in Fig. 1, Somalia's Gini Index remained relatively stable at around 45 through the early 2000s but rose sharply after 2010, reaching nearly 55 by 2015 and maintaining that level thereafter.

Although extensive research has explored the relationship between economic growth and income inequality, particularly through the framework of the Kuznets curve (Auza, 2021; Kapila, 2021; Mdingi & Ho, 2021; Wahiba & El Weriemmi, 2014), less attention has been given to the highly open but institutionally weak economies. Much of the existing literature centers on large emerging markets and developed countries, where relatively stable political and economic conditions prevail, thereby leaving limited countries under persistent institutional fragility and macroeconomic volatility. While empirical findings vary across contexts and methodologies (Khan & Nawaz, 2019; Kunawotor et al., 2020; Law & Soon, 2020; Mallick et al., 2020; Zandi et al., 2022), few studies have systematically assessed how external economic integration interacts with domestic structural vulnerabilities to influence inequality outcomes. Existing analyses often isolate single factors by overlooking the cumulative and reinforcing effects of multiple macroeconomic and institutional variables, particularly in settings where state capacity is weak and conflict exposure is high. Against this backdrop, this study addresses that gap by examining Somalia, a context marked by

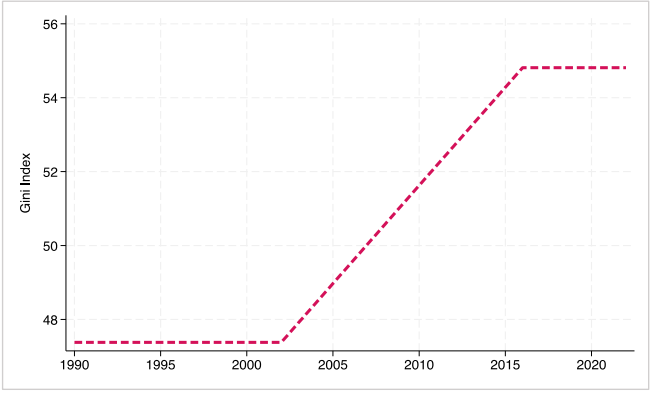

Fig. 1. Gini coefficient index.
Source: WIID (2024)

chronic political instability, weak institutional structures, and sustained exposure to external economic forces. To our knowledge, this is the first study to integrate ARDL, KRLS, and Granger causality in examining income inequality within the unique context of Somalia — a conflict-affected, low-income country. Using annual data from 1990 to 2020 and applying the ARDL bounds testing method, Kernel-based Regularized Least Squares (KRLS), and Granger causality analysis, this study seeks to provide reliable and actionable insights. The findings are expected to guide the development of strategies aimed at reducing income inequality and promoting inclusive economic growth in Somalia, thereby addressing gaps left by previous studies and adding valuable contributions to both the literature and policymakers.

The remainder of the study is organized as follows. The next section reviews related literature and empirical research. The third section details the data sources and econometric methodology used in the analysis. The fourth section presents the results and discusses the findings in relation to existing literature. The fifth section concludes the study and offers relevant policy recommendations.

2. Theoretical and empirical review

Over the past few decades, a substantial body of literature has examined the relationship between income inequality and a range of economic and structural factors, including economic growth, globalization, FDI, institutional quality, unemployment, and inflation. These studies, grounded in both theoretical and empirical frameworks, span different regions, time periods, and methodological approaches. The resulting findings are diverse, which reflects the complex nature of income inequality and its determinants. This section provides a joint theoretical and empirical review by outlining key concepts and summarizing recent evidence relevant to the study.

2.1. Theoretical background

The Kuznets hypothesis, first introduced by Kuznets (1955), posits an inverted U-shaped relationship between economic development and income inequality. According to this view, inequality tends to rise in the early stages of economic growth as industrialization concentrates wealth among a narrow segment of the population, particularly urban elites. Over time, however, income distribution becomes more equitable as economies diversify and mature, owing to structural shifts such as urbanization, expanded access to education, and the institutionalization of redistributive policies (Thomas, 2015). The hypothesis is grounded in the idea that economic growth alters the sectoral composition of employment and income. In its early phase, labour shifts from low-productivity agriculture—typically marked by relative income homogeneity—toward the industrial sector, where wage differentials are greater. This transition initially intensifies inequality. However, as industrialization advances, increased human capital investment, formal labour market expansion, and state capacity to implement inclusive policies are expected to reduce disparities (Melikhova & Čížek, 2014; Riveros et al., 2022). Recent theoretical extensions have tested and questioned the universality of the Kuznets curve. For instance, some studies suggest that the inverted U-shape may not hold uniformly across regions or development levels, with evidence of alternative patterns such as U-shaped or flattened curves due to institutional or policy factors (Huang et al., 2012; Oczki et al., 2017). Moreover, non-parametric approaches suggest that higher-degree polynomial forms may better capture the non-linear dynamics of inequality during development transitions (Mushinski, 2001).

Recent theoretical and empirical studies have integrated inflation, globalization, and FDI within the Kuznets framework to enhance our understanding of the dynamics of inequality, especially in developing states, by expanding upon this foundation. The unequal advantages enjoyed by highly skilled labor and capital owners, coupled with the marginalization of individuals lacking access to technology, markets, and education, can intensify inequality in low-income countries. This phenomenon is a consequence of globalization, marked by heightened openness to trade, capital flows, and integration into global markets (Couto, 2018; Hui & Bhaumik, 2023b; Rezk et al., 2022). Nevertheless, globalization may also mitigate inequality if it is accompanied by robust institutions that disseminate the benefits broadly, promotes labor-intensive exports, and enhances market efficiency (Pereira et al., 2020; Rodríguez, 2020).

In the same vein, FDI has the potential to both reduce and increase inequality. In the short-term, FDI may promote inclusive growth by transmitting technology, raising wages, and creating employment, particularly when directed toward labor-intensive sectors (Lipsey, 2007; Markusen & Venables, 1999). However, if FDI is concentrated in capital-intensive industries, if profits are repatriated, or if benefits are predominantly received by domestic elites, it can increase inequality in the long-term (Alfaro et al., 2004; Le et al., 2021b; Smarzynska Javorcik, 2004). Sectoral composition, education levels, and the robustness of institutional frameworks are the mediators of the impact of FDI on inequality (Alfaro et al., 2004; Smarzynska Javorcik, 2004). It is noteworthy that inflation can hurt income distribution by making it harder for low-income families to buy things since they usually hold cash and don't have investments that protect them from inflation. Richer groups, on the other hand, may gain from revaluing their assets. As a result, inflation is likely to be linked to more inequality, especially in places where the financial system is weak or where social support is limited (Albanesi, 2007; Erosa & Ventura, 2002).

2.2. Empirical review

2.2.1. Economic growth and income inequality

Research into the link between economic growth and income inequality uncovers a variety of complex findings across different contexts. Building on the Kuznets Curve foundation, Auza (2021) used the ARDL approach to analyze data from 1995 to 2017, finding that income inequality impacts economic growth through multiple channels, with significant explanatory power in measures focusing on average income changes. Dorofeev (2022) conducted a *meta*-analysis of data from 1980 to 2019, revealing a negative relationship between economic inequality and growth in 59 % of the literature. However, the author's research showed a positive correlation in 57.8 % of cases across 39 countries. In SSA, Kapila (2021) employed the GMM model to demonstrate a U-shaped relationship, where income inequality negatively affects growth through credit market imperfections but turns positive when the Gini coefficient exceeds 41. Meanwhile, Wahiba and El Weriemmi (2014) examined Tunisia using multiple regression analysis, concluding that economic growth and trade openness exacerbate income inequality, especially after accelerated trade liberalization, and income inequality negatively impacts growth.

