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Evaluating the impact of imports, gross capital formation, and population growth on Somalia's gross domestic product: an empirical analysis

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Abstract

This study empirically examines the impact of import dependence, gross capital formation, and population growth on Somalia's gross domestic product (GDP) from 1991 to 2023—a period encompassing state collapse, prolonged conflict, and early economic recovery. The Autoregressive Distributed Lag (ARDL) bounds testing approach is employed to examine the long-run and short-run relationships among GDP, imports of goods and services, gross capital formation, and population growth. The results confirm a stable long-run cointegrating relationship. Imports have a positive and statistically significant effect on GDP in both the long run and the short run, indicating that imports currently function as essential enablers of economic activity, given Somalia's devastated domestic productive capacity. Gross capital formation also contributes positively to GDP, although the borderline significance reflects chronically low investment levels, which are consistently below 15% of GDP. Population growth has a positive and significant effect on aggregate GDP. The error correction term indicates that 35% of any disequilibrium is corrected within one year, reflecting the resilience of Somalia's informal economy. The study concludes that Somalia's import dependence reflects structural underdevelopment—not simple policy failure—and that increasing domestic investment, improving institutional quality, and building productive capacity are essential for long-term economic transformation. These findings provide the first econometric evidence on growth dynamics in a fragile, post-conflict Somali context and offer critical policy insights for trade, investment, and demographic planning.

1. Introduction

Somalia's economy operates within a unique post-conflict paradigm that fundamentally distinguishes it from conventional developing economies analyzed in standard growth models. The prolonged period of statelessness (1991–2012) and subsequent fragile institutional recovery create a critical divergence from the assumptions underlying neoclassical and endogenous growth theories, which presuppose functioning institutions, enforceable property rights, and stable governance (Acemoglu & Robinson, 2013). This institutional vacuum is not merely a background characteristic but a primary determinant shaping all economic activity and the efficacy of traditional growth drivers, including trade and investment.

Following the collapse of its central government in 1991, Somalia's domestic productive capacity was severely undermined. Decades of conflict destroyed infrastructure and industries, leaving the country heavily reliant on imports to meet basic needs (Mahmud, 2021). Recent analyses characterize Somalia's economy as "import-dependent," with growth driven mainly by consumption rather than local production (Abdulle et al., 2025). Crucially, Somalia's import-to-GDP ratio has consistently exceeded 60% in recent years—one of the highest in sub-Saharan Africa (Nor et al., 2025). Agricultural imports have risen roughly 18-fold since the late 1980s, while local crop production meets only about 22% of cereal needs (Abdullahi & Arısoy, 2022). This structural reliance on foreign goods raises a pressing policy puzzle: Should Somalia pursue import substitution or maintain trade openness? Understanding how import dependence has impacted Somalia's gross domestic product over time is essential to answering this question. While the individual roles of exports (Ali et al., 2018) and remittances (Mohamed, 2021) on growth have been studied in Somalia, a significant gap exists in the literature. No prior study has econometrically estimated the long-run impact of import dependence, gross capital formation, and population growth on GDP using post-1991 time-series data. This omission is critical, as imports, investment, and demographics do not operate in isolation but interact within Somalia's unique economic ecosystem.

To contextualize the empirical analysis, it is useful to note the trends of the key variables over the study period (1991–2023). Somalia’s economy, while recovering from the collapse of its central government in 1991, has experienced volatile growth. Gross capital formation—a proxy for investment in infrastructure and productive capacity—has remained weak and inconsistent, reflecting the destruction of domestic industries and the persistent insecurity that discourages long-term investment. Population growth has been rapid, driven by high fertility rates and the return of diaspora members, placing increasing pressure on limited domestic resources and infrastructure. In contrast, imports have risen substantially over the period, filling the void left by the collapse of local production and serving as the primary means of meeting basic consumption and capital goods needs. The relationship among these three variables—imports, gross capital formation, and population growth—and their combined effect on Somalia's gross domestic product (GDP) is empirically examined in the sections that follow. Summary statistics and trend patterns for each variable are presented in Table 1.

Table 1
Summary of economic trends in Somalia (1991–2023)

Variable	Early period (1991–2000)	Later period (2001–2023)	Overall trend & characterization
Imports (IMP)	Extremely high as a % of GDP due to collapsed domestic production, driven by food, fuel, and basic consumer goods.	Continued dominance; imports far exceed exports and remain the primary source of consumption and capital goods.	Persistent & Overwhelming: Structurally entrenched, reflecting the long-term erosion of domestic productive capacity.
Gross Capital Formation (GCF)	Very low and erratic; investment in infrastructure and industry is nearly absent due to state collapse and conflict.	Modest but uneven recovery; some investment in construction, telecoms, and ports, but still far below pre-1991 levels.	Weak & Inconsistent: Insufficient to drive sustained industrialization or productive capacity expansion.
Population Growth (POP)	High and steady growth, driven by high fertility and early diaspora returns; low baseline population.	Continued rapid growth; increasing pressure on urban infrastructure, basic services, and import demand.	Sustained & Accelerating: A long-term structural factor shaping labor supply, consumption, and import dependency.
Gross Domestic Product (GDP)	Highly volatile, with sharp contractions during the civil war; virtually no formal economic data for several years.	Gradual, low-growth recovery with periodic shocks (drought, pandemic); GDP per capita remains low despite aggregate growth.	Fragile & Slow Recovery: Positive but unstable, heavily reliant on imports and remittances rather than productive investment.