Furthermore, Mdingi and Ho (2021) used various models to reveal that this relationship can be negative, positive, or inconclusive, depending on the model used. Similarly, Temerbulatova et al. (2022) employed bibliometric analysis, revealing that the impact of economic growth on income inequality remains a contentious topic, particularly in developing countries. In the context of Bangladesh, Islam and Azad (2024) found that while personal remittances help reduce income inequality, economic growth tends to increase it. Contrarily, Arifin (2024) conducted a *meta*-analysis using the random effects model and discovered a significant relationship between economic growth and income inequality, with a medium effect size, especially notable in low- and middle-income countries. Higher inequality often limits access to quality education and healthcare, crucial for human capital development and long-term productivity. Furthermore, Akinbode et al. (2019) examined the period from 1990 to 2017 using the panel ARDL model and Granger causality tests. They found that economic growth negatively affects income inequality in the long-run, supporting the Kuznets curve hypothesis.

2.2.2. Globalization and income inequality

Due to the level of the countries' economic development, research exploring the relationship between globalization and income inequality has produced a diverse array of findings in the past decade. For instance, Chowdhury et al. (2021) and Yusuf and Oluwaseun (2022) indicate that while globalization, mainly through exports, tends to widen the income gap, its effects can vary significantly depending on the economic context. Specifically, exports in Nigeria were found to exacerbate income inequality, whereas imports had a mitigating but insignificant impact. Similarly, Abounoori and Zivari Masoud (2015) found contrasting effects of globalization on income inequality in high-income versus upper-middle-income countries, with globalization reducing inequality in high-income countries and increasing it in upper-middle-income ones. Additionally, the role of intellectual property rights in these dynamics was noted, where their support increased inequality in high-income nations but decreased it in upper-middle-income countries. Dorn et al. (2018) further highlighted the importance of institutional contexts, showing that in transition economies like China, globalization significantly heightened income inequality, whereas in advanced economies, institutional frameworks seemed to buffer against such disparities. Lastly, Osode et al. (2020) demonstrated that globalization's impact on income inequality depends on the quality of institutions and the initial levels of inequality. Trade globalization was beneficial in reducing inequality in countries with robust institutions and low initial inequality but had the opposite effect in nations with high initial inequality.

A significant body of studies has explored the complex linkage between economic globalization and income inequality, revealing varied impacts across different countries and contexts. Hui and Bhaumik (2023a) utilized the fixed effects model to demonstrate that globalization reduces inequality in advanced economies while exacerbating it in less developed nations. Rodríguez (2020), using the pooled OLS method, discovered the complex nature of this relationship, noting that a country's development level is crucial in determining globalization's impact on inequality. Similarly, Licong et al. (2023) examined the impacts of economic globalization on income inequality across various countries. By employing *meta*-analysis and *meta*-regression on a large dataset, they found that economic globalization increases inequality in less developed countries but decreases it in more developed ones, with FDI playing a role in mitigating inequality. Auguste (2018), through an analysis of 23 industrial countries over 19 years using the OLS model, found that international trade increases pre-tax income inequality while immigration decreases it, with no significant post-tax impact of globalization indicators. Pereira et al. (2020) discovered that the speed of globalization adaptation negatively affects the Gini index, which suggests that the rate of globalization is more influential than its level. Finally, Springholz (2018) found that both trade and financial globalization contribute to rising income inequality through cross country panel regression analysis.

2.2.2.3. Foreign direct investment and income inequality. Studies on the influence of FDI on income inequality indicate that its effects differ significantly depending on the economic context and level of development. Gam et al. (2023), using data between 2008 and 2020 from 36 developing countries and employing the Bayesian approach, found a U-shaped relationship where FDI initially increases inequality but may reduce it as development progresses. They emphasized the roles of trade and migration as crucial channels influencing this relationship. Similarly, Couto and Center (2018) found that FDI exacerbates income inequality in middle-income countries but has less significant effects in low- and high-income nations. In Vietnam, Le et al. (2021b) used the general method of moments (GMM) to analyze provincial data between 2012 and 2018, revealing that FDI increases income inequality, with effects varying based on education levels and institutional quality. In Indonesia, Indra (2019) utilized the error correction model (ECM) to show that FDI significantly reduces income inequality in the short-run, advocating for policies to attract FDI and boost domestic wages. Conversely, Tsaurai (2020) examined transitional economies using the Bayesian approach, finding that the interaction between information and communication technology (ICT) and FDI had a non-significant effect on inequality by highlighting sectoral influences.

The impact of FDI on income inequality has been thoroughly investigated, revealing a range of effects depending on different economic conditions. Ihsan et al. (2023) utilized the generalized linear model (GLM) to explore how official development assistance, FDI, trade openness, and unemployment rates mitigate income inequality in selected Asian countries. The study advocates for the promotion of globalization, international ties, and stable economic and political environments to reduce income inequality. Conversely, Khan and Nawaz (2019) explored the relationship between trade, FDI, and income inequality in SSA using annual data from 1990 to 2016. Utilizing the system GMM estimator, their study found that trade and FDI significantly affect income inequality. Specifically, for trade, an inverted U-shaped relationship holds, consistent with trade theory. Ard (2015) examined FDI and income inequality within capitalist development contexts using fixed effects, random effects, and pooled OLS models with data from 2005 to 2015, concluding that FDI does not significantly reduce inequality in transitional economies, even with ICT considerations. Szilvasi (2019) focused on Ireland using the random effects model and suggested that FDI tends to increase income inequality, though results were not consistently significant. Rye (2016) used the fixed effects model to emphasize FDI's crucial role in the global financial structure and its substantial economic implications, noting that the surge in FDI inflows to developing countries has intensified debates on its influence on income inequality.

2.2.2.4. Unemployment and income inequality. Unemployment's impact on income inequality has been studied extensively by revealing complex and varied outcomes across different regions and methodologies. Anwar et al. (2017) employed the ARDL approach and discovered that increased development expenditure reduces poverty and unemployment but increases inequality due to capitalism. Gu (2023) identified GDP per capita as the primary driver of income inequality in the U.S., whereas high unemployment rates and inflation exacerbate inequality in Germany. In SSA, Gimba et al. (2024) used the quantile-on-quantile approach to find that unemployment negatively impacts income distribution in middle-income countries but has mixed effects in Burundi and Niger. Similarly, Zandi et al. (2022) demonstrated through the random effect model and GMM that corruption, inflation, and unemployment significantly increase income inequality in developing Asian countries. Conversely, Roberto et al. (2022) found no significant effect of unemployment on income inequality in the Philippines using the OLS model. Mot'ovská (2018) employed a vector error correction model to show that unemployment significantly contributes to income inequality in Namibia. In Spain, Prior Clavero (2021) found that unemployment and inflation negatively influence income inequality. Additionally, Castells-Quintana and Royuela (2012a) found a robust relationship between high unemployment rates and increased income inequality, particularly in urbanized regions. The authors argue that persistent unemployment exacerbates income disparities.

2.2.2.5. Inflation and income inequality. The relationship between inflation and income inequality has been thoroughly researched, showing different impacts depending on the methodology used. Walsh and Yu (2012) found that non-food inflation exacerbates income inequality in international samples and Chinese provinces, while food inflation's effect is mixed. Monnin (2014) identified a U-shaped relationship, where low inflation increases inequality, which decreases the inflation rate before rising again. Conversely, Siami-Namini and Hudson (2019) discovered a significant negative correlation between aggregated

inflation and income inequality, which indicates that higher inflation reduces inequality. Hu et al. (2021) highlighted that this relationship depends on global real interest rates and a country's technological growth. In the U.S., Dincer (2016) found that inflation increases income inequality over the long-run using panel cointegration techniques. Similarly, Maneethai (2021) showed that rising inflation in Thailand and Southeast Asia leads to greater inequality. Altunbaş and Thornton (2022) revealed that adopting an inflation targeting regime worsens household income inequality and reduces labor's GDP share. In Indonesia, Betty (2023) found a positive association between inflation and inequality, noting that inflation diminishes the purchasing power of the poor while benefiting the wealthy. Thalassinos et al. (2012) supported the hypothesis that inflation positively impacts income inequality across various countries. Similarly, Akçelik and Cömert (2017) observed that widening income gaps in Turkey negatively affect poor households, particularly through transportation inflation.