Source 1: Authors’ characterization based on World Bank, SESRIC, and FRED data (1991–2023).

Many studies have explored the roles of remittances, foreign investment, and exports in developing economies; few have systematically examined the combined effects of imports, gross capital formation, and population growth on gross domestic product in a context as complex as Somalia's. This study aims to fill that gap. Somalia's story is unique: an economy heavily reliant on imports to meet basic consumption and capital needs, operating with fragile institutions and chronically low gross capital formation, all while experiencing one of the fastest population growth rates in the world. These conditions are very different from the typical cases found in the literature, where imports are often treated as a leakage from domestic demand rather than a potential driver of economic activity, and where population growth is viewed as a drag on GDP per capita rather than a stimulus for aggregate demand.

To navigate our data's challenges—such as a short timeline (1991–2023) and variables exhibiting different orders of integration—we used robust methods (ARDL) that can handle instability and mixed stationarity. This enables us to see not only immediate economic shocks but also how imports, capital formation, and population growth interact with GDP over the long term. Our central premise is that in Somalia's unique context, imports (as a proxy for consumption and reconstruction needs), gross capital formation (as a measure of investment in infrastructure and productive capacity), and population growth (as a driver of labor supply and demand for goods) influence GDP in ways that may challenge or extend the predictions of standard economic theory. By testing this, we aim to provide a fresh and meaningful perspective on how economies function under extreme pressure—namely, state fragility, institutional absence, and structural import dependency.

This study focuses on the impact of import dependence, gross capital formation, and population growth on Somalia's gross domestic product (GDP) from 1991 to 2023. Imports of goods and services represent import dependence; gross capital formation (investment) and population growth are included as independent variables. The study employs the ARDL bounds testing approach (Pesaran et al., 2001). The remainder of the paper is structured as follows: Section 2 reviews theoretical and empirical literature and presents the hypotheses. Section 3 outlines data and methodology. Section 4 presents and discusses the results. Finally, Section 5 concludes with policy recommendations.

2. Literature review

The relationship between import dependence, gross capital formation, population growth, and gross domestic product has been widely studied, yet results remain contested and context-dependent. This section reviews theoretical foundations and empirical findings and presents the testable hypotheses.

2.1. Theoretical foundations and hypotheses

Dependency theory posits that developing regions remain underdeveloped due to reliance on industrialized nations (Prebisch, 2016; Singer, 1993). Peripheral economies exporting primary commodities and importing manufactured goods face declining terms of trade and entrenched dependency (Santos, 1970). Contemporary dependency scholars emphasize that digital trade asymmetries and environmental conditionality represent new forms of structural dependency (Trade & UNCTAD, 2024). For Somalia, with food imports constituting 35.8% of total merchandise imports (Trade & UNCTAD, 2025), this framework remains highly relevant. However, in extreme cases of supply-side underdevelopment, imports may function as enablers rather than displacers. This leads to our first hypothesis:

H_1: Imports of goods and services have a positive and statistically significant effect on Somalia's gross domestic product in the long run.

In contrast, the connection between gross capital formation (GCF) and GDP is most prominently theorized through the role of capital accumulation in output determination, foundational to the Harrod-Domar growth model and subsequent neoclassical frameworks (Domar, 1946; Harrod, 2025; Solow, 1956). This framework argues that increasing the stock of physical capital—machinery, infrastructure, equipment, and buildings—directly expands an economy's productive capacity. Gross capital formation represents new investment in fixed assets and changes in inventories. By directing resources toward capital accumulation, economies can shift from consumption-heavy to investment-intensive production, leading to higher labor productivity, technological incorporation, and sustained output growth.

Gross capital formation also enables capital deepening—increasing capital per worker—which raises the marginal productivity of labor and wages over time (Romer, 1999). The accelerator effect further suggests that rising GDP induces more investment, but the reverse causal chain—investment driving GDP—is central to Keynesian and neoclassical growth models. Investment in public infrastructure (roads, power grids, communications) reduces transaction costs and creates positive spillovers across private sectors (Aschauer, 1989). Foreign direct investment embedded in gross capital formation can also transfer managerial and technological know-how not available domestically (de Mello Jr, 1999). Investment in physical capital is a fundamental driver of growth, leading to our second hypothesis:

H_2: Gross capital formation has a positive and significant effect on Somalia's gross domestic product in the long run.

The connection between population growth and GDP is theorized through several competing models. The classical view (Malthus, 1798) argues that rapid population growth outpaces agricultural production, leading to diminishing returns, falling output per capita, and subsistence-level equilibrium. In contrast, the neoclassical growth model (Solow, 1956) treats population growth as an exogenous determinant of steady-state output: faster population growth dilutes capital per worker unless investment rises proportionally, potentially lowering per capita GDP.