2.2.2.6. Institutional quality and income inequality. The literature examining the effects of institutional quality on income inequality reveals nonlinear dynamics, which vary by region, development level, and moderating factors. Several studies find that institutional quality exerts a threshold effect on inequality reduction. Law et al. (2014) and Madni and Anwar (2021) reveal that financial development only reduces inequality once a minimum institutional quality threshold is reached. This view is reinforced by Asamoah (2021), who finds a disproportionate influence of institutions on inequality in developing countries, particularly when institutional indicators cross higher thresholds. Others emphasize the moderating role of institutions in broader economic relationships. For example, Nam et al. (2024) and Goh and Law (2019) demonstrate that institutional quality moderates the impact of trade openness on inequality—stronger institutions mitigate the inequality-worsening effects of liberalization. Similarly, Huynh (2021) reported that FDI's impact on income inequality depends on the institutional environment, with better institutions offsetting adverse distributional outcomes. Adeleye (2024) provide comparative evidence from Latin America and SSA regions discovering that institutional quality enhances the equity-promoting effects of human capital and economic growth.

Evidence also points to nonmonotonic effects. Náplava (2020) finds that in post-Soviet countries, improvements in institutional quality initially increase inequality before eventually reducing it—a pattern aligned with the institutional Kuznets curve proposed by Kunieda and Takahashi (2022), where inequality first rises and then falls as institutions strengthen during economic development. In the African context, Kunawotor et al. (2020) report that only specific aspects of institutional quality—such as control of corruption and rule of law—are effective in reducing inequality, while other governance indicators have limited impact. The literature further explores sector-specific interactions. Kammas et al. (2023) argue that institutional quality mediates the relationship between inequality and public education expenditure, which influences redistributive outcomes. Drabo (2010) finds that the adverse effects of inequality on health status are significantly less severe in countries with stronger institutions. Likewise, Law and Soon (2020) indicate that institutional quality dampens the inflation-induced increase in inequality. In advanced countries, Josifidis et al. (2017) confirm a strong and significant negative link between institutional quality and income inequality. Finally, Wai Mun et al. (2022) suggest that recomposed measures of institutional quality—those integrating multiple governance aspects—are especially effective in alleviating extreme inequality.

Despite extensive research on the individual impacts of economic growth, globalization, FDI, institutional quality, unemployment, and inflation on income inequality, two key gaps remain. First, few studies examine how these variables interact collectively to shape inequality, especially in low-income economies with weak institutional capacity. Much of the existing literature isolates specific drivers, yet the joint effects of external integration and domestic structural constraints remain empirically underexplored. Second, there is a notable lack of country-specific evidence from conflict-affected settings such as Somalia, where the mechanisms driving inequality may differ markedly from those in more stable environments. By examining these drivers jointly within Somalia's particular economic and political situation, this study contributes to a clearer realization of how global and domestic forces intersect to influence income inequality. Moreover, it tests the Kuznets Curve hypothesis in a setting where structural transformation has been interrupted by conflict and institutional fragility. In doing so, the analysis extends current debates on inequality beyond the conventional focus on middle- and high-income countries. It also provides insights with relevance for similarly situated economies in Africa and beyond. Additionally, through the KRLS framework, this undertaking enables a novel depiction of pointwise marginal impacts by revealing how the effects of explanatory variables on income inequality vary across their distributions—an aspect often overlooked in conventional linear models.

4. Data collection and methodology

4.1. Data description

This study employs annual time series data from 1991 to 2020 to investigate the effects of economic growth, globalization, FDI, institutional quality, unemployment, and inflation on income inequality in Somalia. Understanding the underlying drivers of inequality is essential for addressing poverty, promoting inclusive development, and fostering long-term socio-economic stability (International Monetary Fund, 2022). Identifying these determinants enables policymakers to formulate more effective strategies for resource allocation and to align national policies with broader global development frameworks. Therefore, the dependent variable in this study is income inequality, while the independent variables include GDP per capita (economic growth), the KOF Globalization Index, FDI inflows (% of GDP), institutional quality, unemployment, and inflation. All data used are sourced from publicly available and internationally recognized databases to ensure transparency, consistency, and reliability. Income inequality data were obtained from the World Income Inequality Database (WIID). Economic growth and unemployment data were retrieved from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) (Mohamed & Abdi, 2024). Globalization is measured using the KOF Globalization Index, a comprehensive metric of a country's global integration (Dorn et al., 2018; Licong et al., 2023). FDI data were collected from the United Nations Conference on Trade and Development (UNCTAD) (Gam et al., 2023). Institutional quality was captured using the International Country Risk Guide (ICRG) indicators, specifically the measure of corruption in the political system, including aspects such as nepotism, patronage, and political-business linkages (Law & Soon, 2020). Inflation data were obtained from the Food Security and Nutrition Analysis Unit (FSNAU) (Abdi, Warsame, et al., 2024).

3.3. Model specification

To achieve the study's objectives, this paper employs the ARDL model developed by Pesaran et al. (2001a), which is particularly well-suited for analyzing both short- and long-run relationships among time series variables. The ARDL technique offers several methodological advantages. Firstly, it allows for the simultaneous estimation of short-term dynamics and long-run equilibrium, which enables a comprehensive understanding of the interaction between variables over time. Secondly, it is robust when applied to small sample sizes, which makes it particularly advantageous for studies constrained by limited time series observations (Abdi, Zaidi, et al., 2024; Mohamed, 2024). Thirdly, the ARDL bounds testing procedure accommodates regressors with

different orders of integration—specifically I(0), I(1), or a combination of both—without requiring pre-testing for unit root homogeneity, as long as none of the variables are I(2) (Pesaran et al., 2001a). This flexibility enhances its reliability over traditional cointegration techniques. Given the characteristics of our dataset and the objective to estimate both short- and long-run effects, the ARDL model is a robust and appropriate econometric strategy for this study (Islam & Azad, 2024). This versatility ensures accurate cointegration analysis regardless of the stationarity properties of the data. We delineate the model of the study as follows:

$$GINI = f(GDPPC) \tag{1}$$

where GINI represents income inequality. GDPPC is symbolic of economic growth. Considering the Kuznets (1955) hypothesis, Equation (2) is specified in this study to examine both linear and non-linear relationships between economic growth and income inequality.

$$GINI = f(GDPPC, GDPPCS) \tag{2}$$

where GDPPCS signifies GDPPC square. In equation (2), GDPPC is expected to be positive (GDPPC > 0), whereas GDPPC squared is negative (GDPPCS < 0). This suggests that the GINI coefficient, a measure of income inequality, depends on both GDPPC and its quadratic term. In accordance with the methodologies of Rodríguez (2020), Yusuf and Oluwaseun (2022), Law and Soon (2020), Gam et al. (2023), Couto, (2018), and Shahbaz (2010), we augmented our model by integrating additional relevant variables.