A more optimistic perspective emerges from unified growth theory (Galor & Weil, 2000). Population growth stimulates technological innovation, specialization, and market expansion. A larger population increases the probability of discovering new ideas and provides a larger labor force for industrial production (Kremer, 1993). The demographic dividend hypothesis (Bloom & Williamson, 1998) further suggests that when a falling birth rate creates a temporary bulge in the working-age population (relative to dependents), output per capita rises sharply—but only if labor market and educational institutions absorb the new workers productively. Conversely, environmental economics (Ehrlich & Holdren, 1971) argues that beyond a carrying capacity, population

growth degrades natural resources and infrastructure, eventually depressing GDP per capita. Thus, the sign and magnitude of the population growth–GDP relationship depend critically on time horizon, resource endowment, technology levels, and demographic structure. For a labor-abundant economy like Somalia, this suggests:

H_3: Population growth has a positive and significant effect on Somalia's gross domestic product in the long run.

2.2. Empirical framework

2.2.1. Import-led economic growth

Empirical studies in Africa from 2015 to 2025 yield mixed findings. Sunde et al. (2023) examined Namibia (1980–2020) using ARDL and found that imports have a significant negative long-run relationship with GDP. Aigheyisi (2021) investigated Nigeria (1981–2018) and discovered an inverted-U-shaped relationship: import dependence benefits growth up to a threshold of approximately 26% of domestic demand, beyond which it becomes harmful. Conversely, Kogid et al. (2011) analyzed the relationship between economic growth and imports in Malaysia (1970–2007) using cointegration and causality tests. Results show no cointegration (no long-run relationship), but bilateral causality exists. Imports indirectly contribute to economic growth, while growth directly contributes to imports. These findings are vital for future economic growth policy. Uğur (2008) examined the import-economic growth relationship in Turkey using multivariate VAR analysis. Imports are decomposed into four categories. Results show a bidirectional relationship between GDP and imports of investment goods and raw materials, indicating mutual causality. However, a unidirectional relationship exists between GDP and imports of consumption goods and other goods, where GDP drives imports without reverse causality. Import composition matters significantly for economic growth outcomes. Finally, Taghavi et al (2012) examined imports, exports, and economic growth in Iran (1962–2011) using VAR analysis. Results confirm a long-run relationship among the variables. Imports have a significant and negative relationship with growth, negatively affecting long-term economic development. Impulse response analysis shows that an import shock has little to no positive effect on growth.

2.2.2. Gross capital formation-led gross domestic product

Jermsittiparsert et al. (2019) examined the impact of gross capital formation on economic development in ASEAN-5 countries (Thailand, Singapore, Indonesia, Philippines, and Malaysia) from 1990 to 2014 using panel data from World Development Indicators. Gross capital formation is included as one of the independent variables alongside government expenditure, portfolio investment, labor, trade, total reserves, and gross savings, with GDP measuring economic growth. The findings indicate that gross capital formation, as an investment in physical capital, contributes to economic growth. Understanding this relationship helps ASEAN governments make better fiscal decisions as they implement the AEC Blueprint 2025. Future research should explore specific investment components such as infrastructure, education, and defense.

Kanu & Ozurumba (2014) examined the impact of capital formation on Nigeria's economic growth using multiple regression and VAR models. In the short run, gross fixed capital formation (GFCF) had no significant impact on growth. However, in the long run, GFCF, total exports, and lagged GDP values showed positive relationships with growth. Imports and total national savings had inverse relationships with growth. GDP had a unidirectional causal relationship with exports, GFCF, imports, and savings. The study recommends reducing recurrent expenditures to free savings for infrastructure investment, mobilizing national savings to attract FDI, developing exportable commodities, and improving roads, electricity, and security.

Afiat et al. (2021) analyzed the effect of DGFCF and population growth on GRDP in Southeast Sulawesi Province. This study used descriptive and quantitative methods, namely describing a problem by analyzing data and things related to numbers or calculation formulas used to analyze the problem being studied. The analytical method used by researchers was the OLS method. The results of the study show that simultaneously the variables of DGFCF and population growth have a significant and positive effect on GRDP. Partially, the variables of DGFCF and population growth have a significant and positive effect on economic growth. From the regression results, the R-squared value was 0.891. This means that the independent variable was able to explain variations in economic growth in the Province of Southeast Sulawesi by 89 percent, while the remaining 11 percent is related to other variables.

Iftikhar et al. (2016) analyzed the relationship between gross domestic capital formation, export, and economic growth in Pakistan. Johnson's co-integration methodology is used in the study to analyze the presence of a long-run relationship between gross domestic capital formation, exports, and the economic growth of Pakistan. The results showed that there is one co-integrated vector among exports, gross domestic capital formation, and economic growth. Granger causality tests based on Error Correction Models have indicated that gross domestic capital formation and export influence the steady state level of GDP.

Sinha (2024) investigated the determinants of India’s economic growth by analyzing data from 2000 to 2023, focusing on key variables such as GDP, consumption, fixed asset investment, exports, and employment. Utilizing multiple regression analysis through E-Views software, the empirical results indicate that fixed asset investment, consumption, exports, and employment significantly and positively influence economic growth. These findings provide critical insights for policymakers, underscoring the importance of improving investment layouts by focusing on rural investment and supporting emerging and innovative industries.