$$GINI = f(GDPPC, GDPPCS, GLO, FDI, IQ, UNE, CPI) \tag{3}$$

where GLO symbolizes globalization, FDI stands for foreign direct investment, IQ represents institutional quality, UNE signifies unemployment, and CPI denotes consumer prices. The expected signs of the explanatory variables in the model are theoretically informed and aligned with prior empirical findings. Economic growth is anticipated to increase income inequality in the early stages of development. At the same time, its squared term is expected to carry a negative coefficient, which captures a potential Kuznets-type inverted U-shaped relationship. Globalization is generally expected to exert upward pressure on income inequality, particularly in low-income or emerging economies, where the gains from global integration are often unevenly distributed across population groups. FDI is presumed to reduce income inequality by facilitating job creation, capital accumulation, and technology transfer, particularly in underserved or informal sectors. Moreover, institutional quality is expected to have a negative association with inequality, as stronger institutions promote the rule of law, equitable access to public services, and more inclusive policy frameworks. Unemployment is likely to increase inequality by restricting access to stable income, while inflation disproportionately affects low-income households by eroding their purchasing power, thereby further widening income disparities. To improve the statistical robustness of the estimations, all variables were transformed into their natural logarithms. This transformation helps to mitigate potential heteroskedasticity, reduce skewness, and normalize the distribution of the data. Moreover, it enables a more intuitive interpretation of the coefficients in elasticity form, reflecting percentage changes in the dependent variable in response to percentage changes in the explanatory variables (Gujarati, 2002; Mohamed & Abdi, 2024; Wooldridge, 2016). Equation (3) can be further elaborated as follows:

$$\begin{aligned} lnGINI_t = {} & \alpha_0 + \beta_1 lnGDPPC_t + \beta_2 lnGDPPCS_t + \beta_3 lnGLO_t + \beta_4 lnFDI_t \\ & + \beta_5 lnIQ_t + \beta_6 lnUNE_t + \beta_7 lnCPI_t + \varepsilon_t \end{aligned} \tag{4}$$

Building on Equation (4), the ARDL model that integrates both long-run and short-run dynamics can be articulated as follows:

$$\begin{aligned} \Delta lnGINI_t = {} & \alpha_0 + \beta_1 lnGINI_{t-1} + \beta_2 lnGDPPC_{t-1} + \beta_3 lnGDPPCS_{t-1} \\ & + \beta_4 lnGLO_{t-1} + \beta_5 lnFDI_{t-1} + \beta_6 lnIQ_{t-1} + \beta_7 lnUNE_{t-1} \\ & + \beta_8 lnCPI_{t-1} + \sum_{i=1}^{p} \phi_1 \Delta lnGINI_{t-i} + \sum_{i=1}^{p} \phi_2 \Delta lnGDPPC_{t-i} \\ & + \sum_{i=1}^{q} \phi_3 \Delta lnGDPPCS_{t-i} + \sum_{i=1}^{q} \phi_4 \Delta lnGLO_{t-i} + \sum_{i=1}^{q} \phi_5 \Delta lnFDI_{t-i} \\ & + \sum_{i=1}^{q} \phi_6 \Delta lnIQ_{t-i} + \sum_{i=1}^{q} \phi_7 \Delta lnUNE_{t-i} + \sum_{i=1}^{q} \phi_8 \Delta lnCPI_{t-i} \\ & + \eta ECT_{t-1} + \varepsilon_t \end{aligned} \tag{5}$$

where α_0 represents the constant term. The coefficients β_1 through β_8 represent the long-run parameters of the model, while ϕ_1 through ϕ_8 signify the short-run regressors. The variables p and q denote the optimal lag lengths of the dependent and independent variables, respectively. The symbol Δ indicates short-run variables, and η represents the coefficient of the error correction term (ECT). To ascertain the presence of long-run cointegration between the explained and explanatory variables, the F-statistic of the bounds test is employed to evaluate the null hypothesis $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8$, which posits that the sampled variables do not exhibit a long-run relationship. This is contrasted with the alternative hypothesis $H_a : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8$, suggesting that the variables share a long-run relationship. The bounds testing method utilizes the Wald test, assessed through F-statistics, to determine long-run cointegration among variables. If the F-statistic exceeds the upper critical bound, denoted as I(1), it confirms the presence of long-run cointegration. Conversely, if it falls below the lower critical bound, denoted as I(0), it suggests no cointegration. However, when the F-statistic value lies between these bounds I(0) and I(1), the results are inconclusive regarding the presence of cointegration (Pesaran et al., 2001b). This approach ensures a rigorous evaluation of the long-term relationships among the variables in the study.

5. Analytical outcomes and discussion

5.1. Summary statistics

The descriptive statistics and correlation matrix for the parameters are detailed in Table 1. Panel A of the table provides a comprehensive summary of the mean, standard deviation, maximum, minimum, and other pertinent statistics. According to the data, GDPPC squared has the highest mean value of 33.66 and the highest maximum value. In contrast, institutional quality exhibits the lowest mean value of −0.02, while FDI has the lowest minimum value. Additionally, GDPPC squared shows the highest variability, whereas unemployment has the lowest standard deviation. The Jarque-Bera test results reveal that, with the exception of the logs of globalization, institutional quality, and FDI, the data distributions are normal. The pairwise correlation results, presented in Panel B of Table 1, measure the degree to which two variables move together or apart. The analysis indicates that all variables, except for institutional quality and unemployment, demonstrate a positive correlation with income inequality. This suggests that increases in these variables are associated with increases in income inequality. Notably, institutional quality and unemployment demonstrate a negative correlation, which implies that higher institutional quality and lower unemployment rates are linked to reduced income inequality.

4.3. Unit root test

In time series modeling, it is crucial to test for unit root properties before conducting ARDL analysis to ensure unbiased results (Mohamed et al., 2025). This study first determines the integration order of variables using the Dickey-Fuller Min-t test. The null hypothesis posits the

Table 1
Descriptive result and correlation matrix.

Panel A: Descriptive results

	lnGINI	lnGDPPC	lnGDPPCS	lnGLO	lnFDI	lnIQ	lnUNE	lnCPI
Mean	3.918	5.793	33.661	3.271	2.547	−0.024	2.961	3.714
Maximum	4.004	6.346	40.267	3.416	3.360	1.386	2.992	4.844
Minimum	3.858	5.389	29.042	3.191	0.000	−0.693	2.935	2.130
Std. Dev.	0.060	0.319	3.754	0.078	0.642	0.345	0.015	0.946
Skewness	0.339	0.542	0.598	0.885	−2.011	1.782	0.221	−0.375
Kurtosis	1.442	1.999	2.042	2.227	9.031	10.902	2.401	1.627
Jarque-Bera	3.727	2.813	3.035	4.819	67.874	97.050	0.716	3.159
Probability	0.155	0.245	0.219	0.090	0.000	0.000	0.699	0.206
Observations	31	31	31	31	31	31	31	31

Panel B: Correlation matrix

lnGINI	1.000							
LnGDPPC	0.960	1.000						
lnGDPPCS	0.958	1.000	1.000					
lnGLO	0.847	0.905	0.910	1.000				
lnFDI	0.147	−0.006	−0.017	−0.130	1.000			
lnIQ	−0.534	−0.480	−0.487	−0.569	−0.015	1.000		
lnUNE	−0.605	−0.554	−0.549	−0.447	−0.042	0.212	1.000	
lnCPI	0.911	0.844	0.838	0.737	0.294	−0.548	−0.686	1.000

Table 2
Dickey-fuller min-t unit root test.

Innovative outlier			Additive outlier	
Variable	T-statistics	Break data	T-statistics	Break data
lnGINI	−5.115***	2002	−5.223***	2003
ΔlnGINI	−2.082	2016	−1.851	2012
lnGDPPC	−1.653	2014	−5.611***	2006
ΔlnGDPPC	−5.840***	2016	−6.249***	1994
lnGDPPCS	−1.801	2013	−5.669***	2006
ΔlnGDPPCS	−6.031***	2016	−5.814***	1994
lnGLO	−3.878	2013	−5.707***	2006
ΔlnGLO	−5.501***	2014	−5.701***	2014
lnFDI	−4.057	2018	−3.704	2004
ΔlnFDI	−12.824***	2018	−8.976***	2018
lnIQ	−10.623***	2018	−13.069***	2017
ΔlnIQ	−13.633***	2017	−8.352***	2017
lnUNE	−2.055	2000	−2.045	2000
ΔlnUNE	−14.396***	2019	−5.589***	2020
lnCPI	−2.882	1995	−2.525	1995
ΔlnCPI	−8.779***	2013	−4.990***	1997

Notes: Δ represents the first difference. The reported test statistics are based on an intercept-only model. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

presence of a unit root, indicating non-stationarity, while the alternative hypothesis suggests stationarity. The results, presented in Table 2, reveal that the variables exhibit varying levels of stationarity: some are integrated at level I(0), and others are stationary at first difference I(1). Importantly, none of the variables are stationary at the second-difference level I(2). Consequently, the study proceeds to estimate bounds test cointegration, which ensures the robustness and reliability of the subsequent ARDL analysis.