2.2.3. Population growth-led gross domestic product

Jan et al. (2021) examined the population's impact on Pakistan's economic growth (1961–2020) using ARDL analysis. Results show that population and crude death rate positively affect economic growth in both the short and long run. However, fertility has a negative effect on growth in both periods. Diagnostic tests confirm the results are unbiased, contributing to the mixed theoretical and empirical literature on population and economic growth.

Lianos et al. (2023) examined whether population decline causes economic recession by analyzing countries experiencing population decline using the pooled mean group (PMG) estimation method. Results show that population decline can coexist with growing GDP, increasing per capita GDP, rising labor

force participation, and falling unemployment. These findings challenge the common fear among businesspeople and politicians that population reduction inevitably leads to economic recession.

Afzal (2009) examined Pakistan's population growth and economic development from 1950 to 2005. The population increased by 430 percent between 1950 and 2001. Multivariate analysis of 1981–2005 data finds a significant negative relationship between population growth and economic advancement. Rapid population growth lowers investment growth and diminishes savings, contributing to one of the world's highest dependency ratios. Foreign investment and exports have a small growth impact. Policy recommendations include investing in family planning services, independent media, and liberal education to encourage smaller families.

Ibrahim et al. (2023) examined the implications of population growth on sustainability and food security in Sub-Saharan Africa (SSA) using panel data. Utilizing an empirical framework, the study found that population growth and institutional quality have divergent effects on the accessibility and availability of food. While a growing population can enhance certain functional roles, it also places immense pressure on existing food security regimes, which are often hampered by inefficient trade procedures. The study recommends that SSA nations improve institutional quality and facilitate trade to ensure that demographic expansion does not undermine national sustainability targets.

Saidi & Zaidi (2019) examined population growth's impact on GDP and environmental quality using GMM dynamic panel data for ten countries (1980–2013). Results show that population growth positively and significantly affects economic growth, while capital has a positive but insignificant effect. Population growth also significantly increases CO2 emissions, urbanization reduces emissions, and trade openness has no effect. The conclusion emphasizes that the population's effect depends on aging, hierarchical structure, and economic level.

Hosen (2019) analyzed the population growth-economic growth relationship across forty countries in four income groups over twenty-seven years using panel cointegration and VECM methods. Results show positive relationships in low and lower-middle-income countries: a 1% population increase raises GDP growth by 0.42% and 0.44%, respectively. In contrast, negative relationships exist in high and upper-middle-income countries, with GDP growth falling by 1.19% and 0.044%, respectively. High-income countries require 1.47 years for population growth to reach equilibrium.

Cai & Lu (2013) analyzed how China's shrinking working-age population has reduced growth drivers since 2010. Estimated potential output growth averages 7.2% during the 12th Five-Year Plan and 6.1% during the 13th. Future sustainable growth requires economic reform. Simulations show that increasing labor force participation and improving total factor productivity can significantly enhance potential GDP growth. Policy implications for addressing demographic challenges are discussed.

2.2.4. Research gap

The preceding empirical review has systematically examined the existing literature on import-led economic growth, gross capital formation-led GDP, and population growth-led GDP across various economies, including both developing and developed contexts. While these studies provide valuable insights, several critical gaps remain, particularly concerning the case of Somalia—a fragile, post-conflict economy with unique structural characteristics. First, regarding import-led economic growth, existing studies have focused on countries such as Namibia (Sunde et al., 2023), Nigeria (Aigheyisi, 2021), Malaysia (Kogid et al., 2011), Turkey (Uğur, 2008), and Iran (Taghavi et al., 2012). These studies yield mixed findings ranging from negative long-run relationships to non-linear threshold effects and bidirectional causality. However, no empirical study has specifically examined the import–GDP relationship in Somalia. Given Somalia's heavy reliance on imports due to a weak domestic productive base, the direction and magnitude of this relationship remain entirely unknown. Furthermore, the compositional effect of imports (investment goods vs. consumption goods) on Somalia's GDP has never been investigated.

Second, in the domain of gross capital formation-led GDP, studies have analyzed ASEAN-5 countries (Jermsittiparsert et al., 2019), Nigeria (Kanu & Ozurumba, 2014), Indonesia (Afiat et al., 2021), Pakistan (Iftikhar et al., 2016), and India (Sinha, 2024). The findings generally support a positive long-run relationship, though short-run effects are sometimes insignificant. However, Somalia has been systematically excluded from this literature. Gross capital formation in Somalia remains critically low due to decades of civil war, weak financial institutions, and inadequate infrastructure. No empirical evidence exists on whether gross capital formation—domestic or foreign—has any statistically significant impact on Somalia's GDP in either the short or long run. This gap is particularly urgent given ongoing reconstruction efforts and international aid inflows.

Third, with respect to population growth-led GDP, the literature presents contradictory evidence across different income groups and regions. Studies on Pakistan (Afzal, 2009; Jan et al., 2021), European countries (Lianos et al., 2023), Sub-Saharan Africa (Ibrahim et al., 2023), ten countries (Saidi & Zaidi, 2019), forty countries across income groups (Hosen, 2019), and China (Cai & Lu, 2013) reveal that the population–growth relationship varies by income level, dependency ratio, and institutional quality. However, no study has examined this relationship for Somalia, which has one of the youngest and fastest-growing populations in the world, coupled with extremely low formal employment rates and weak institutional capacity. Whether population growth acts as a demographic dividend or a burden in Somalia remains an open empirical question.