Table 3
F-bounds test.

F-statistics	significance level	critical values	
		$k = 7$	
		I(0)	I(1)
26.905	1 %	4.104	6.151
	5 %	2.875	4.445
	10 %	2.384	3.728

Notes: The Wald F-statistics are compared using the critical values provided by Narayan (2005). K represents the number of explanatory variables.

4.4. Bounds cointegration testing

The study employs the Krolzig and Hendry (2001) general-to-specific approach within the ARDL framework to identify the variables' integration order and determine the optimal lag length for the models. This method systematically removes variables with the highest p-values, addressing issues of serial correlation and model stability by ensuring that the error term becomes uncorrelated and the parameters stabilize. Due to the limited number of observations in our dataset, the analysis initially considered two lags but ultimately settled on one. The results of the bounds test, presented in Table 3, assess the long-run cointegration between income inequality and the regressors. The Wald F-statistic of 26.905 exceeds the upper bound critical values at the 5 % significance level (4.445), 1 % level (6.151), and 10 % level (3.728). Consequently, we reject the null hypothesis of no long-term cointegration among the variables. This finding supports the existence of a long-term cointegration relationship between income inequality and the examined regressors.

4.5. Long-run and short-run results

Following the validation of long-run relationships between the variables, we calculated long-run coefficients using the ARDL method. Table 4 demonstrates that, at the 1 % significance level, most explanatory variables significantly impact income inequality in Somalia, with the exceptions of institutional quality and FDI. Interestingly, GDP per capita has a dual effect: it positively influences income inequality, whereas GDP per capita squared has a negative impact, reflecting the Kuznets curve hypothesis in Somalia. Specifically, a 1 % increase in GDP

Table 4
Long run coefficients.

Variables	Coefficients	t-statistics
lnGDPPC	0.4215***	(3.8432)
lnGDPPCS	−0.0375***	(−3.8840)
lnGLO	0.0622***	(3.0486)
lnFDI	−0.0004	(−0.3928)
lnIQ	−0.0018	(−0.3964)
lnUNE	0.4175***	(2.9506)
lnCPI	0.0118***	(4.8119)
Constant	−2.5003***	(−5.4037)

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

per capita raises income inequality by 0.42 %. However, a 1 % increase in GDP per capita squared reduces it by 0.03 % in the long-run. This supports the idea that income inequality decreases as nations develop, implying that as Somalia's economy grows, income inequality may initially worsen but improve at higher levels of development. Conversely, globalization has a positive effect on long-run income inequality, with a 1 % increase in globalization leading to a 0.06 % rise in income inequality. This suggests that Somalia's integration into the global economy might exacerbate income disparities unless accompanied by policies that ensure equitable growth. In the long-run, unemployment exhibits a statistically significant and positive relationship with income inequality. Specifically, a 1 % increase in unemployment leads to a 0.41 % rise in income inequality, which affirms the importance of targeted employment policies to mitigate widening disparities. Similarly, inflation, measured through the CPI, significantly increases income inequality, with a 1 % rise in consumer prices associated with a 0.01 % increase in inequality. This suggests that price stability should be a priority in Somalia's economic policy to avoid exacerbating income disparities. Although the estimated long-run coefficients for FDI and institutional quality are negative, their effects are statistically insignificant.

On the other hand, the short-run outcomes of the study are demonstrated in Table 5. In the short-run, GDP per capita exhibits a large positive coefficient of 1.188, which indicates a significant increase in income inequality due to economic growth. Additionally, the previous year's GDP shows a significant positive effect with a coefficient of 0.617, further amplifying income inequality. In contrast, the squared GDP per capita has a significant negative coefficient of 0.099, while its lagged value has a coefficient of −0.054. This suggests that while initial economic growth increases income inequality, higher levels of GDP per capita eventually contribute to reducing it, consistent with the Kuznets curve hypothesis. Globalization also impacts income inequality in the short-run. A percentage change in the previous year's globalization increases income inequality by 0.077 % and 0.081 %, respectively. Both coefficients are significant, indicating that past globalization has a notable short-run effect on increasing income disparities in Somalia. FDI exhibits mixed results in the short-run. The coefficient for current FDI is −0.002 %, which suggests that a change in current FDI slightly reduces income inequality. Conversely, the previous year's FDI has a coefficient of 0.004 %, indicating that it increases income inequality. These findings suggest that the timing of FDI impacts income inequality differently, with immediate effects reducing inequality and lagged effects increasing it.

Furthermore, a 1 % change in the previous year's institutional quality reduces short-run income inequality by 0.025 %. This significant effect suggests that higher institutional quality can effectively mitigate income inequality in the short-run in Somalia. Moreover, unemployment exhibits mixed effects on income inequality in the short-run. The coefficient for current unemployment is 0.307 %, which indicates a significant increase in income inequality. In contrast, changes in the previous year's unemployment reduces income inequality, with a 1 % change in lagged unemployment significantly decreasing income inequality by 0.305 %. These mixed results suggest that while the immediate effect of rising unemployment exacerbates income inequality, labor market adjustments over time may alleviate this impact. Inflation also plays a crucial role in the short-run. The coefficient for the lagged value of the CPI is 0.009 %, which indicates that a 1 % change in CPI in the previous period significantly increases income inequality by approximately 0.009 %. Finally, the ECT has a negative and statistically significant coefficient of 0.0014 %, demonstrating a significant adjustment toward long-term equilibrium when deviations occur. The adjusted R^2 value of 0.911 suggests that the model explains approximately 91.1 % of the variance in income inequality in the short-run.

Table 5
Short-run coefficients.

Variable	Coefficient	t-statistics
$\Delta lnGINI_{t-1}$	0.7607***	(5.6349)
$\Delta lnGINI_{t-2}$	0.4452**	(2.9488)
ΔlnGDPPC	1.1884***	(5.1337)
$\Delta lnGDPPC_{t-2}$	0.6180***	(0.0001)
ΔlnGDPPCS	−0.0999***	(−5.1142)
$\Delta lnGDPPCS_{t-2}$	−0.0543***	(−5.3903)
$\Delta lnGLO_{t-1}$	0.0770**	(2.9638)
$\Delta lnGLO_{t-2}$	0.0813***	(3.8212)
ΔlnFDI	−0.0024**	(−2.9848)
$\Delta lnFDI_{t-2}$	0.0048***	(4.6260)
$\Delta lnIQ_{t-2}$	−0.0259***	(−4.7800)
ΔlnUNE	0.3072***	(3.8953)
$\Delta lnUNE_{t-1}$	−0.3056***	(−4.3688)
$\Delta lnCPI_{t-1}$	0.0088***	(3.3766)
ECT_{t-1}	−0.0010***	(−3.6186)
Adjusted R^2	0.911	

Note: ***, **, and * denote significance at the 1 %, 5 %, and 10 % levels, respectively. Parenthesis-enclosed numbers represent the t-statistic.