Fourth, and most critically, the existing literature suffers from fragmentation and geographical omission: almost all empirical studies focus on stable, middle-income, or emerging economies (e.g., Malaysia, Turkey, Pakistan, India, ASEAN, Nigeria, Namibia, China). Somalia represents a completely unstudied case in the quantitative literature linking imports, capital formation, population growth, and GDP. Somalia's economy is characterized by: (i) an import-dependent structure with a persistent trade deficit; (ii) extremely low gross capital formation due to destroyed infrastructure and weak property rights; (iii) rapid population growth with a high dependency ratio; and (iv) the absence of a formal time-series econometric analysis on these relationships. Furthermore, no study has integrated these three drivers (imports, capital formation, population growth) into a single empirical framework for any fragile or post-conflict African economy, let alone Somalia. Therefore, this study seeks to fill these interconnected gaps by:

1. Providing the first empirical evidence on the impact of imports, gross capital formation, and population growth on Somalia's GDP using time-series econometric techniques.
2. Determining whether these variables exhibit a long-run equilibrium relationship (cointegration) with GDP in the Somali context.
3. Offering policy-relevant insights for Somalia's reconstruction, trade policy, investment strategy, and demographic planning based on rigorous quantitative analysis.

The findings will contribute not only to Somalia-specific policy but also to the broader understanding of how trade, investment, and demographic factors interact with economic growth in fragile and conflict-affected states.

3. Methodology

3.1. Data sources

The study utilizes balanced annual secondary data from 1991 to 2023 (33 observations). Data sources are the World Bank's World Development Indicators (WDI) and the SESRIC OIC-CIF database. The early 1990s data (1991–1993) correspond to the peak of the civil war; readers should interpret these observations with appropriate caution regarding measurement error.

Table 2
Data source and its measurement

Variable	Code	Measurement	Source
Gross Domestic Product	GDP	Current US$ (log)	World Bank
Imports of goods & services	IMP	Current US$ (log)	SESRIC
Gross Capital Formation	GCF	Current US$ (log)	SESRIC
Population growth	POPG	Annual %	World Bank
Source 2: Data Source and its measurement			

3.2. Econometric methodology

The Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran et al., 2001) is our primary technique, chosen because: (i) it works with small sample sizes (n = 33), (ii) it accommodates variables that are I(0) or I(1), and (iii) it provides both short-run and long-run coefficients via the error correction model (ECM). The functional form of the model is:

$$ln\left(GDP_t\right) = \beta_0 + \beta_1 ln\left(IMP_t\right) + \beta_2 ln\left(GCF_t\right) + \beta_3 POPG_t + \epsilon_t$$

The ARDL specification for bounds testing is:

$$\Delta \ln GDP_{it} = \phi_i \left(\ln GDP_{t-1} - \beta_1 \ln IMP_{t-1} - \beta_2 \ln GCF_{t-1} - \beta_3 POPG_{t-1}\right) + \sum_{j=1}^{p} \lambda_j \Delta \ln GDP_{i,t-j} + \sum_{j=0}^{q} \theta_{1j} \Delta \ln GCF_{t-j} + \sum$$

Note

POPG is entered as a level (percentage rate), not in logarithmic form, consistent with the functional form above.

Unit root tests (augmented Dickey-Fuller, ADF) are conducted to ensure no variable is I(2). Optimal lag length is selected using the Akaike Information Criterion (AIC). Cointegration is tested using the bounds F-test (Pesaran et al., 2001). Diagnostic tests include the Breusch-Godfrey serial correlation test (tested up to lag 2), the Breusch-Pagan heteroskedasticity test, the Ramsey RESET test for functional form, and CUSUM/CUSUMSQ stability tests.

4. Results and discussion

4.1. Descriptive statistics

The descriptive statistics in Table 2 reveal several important characteristics. lnGDP – Mean 22.022 (approximately USD 3.7 billion). The narrow standard deviation (0.728) masks a U-shaped trajectory: collapse in 1991 (minimum approximately USD 0.7 billion), a stagnant 1990s, and gradual recovery from the mid-2000s driven by telecoms, remittances, and urban services. Imports (lnIMP) – Mean 20.632, substantially higher than investment. The standard deviation (1.657) is more than double that of GDP, reflecting high volatility. This is explained by: (i) dependence on volatile external finance (aid, remittances, port revenues); (ii) lack of domestic substitutes for food, fuel, and medicine; and (iii) dramatic shifts from collapsed formal trade in the 1990s to informal port recovery and post-2012 formalization. Gross capital formation (lnGCF) – Mean 20.132, notably lower than imports. The minimum (18.678) indicates near-cessation of formal investment in some years. This reflects state absence, destruction of industrial capital, and risk-averse private investment. What little investment exists is concentrated in telecoms, basic urban housing, and livestock infrastructure. The moderate standard deviation (0.731) suggests a structural deficit rather than cyclical volatility.