4.6. Kernel regularized least squares (KRLS)

The sensitivity test results using the KRLS approach provide crucial insights into how various economic indicators affect income inequality. The ARDL bound test is limited by its assumption that the marginal effects of variables remain consistent over time. To address this limitation and account for the varying effects among the sampled parameters, the KRLS machine learning techniques presented in Table 6, as developed by Hainmueller and Hazlett (2014), were implemented. Examining GDP per capita, the mean pointwise marginal effects reveal a notable increase in income inequality, particularly pronounced in the higher quantiles of the income distribution, which is statistically significant at the 1 % threshold. The influence of GDP per capita squared on income inequality in Somalia presents a complex picture. The mean pointwise marginal effects indicate that it exacerbates income inequality in the upper quantiles but reduces it in the lower quantiles, which is significant at the 1 % level. The analysis shows that the mean pointwise marginal effects of globalization have differing impacts on income inequality across quantiles. In the upper quantiles, a rise in globalization tends to heighten income inequality, while in the lower quantiles, it seems to mitigate it. However, these effects lack statistical significance.

Additionally, FDI shows no significant effect on income inequality. Its impact is minimal and varies slightly across quantiles, but overall, it does not significantly alter income inequality. In Somalia, the mean pointwise marginal effects of increased institutional quality consistently demonstrate a reduction in income inequality across all quantiles, which is significant at the 1 % level. Furthermore, the analysis finds that unemployment has a mixed impact on income inequality. In the lower quantiles, higher unemployment reduces income inequality, while in the upper quantiles, it exacerbates it. This effect is highly significant at the 1 % level. In contrast, inflation consistently increases income inequality across all quantiles, which suggests that higher consumer prices lead to greater income disparity in Somalia. Fig. 3 depicts the pointwise marginal effects of multiple determinants on income inequality in Somalia, employing the KRLS methodology to effectively capture both long-term and short-term impacts. On the other hand, the diagnostic statistics reveal a robust model fit, with an R^2 value of 0.9972, indicating that 99.72 % of the variance in income inequality is explained by the model. Other diagnostic measures, such as lambda, tolerance, sigma, effective degrees of freedom, and Looloss, further support the model's reliability.

4.7. Granger causality test

We applied the Granger causality test to investigate causal relationships among the variables, as detailed in Table 7. The analysis uncovered significant findings, revealing bidirectional causality between GDP per capita, GDP per capita squared, globalization, and

Table 6
Individual point derivatives using KRLS.

lnGINI	Avg.	SE	t-statistic	p-value	P-25	P-50	P-75
lnGDPPC	0.0290	0.0030	9.8140	0.0000	−0.0060	0.0130	0.0760
lnGDPPCS	0.0020	0.0000	10.1660	0.0000	−0.0010	0.0010	0.0060
lnGLO	0.0040	0.0170	−0.2440	0.8100	−0.0980	−0.0260	0.1100
lnFDI	0.0010	0.0020	−0.6410	0.5280	−0.0070	0.0000	0.0060
lnIQ	0.0120	0.0020	−5.6450	0.0000	−0.0210	−0.0200	−0.0130
lnUNE	0.3920	0.0960	−4.0910	0.0000	−0.9760	−0.6560	0.0990
lnCPI	0.0080	0.0020	4.9220	0.0000	0.0000	0.0040	0.0170
Diagnostics							
Lambda	0.0567						
Tolerance	0.01						
Sigma	7						
Eff. Df	16.31						
R^2	0.9972						
Looloss	0.1418						
Obs	31						

Table 7
Pairwise granger causality tests.

Null hypothesis:	F-Statistic	Prob.	Direction
lnGDPPC ≠ lnGINI	4.8400	0.0365	Bidirectional
lnGINI ≠ lnGDPPC	14.2807	0.0008	
lnGDPPCS ≠ lnGINI	6.6367	0.0158	Bidirectional
lnGINI ≠ lnGDPPCS	14.7851	0.0007	
lnGLO ≠ lnGINI	4.0303	0.0548	Bidirectional
lnGINI ≠ lnGLO	4.7223	0.0387	
lnFDI ≠ lnGINI	10.2694	0.0035	Unidirectional
lnGINI ≠ lnFDI	0.0489	0.8266	
LNIQ ≠ lnGINI	0.3113	0.5815	Unidirectional
lnGINI ≠ lnIQ	9.3254	0.0050	
lnUNE ≠ lnGINI	5.3424	0.0287	Unidirectional
lnGINI ≠ lnUNE	0.9455	0.3395	
lnCPI ≠ lnGINI	38.6534	0.0000	Unidirectional
lnGINI ≠ lnCPI	0.4499	0.5081	

Notes: ≠ demonstrates that A does not Granger cause B.

income inequality. However, institutional quality, unemployment, inflation, and FDI each exhibit a unidirectional causality with income inequality. Specifically, there is a reciprocal relationship where changes in GDP per capita significantly influence income inequality and vice versa. This indicates that economic growth and income distribution are interdependent. Similarly, the non-linear effects of economic growth (captured by squared GDP per capita) have a two-way causal linkage with income distribution. Moreover, globalization has a bidirectional causal association with income inequality. Additionally, while changes in FDI significantly cause income inequality, the reverse is not true. This implies that FDI influences income distribution through mechanisms such as job creation and technology transfer. Income inequality unidirectionally affects the quality of institutions, possibly through social and political pressures for reforms, although the quality of institutions does not significantly impact income inequality. Higher unemployment rates have a unidirectional causal effect on income inequality, while the reverse relationship is insignificant. This indicates that unemployment reduces household incomes and increases poverty levels. Lastly, inflation significantly causes income inequality by eroding purchasing power and disproportionately affecting lower-income households, with no significant reverse causality.

Table 8
Diagnostic tests.

Test	Type	Statistics
Normality	JB Test	0.5611 (−0.755)
Heteroskedasticity	BPG test	−11.537 (−0.566)
Serial Correlation	LM test	2.1473 (−0.143)

Note: Values in the (…) represent the p-values.

4.8. Diagnostic tests

To ensure the robustness and reliability of the estimated results, several diagnostic tests were conducted, including measures for serial correlation, normality, and heteroskedasticity. The outcomes of these diagnostic tests are reported in Table 8. Detecting serial correlation was crucial as the variable is correlated with itself over different time intervals. Serial correlation can lead to inefficient estimates and compromise the validity of statistical tests. Identifying and addressing serial correlation enhanced the precision and reliability of the estimates. Moreover, normality tests were performed to check for deviations from the normal distribution, which could indicate the presence of outliers or an inappropriate functional form. Ensuring normality is vital for the validity of inferential statistics and hypothesis testing. Additionally, heteroskedasticity, or the presence of non-constant variance in error terms, can result in incorrect standard errors and inefficient estimates. The confirmation of homoscedasticity ensured that the variance of the errors was constant, leading to more reliable and accurate results.

Furthermore, the CUSUM (cumulative sum) and CUSUM square tests were utilized to evaluate the stability of the model over time. The CUSUM test detects systematic changes in the model parameters, while the CUSUM square test identifies changes in the variance of the error terms. These tests are particularly useful in time series analysis, where parameter stability is crucial for making reliable predictions and inferences. The results of these tests, illustrated in Fig. 2, demonstrate that the model parameters remain stable throughout the observed period. To assess the presence of multicollinearity among the explanatory variables, the Variance Inflation Factor (VIF) was examined. The results indicate that all centered VIF values fall below the conventional threshold of 10, with the exception of GDP per capita, which recorded a VIF of approximately 10.21. While this value marginally exceeds the commonly accepted cut-off, it is not deemed severe enough to compromise the reliability of the model, particularly given the theoretical relevance of economic growth in the analysis of income inequality. All other explanatory variables—including globalization, institutional quality, foreign direct investment, and consumer prices—exhibited centered VIF values well below the critical level, suggesting no multicollinearity concerns (Gujarati, 2002; Kutner et al., 2005). These results reinforce the robustness of the regression estimates and confirm that multicollinearity is not a significant issue. Full results of the VIF analysis are presented in Table 9. The analysis of the study was conducted using Eviews 12 and Stata 18.