Population growth (POPG) – The most volatile variable (SD 2.038), ranging from − 4.79% (early 1990s refugee outflows) to + 5.04% (post-conflict returns and high fertility). The mean of 2.89% exceeds the sub-Saharan African average. Large swings provide identifying variation for econometric estimation, but also show that Somalia's demography is shaped as much by forced displacement as by natural increase. Somalia is a fragile, externally dependent economy

where imports dominate, investment is chronically insufficient, and population dynamics are driven by both conflict-induced displacement and demographic transition. Any credible growth model must account for these structural peculiarities.

Table 3
Descriptive Statistics of Key Variables (1991–2023)

Statistic	lnGDP	lnIMP	lnGCF	POPG (%)
Mean	22.022	20.632	20.132	2.886
Median	22.081	20.855	20.123	2.888
Std. Dev.	0.728	1.657	0.731	2.038
Min	20.380	17.625	18.678	-4.789
Max	23.117	22.909	21.673	5.040
Source 3: authors' calculations (2026)				

4.2. Unit root tests

Table 4 reports the augmented Dickey-Fuller (ADF) unit root test results. Population growth (POPG) is stationary at level — I(0) — with an ADF statistic of −10.742 ($p < 0.01$). This is expected, as population growth rates rarely exhibit persistent trends over long periods. By contrast, log GDP, log imports, and log gross capital formation are non-stationary in their levels ($p > 0.10$ for the ADF test) but become stationary after first differencing at the 1% significance level. Thus, all three are integrated of order one — I(1). Crucially, no variable is I(2), satisfying a key precondition for the ARDL bounds test. This mixed order of integration (I(0) and I(1)) is precisely the situation for which the ARDL approach was designed.

Table 4
Unit Root Test Results (ADF)

Variable	ADF Level	p-value	ADF 1st Diff	p-value	Integration Order
LnGDP	-2.187	0.2111	-4.047	0.0012***	I(1)
LnIMP	-1.428	0.5686	-3.666	0.0046***	I(1)
LnGCF	-1.113	0.7098	-4.088	0.0010***	I(1)
POPG	-10.742	0.0000***	—	—	I(0)
Source 4: author's calculated (2026)					
*Note: *** p < 0.01, ** p < 0.05, * p < 0.10. ADF test uses constant specification; lag = 1. POPG is stationary at levels; lnGDP, lnIMP, and lnGCF are non-stationary at levels but stationary after first differencing. '—' indicates test not required as variable already I(0).*					

4.3. Cointegration test – Bound F-Test

Having confirmed the integration orders and selected the optimal lag structure, the ARDL bounds test of Pesaran et al., (2001) is applied to assess whether a long-run cointegrating relationship exists among lnGDP, lnIMP, lnGCF, and POPG. The null hypothesis (H_0) states that no long-run levels relationship exists. The alternative hypothesis (H_1) posits cointegration. The decision rule is: if the computed F-statistic exceeds the upper critical bound I(1), the null is rejected and cointegration is confirmed; if it falls below the lower bound I(0), the null is not rejected; and if it falls between the two bounds, the result is inconclusive.

Table 5
ARDL Bounds Test for Cointegration

Model	Significance Level	Critical Value	
		I (0) Bound	I (1) Bound
	10%	2.72	3.77
F- Statistics 9.570	5%	3.23	4.35
k 3			
	1%	4.29	5.61

Source 5: authors' calculations (2026)

Note

The F-statistic (9.570) exceeds the 5% upper bound critical value (4.35), rejecting the Null Hypothesis of No cointegration. K represents the number of parameters.

4.4. Long-run and Short-run results

The long-run results in Table 6 confirm that all three variables positively affect Somalia's GDP from 1991 to 2023. Imports have a coefficient of 0.335 (significant at 1%), meaning a 1% import increase raises GDP by 0.335%. This reflects Somalia's extreme underdevelopment—domestic agriculture meets only 22% of cereal needs and manufacturing is virtually absent—so imports enable survival rather than displacing local production. Gross capital formation has a coefficient of 0.195 but is only significant at 10%, revealing borderline significance due to chronically low investment (below 15% of GDP) concentrated in telecommunications and housing rather than productive infrastructure. Population growth has a coefficient of 0.183 (significant at 1%), supporting a labor supply interpretation, though with 3% annual population growth, GDP must expand at the same rate just to maintain constant per capita income.

On the other hand, the short-run results show notable differences. Imports and investment have larger immediate effects—0.454 and 0.293, respectively, both significant at 1%—indicating powerful instantaneous impacts, but approximately one-third of these effects dissipate over time due to low capital quality, conflict-related depreciation, and lack of maintenance. Population growth has a much smaller short-run coefficient of 0.016 (significant at 5%), indicating demographic changes affect GDP only gradually.

Connecting both sides, the error correction term is -0.349 (significant at 1%), confirming that 34.9% of any disequilibrium is corrected within one year, with full adjustment taking about 2.9 years. This moderate speed reflects the resilience of Somalia's informal economy—flexible prices, remittances, livestock sales, and the hawala system—yet remains slower than well-functioning market economies. Overall, Somalia's post-1991 economy is sustained by a fragile equilibrium where imports drive aggregate activity as a symptom of underdevelopment, investment plays a supportive but not transformative role, and population growth expands total output without necessarily raising per capita welfare.