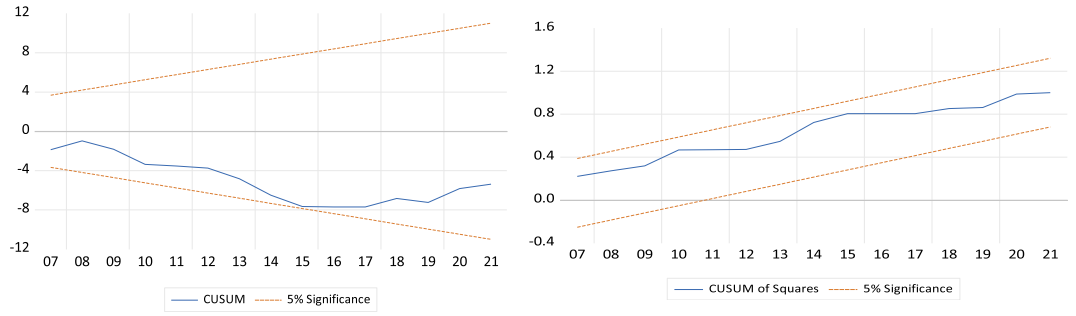

Fig. 2. Model stability using CUSUM test and CUSUM of squares test.

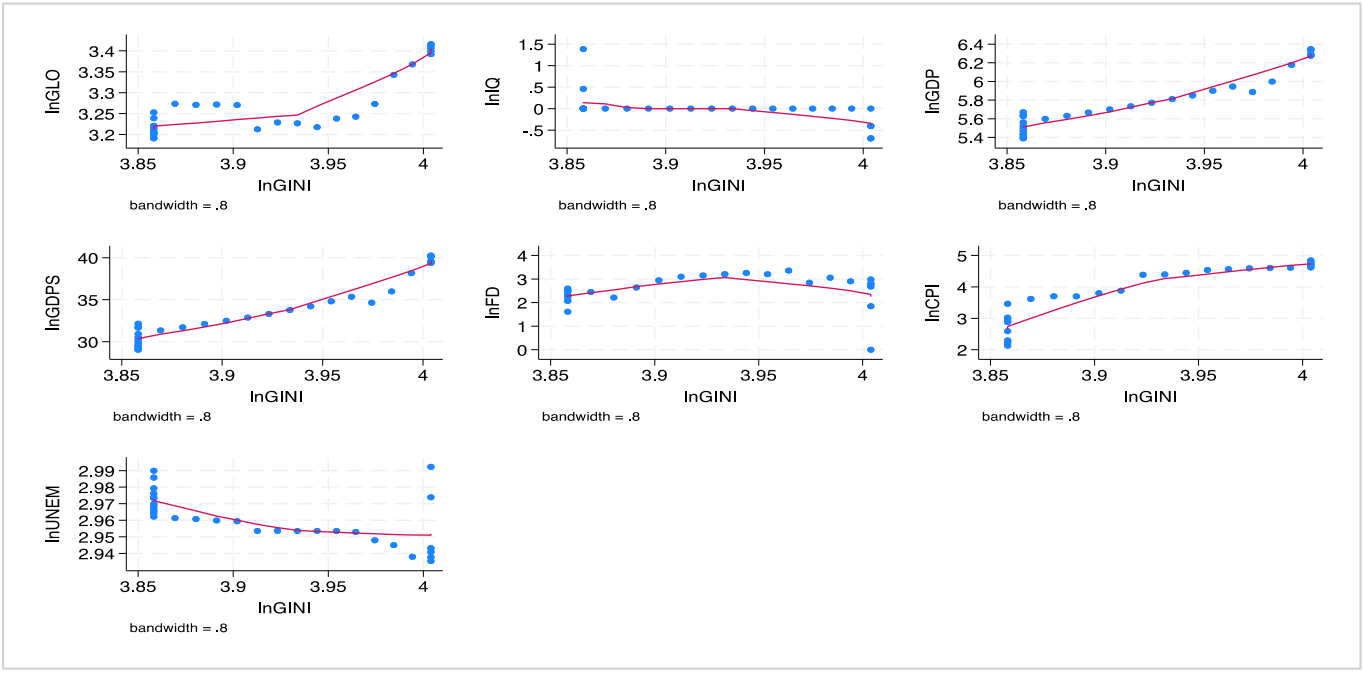

Fig. 3. Depiction of the pointwise marginal impact of the explanatory variables on income inequality.

Table 9
Variance inflation factor (VIF) results.

Variable	Centered VIF
lnGDPPC	10.21298
lnGLO	7.171247
lnIQ	1.751121
lnFDI	1.583492
lnCPI	5.815250

4.9. Discussion of the findings

The results of this study confirm the presence of the Kuznets curve in Somalia, consistent with the theoretical framework proposed by Kuznets (1955) and supported by empirical findings from Wahiba (2014) and Mdingi and Ho (2021). This inverted U-shaped relationship suggests that income inequality initially rises during the early stages of economic development, as gains from growth are unevenly distributed due to disparities in access to education, capital, and employment opportunities. However, as the economy matures, investments in human capital, the expansion of social protection systems, and the implementation of redistributive policies may begin to narrow the income gap. In Somalia's context, this pattern implies that sustained economic development—coupled with institutional strengthening and inclusive policy measures—can play a pivotal role in reducing inequality over time. Similar Kuznets-type dynamics have been observed in other low-income and developing economies. For instance, Islam & Azad (2024) found that Bangladesh's income inequality increased during its initial development phases. Nevertheless, the disparities began to diminish as human capital investments increased. Similarly, Nigeria's inequality increased during periods of economic liberalization(Chowdhury et al., 2021), underscoring the necessity of redistributive interventions in conjunction with growth-oriented policies.

The findings reveal that globalization has a statistically significant and positive long-run effect on income inequality in Somalia. This outcome is consistent with previous studies (Auguste, 2018; Dorn et al., 2018; Yusuf & Oluwaseun, 2022; Rodríguez, 2020), which argue that the adverse impact of globalization on inequality arises from its uneven benefits across socio-economic groups. In Somalia's context, globalization may disproportionately favor individuals and firms with greater access to education, technology, and capital, thereby widening the income gap. The lower-income population often lacks the skills and infrastructure needed to engage in global markets, whicu leads to an unequal distribution of gains. While globalization may have long-term potential for integration and opportunity, its benefits in fragile economies tend to be captured by elites. This result is similar to what happened in the Democratic Republic of the Congo, where growth caused by globalization was mostly in the mining industries and didn't

help most people (Denisova & Kostelyanets, 2019). Also, in Nigeria, the link between globalization and inequality is greatly affected by poor institutional quality and unorganized work (Yusuf & Oluwaseun, 2022). These cases show again that how globalization affects different groups depends on how well countries can absorb it and how they run their governments. Conversely, Pereira et al. (2020) found that a rapid pace of globalization could reduce inequality, as faster integration might enhance market access, expand employment, and stimulate inclusive growth—effects that depend heavily on the institutional and structural readiness of the economy.

Regarding FDI, the long-run effect is statistically insignificant, which suggests limited structural influence on inequality in Somalia over time. However, in the short-run, FDI significantly reduces income inequality. This short-term impact may operate through channels such as job creation, wage enhancement, and the transfer of managerial and technical skills to local workers. FDI inflows can also boost productivity in underdeveloped sectors, increase access to formal employment, and improve connectivity with international markets—benefits that tend to reach lower-income groups more directly in the initial stages. These findings align with Ihsan et al. (2023) and Indra (2019), who also observed a short-run inequality-reducing effect of FDI in developing economies. For example, in Vietnam, (Le et al., 2021a) Le et al. (2021b) discovered that FDI considerably decreased inequality in provinces with higher education levels and institutional governance—factors that Somalia now lacks, which may explain why FDI's influence is insignificant in the long term. However, the persistence of such benefits depends on domestic absorptive capacity, labor market inclusivity, and the reinvestment of FDI-generated gains within the host economy.