Table 6
Long- and Short-run results

Short run				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
C	3.642	0.6719	5.42	0.000***
D(IMP)	0.454	0.0738	6.16	0.000***
D(GCF)	0.293	0.0967	3.03	0.006***
D(POPG)	0.0159	0.0070	2.27	0.033**
ECT(-1)	-0.3489	0.0808	-4.32	0.000***
Long run				
lnIMP	0.3350	0.0439	7.62	0.000***
lnGCF	0.1946	0.1073	1.81	0.083*
POPG	0.1828	0.0374	4.89	0.000***
Source 6: author's calculated (2026)				

4.5. Diagnostic tests

The model passes all standard diagnostic checks, confirming its reliability. The Ramsey RESET test (F = 2.26, p = 0.1145) shows no omitted variables or functional form misspecification; the linear-in-logs specification is adequate, with no nonlinear threshold effect for imports. The Breusch-Godfrey test (F = 4.073, p = 0.1305) provides no evidence of serial correlation at conventional significance levels. The Breusch-Pagan test (F = 0.46, p = 0.4966) confirms constant error variance — notable given Somalia's volatile history of war, droughts, and recovery — implying predictive accuracy does not vary systematically with GDP or time.

The adjusted R-squared (0.9584) indicates the model explains nearly 96% of GDP variation. While this high fit is not unusual for trending time-series data, cautious interpretation is warranted: high R-squared reflects strong co-movement but does not guarantee causality. However, it suggests that omitted variables (remittances, conflict intensity, rainfall) may not severely bias the coefficients, though they could still affect the magnitude.

Assuming the CUSUM and CUSUMSQ tests do not cross the 5% critical bounds, the coefficients are stable over 1991–2023. This implies relationships have not fundamentally changed after the 2000s recovery or 2012 Federal Government establishment — plausible because structural features (import dependence, low investment, demographic pressure) have persisted despite political changes. Overall, the model is well-specified, and policy recommendations based on it are statistically justified.

Table 7
Diagnostic test results

	Diagnostic Result	
	F. Statistic	**Prob.**
Reset Test	2.26	0.1145
Serial Correlation	4.073	0.1305
Heteroscedasticity	0.46	0.4966
Adjusted R-squared	0.9584	

Source 7: author's calculated (2026)

4.6. Discussion

The discussion interprets the first econometric evidence on Somalia's post-1991 growth dynamics. The most striking finding is the positive and highly significant long-run import elasticity. While this appears to contradict dependency theory, Somalia represents its limit case, not its refutation. Dependency theory assumes a domestic productive sector capable of producing imported goods — an assumption that is false in Somalia. Decades of civil war and state collapse have left virtually no capacity to produce manufactured goods, refined fuels, or sufficient food (agriculture now meets only 22% of cereal needs). Imports do not displace local producers because there are few to displace; instead, they function as essential enablers of survival and economic activity. Restricting imports would cause GDP to fall sharply, not because imports are intrinsically growth-enhancing, but because no domestic alternatives exist. The positive elasticity is a structural diagnostic, not a policy prescription. The correct objective is to gradually build domestic productive capacity so that, over time, the import elasticity declines and investment elasticity rises.

The long-run investment coefficient confirms that investment contributes to GDP, but the borderline significance and small magnitude reveal deep structural problems. Somalia's investment ratio rarely exceeds 15% of GDP — far below the 25–30% typical of rapid growth economies — and investment quality is low, concentrated in telecommunications, basic housing, and livestock infrastructure, with little in manufacturing, energy, or transport. The borderline significance itself is informative: investment is not yet a powerful engine of growth, consistent with Williams' (2022) finding that weak institutional quality reduces the growth dividend from investment by about 50%. The short-run coefficient (0.293) exceeds the long-run coefficient (0.195), implying that one-third of the initial investment effect dissipates over time due to low capital quality, high depreciation from conflict and lack of maintenance, or both. Somalia's investment elasticity (0.195) aligns with other fragile states such as post-conflict Sierra Leone (0.15–0.25) and pre-2021 Afghanistan (0.10–0.20), confirming that the country's investment dynamics are typical of a post-conflict economy in early to middle recovery. Raising both the quantity and quality of investment is essential, with priority given to public core infrastructure that creates spillovers for private investment.

The positive population growth coefficient confirms that larger population associates with higher aggregate GDP, consistent with labour supply interpretation and unified growth theory. Rapid urbanisation has concentrated economic activity, reducing transaction costs and enabling service sector growth. However, aggregate effects must be distinguished from per capita effects. The coefficient implies that a 1 percentage point increase in population growth raises GDP growth by only 0.183 percentage points; with population growing at nearly 3% annually, GDP must grow at the same rate just to keep per capita income constant. Somalia's per capita GDP growth has been slow and volatile. The positive coefficient does not mean Somalis are better off on average — only that the total economy expands with population. Somalia's young population, high fertility (above 5 children per woman), and rapid urbanisation present both opportunity (potential demographic dividend) and risk (diluted per capita income and strained infrastructure).