Institutional quality is found to be statistically insignificant in the long-run. However, in the short-run, institutional quality exerts a significant negative effect on inequality in Somalia, which indicates that stronger institutions contribute to more equitable economic outcomes in the near term. This effect may operate through several channels, including enhanced rule of law, reduced corruption, improved regulatory quality, and more equitable access to public services and opportunities. Institutions that ensure transparency, accountability, and effective redistribution can help reduce the structural barriers that perpetuate inequality. These findings are consistent with Osode et al. (2020), who note that institutional impacts may emerge more prominently in the short-term, particularly in settings marked by chronic inequality and weak state capacity. In Somalia's context, this indicates the importance of immediate governance reforms aimed at improving institutional effectiveness as a mechanism to reduce inequality and support inclusive development.

Consistent with the findings of Gu (2023) and Zandi et al. (2022), this study identifies a significant positive association between unemployment and income inequality in Somalia. This relationship is primarily driven by the loss of income and restricted access to economic opportunities among the unemployed, which disproportionately affects low-income households. High unemployment contributes to an uneven distribution of resources and limits upward mobility, which reinforces structural inequality within the labor market. Moreover, prolonged joblessness can erode human capital, diminish household resilience, and increase dependency on informal or precarious employment, all of which exacerbate income disparities. In low-income economies such as Somalia, where labor markets are already constrained and social protection mechanisms are limited, these dynamics are particularly pronounced. To tackle the adverse effects of unemployment, targeted employment policies and labor market reforms that expand decent work opportunities can serve as a central strategy for reducing inequality. Castells-Quintana and Royuela (2012b) have identified a strong connection between urban joblessness and entrenched income disparities in sub-Saharan countries such as South Africa and Namibia. This is particularly relevant. The significance of implementing coordinated employment policies at the regional level is underscored by these similarities in labor market challenges.

The positive association between inflation and income inequality observed in this study is consistent with Altunbaş and Thornton (2022), Betty (2023), and Thalassinos et al. (2012). Inflation disproportionately affects lower-income households by eroding their purchasing power, particularly as they spend a greater share of their income on basic necessities such as food, housing, and transportation (Lustig, 2008). As prices rise, the real income of these households declines, while wealthier individuals—who are more likely to hold assets that appreciate with inflation—are less adversely affected. This asymmetry exacerbates income disparities. In addition, inflation can weaken savings, disrupt consumption patterns, and reduce access to essential goods and services for vulnerable populations. Empirical studies by Dincer (2016) and Maneethai (2021) further support the inflation-inequality nexus across diverse economic contexts. In the case of Somalia, where food price volatility and weak monetary institutions are prevalent, these effects are magnified. This indicates that inflation-targeting policies are crucial to safeguard real incomes and mitigate distributional imbalances.

6. Summary and policy suggestions

Investigating income inequality in Somalia is essential to recognize the socio-economic disparities that hinder inclusive growth and development. Addressing these disparities can lead to more effective policies that promote equitable economic progress. Understanding the determinants of income inequality helps identify key factors that need to be managed to reduce poverty and enhance social stability. Hence, the study aims to explore the determinants of income inequality in Somalia from 1990 to 2020. The research uses Dickey-Fuller test to assess stationarity. Some variables are stationary at level I(0), others at first difference I(1), making the ARDL approach suitable for analysis. The study presents a comprehensive analysis of the impacts of various economic factors on income inequality in Somalia. Initially, as GDP per capita increases, income inequality also rises, reflecting the positive influence of economic growth on income disparities. However, as the economy continues to develop and GDP per capita reaches higher levels, income inequality begins to decrease. This pattern supports the Kuznets curve hypothesis, suggesting that Somalia, as its economy grows, may experience a phase where income inequality rises before it starts to decline. Globalization consistently increases income inequality in both the long-run and the short-run.

In addition, FDI and institutional quality exhibit interesting dynamics. In the short-run, these factors are associated with a decrease in income inequality, although these effects are not statistically significant in the long-run. Higher unemployment rates significantly increase income inequality in both the long-run and short-run by reducing household incomes and increasing poverty levels. Inflation also worsens income inequality across both time frames, as rising prices disproportionately affect lower-income households, eroding their purchasing power and increasing income disparities. Finally, the ECT is negative and statistically significant, indicating a significant adjustment toward long-term equilibrium when deviations occur. The model successfully clears diagnostic tests, indicating the absence of notable issues such as autocorrelation, heteroskedasticity, or non-normality. Stability of model parameters over time is affirmed by CUSUM and CUSUM square tests. In addition, sensitivity analysis via KRLS confirms robustness under the ARDL framework. Moreover, Granger causality tests reveal bidirectional causality between GDP per capita and income inequality, as well as globalization and income inequality. Moreover, FDI, institutional quality, unemployment, and inflation have unidirectional influence income inequality.

Based on the empirical findings of this study, several policy directions emerge for addressing income inequality in Somalia. The presence of a Kuznets-type relationship suggests that inequality initially rises with economic growth but eventually declines as development progresses. Accordingly, policies should prioritize inclusive growth strategies that ensure the broad-based distribution of gains, particularly

through support for sectors with high employment potential and integration of marginalized populations into the formal economy. The persistent inequality-worsening effect of globalization suggests the need for interventions that broaden access to global opportunities, enhance domestic productive capacity, and mitigate the adverse effects on vulnerable groups through targeted adjustment mechanisms. While the long-run impact of foreign direct investment is statistically insignificant, its short-run inequality-reducing effect indicates the potential benefits of attracting investment that generates employment, promotes technology diffusion, and strengthens linkages with local enterprises. Similarly, the short-term role of institutional quality in reducing inequality demonstrates the importance of governance reforms that enhance transparency, accountability, and equitable access to public resources. Finally, the significant and adverse effects of both unemployment and inflation on income distribution call for coordinated labor market and macroeconomic policies—focused on job creation, particularly for youth and low-skilled workers, and maintaining price stability to protect the purchasing power of low-income households. These measures, if properly designed and implemented, could contribute meaningfully to reducing income disparities and fostering a more equitable development pathway in Somalia.

While this study provides important insights into the determinants of income inequality in Somalia, it has several limitations. The analysis was constrained by the availability of consistent time series data, which limited the sample period to 1991–2020. As a result, more recent developments—particularly those influenced by post-2020 global shocks—could not be captured. In addition, the model excludes several variables that are known to influence income inequality, such as education, trade openness, population growth, and government expenditure, primarily due to data limitations and concerns about model robustness. Notably, the exclusion of education and trade openness—both key structural drivers—may restrict the explanatory depth of the study. Future research should seek to incorporate these variables as more reliable and extended data become available, and consider alternative estimation techniques that can accommodate a broader set of determinants. Further exploration of interaction effects and nonlinear dynamics may also provide better understanding of the structural mechanisms underpinning inequality in developing economies like Somalia.

CRediT authorship contribution statement

Abdikafi Hassan Abdi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Abdisalan Aden Mohamed:** Validation, Software, Methodology, Investigation, Formal analysis. **Abdinur Ali Mohamed:** Writing – review & editing, Validation. **Abdullahi Abukar Mohamed:** Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The datasets employed in this study are accessible via the following links:

KOF Globalization Database: https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

WIID Database: https://www.wider.unu.edu/project/wiid-world-income-inequality-database

SESRIC Database: https://oicstat.sesric.org/

UNCTAD Database: https://unctadstat.unctad.org/datacentre/

ICRG Database: https://epub.prsgroup.com/products/icrg-historical-data

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