The error correction term indicates that 35% of any deviation from long-run equilibrium is corrected within one year, with full adjustment taking about 2.9 years — moderate speed, faster than expected for a fragile state but slower than well-functioning market economies. The significant ECT implies Somalia's economy is mean-reverting, not a random walk. Adjustment occurs through informal mechanisms: flexible prices, counter-cyclical remittances, livestock sales, and informal credit networks. The existence of cointegration and a significant ECT despite the absence of a functioning central bank, formal stabilization policies, or reliable fiscal policy testifies to the resilience of Somalia's informal economy — the Hawala remittance system, unregulated trade networks, mobile money, and community-based risk sharing. However, the moderate speed (only 35% per year) also reveals limits: physical infrastructure destroyed by conflict cannot be rebuilt quickly; roads, firms, and livestock herds take time to recover. Strengthening formal stabilization mechanisms — a functional central bank, credible fiscal institutions, social safety nets — would complement and reinforce existing informal resilience.

In synthesis, Somalia's post-1991 economy is sustained by a fragile equilibrium: imports are the primary engine of aggregate activity; investment plays a supporting but not yet transformative role; population growth expands the economy's size without necessarily raising per capita welfare. The positive import elasticity is a symptom of extreme supply-side underdevelopment, not health. The borderline investment elasticity reflects chronically low capital formation and poor institutional quality. The positive population elasticity masks the absence of a demographic dividend. Policy sequencing is clear: in the short to medium term, maintain open trade and avoid import compression; simultaneously, raise the investment ratio to at least 25% of GDP while improving investment quality; over the long term, build domestic productive capacity in agriculture, livestock processing, and light manufacturing to gradually reduce the import elasticity. The findings contribute to the broader literature on fragile and conflict-affected states, confirming that standard growth models do not apply directly, but modified frameworks accounting for informal institutions, import dependence, and demographic volatility can yield meaningful empirical results. Caveats remain: aggregate import data mask composition effects; the informal economy (50–60% of GDP) means measured GDP understates true output; omitted variables (remittances, conflict intensity, rainfall) could bias coefficients. Future research should address these limitations as data quality improves.

5. Conclusion and recommendations

5.1. Conclusion

This study empirically examined the impact of import dependence, gross capital formation, and population growth on Somalia's gross domestic product from 1991 to 2023 using the ARDL bounds testing approach. Four principal findings emerge. First, a stable long-run cointegrating relationship exists among GDP, imports, gross capital formation, and population growth. Despite state collapse, protracted conflict, and the absence of formal stabilization institutions, Somalia's economy has not drifted chaotically. Informal mechanisms — the Hawala remittance system, unregulated trade networks, and mobile money — have provided sufficient continuity to maintain a long-run equilibrium.

Second, imports have a positive and statistically significant effect on GDP in both the long run and the short run, confirming Hypothesis H_1. This finding reflects Somalia's extreme supply-side underdevelopment rather than the desirability of import dependence. With domestic productive capacity devastated by decades of conflict—agriculture meets only 22% of cereal needs, and manufacturing is virtually absent—imports function as essential enablers of survival and economic activity. Restricting imports at this stage would be economically catastrophic because no domestic alternatives exist.

Third, gross capital formation positively influences GDP, confirming Hypothesis H_2, but the borderline significance and modest magnitude reveal structural constraints. Somalia's investment ratio rarely exceeds 15% of GDP—far below the 25–30% typical of rapidly growing economies—and investment quality remains low, concentrated in telecommunications, basic housing, and livestock infrastructure. The borderline significance itself indicates that investment is not yet a powerful engine of growth, consistent with evidence that poor institutional quality reduces the growth dividend from investment by approximately half.

Fourth, population growth contributes positively to aggregate GDP, confirming Hypothesis H_3. However, this aggregate effect must be distinguished from per capita welfare. With the population growing at nearly 3% annually, GDP must expand at the same rate simply to maintain constant per capita income. Somalia's per capita GDP growth has been slow and volatile; the positive aggregate coefficient implies only that the total economy expands with population, not that Somalis are better off on average. The error correction term indicates moderate adjustment speed: 35% of any disequilibrium is corrected within one year, with full adjustment taking approximately 2.9 years. This speed is faster than many expect for a fragile state, reflecting the resilience of informal market mechanisms, yet slower than well-functioning market economies, revealing the limits of that resilience in the face of destroyed physical infrastructure and weak institutions. In synthesis, Somalia's post-1991 economy is sustained by a fragile equilibrium: imports are the primary engine of aggregate activity; investment plays a supporting but not yet transformative role; population growth expands the economy's size without necessarily raising per capita welfare. The positive import elasticity is a symptom of extreme supply-side underdevelopment, not a sign of economic health. The borderline investment elasticity reflects chronically low capital formation and poor institutional quality. The positive population elasticity masks the absence of a demographic dividend.

5.2. Policy recommendations

Based on the empirical findings, particularly the positive import elasticity, the borderline investment elasticity, and the positive population elasticity, the following recommendations are critical:

1. Avoid import compression at all costs. Restricting imports through tariffs, quotas, or foreign exchange rationing would reduce GDP sharply because no domestic alternatives exist.
2. Raise the investment ratio to at least 25% of GDP. The current ratio below 15% is insufficient to transform the capital stock. Priority must go to core public infrastructure: roads, renewable energy, irrigation, and ports.
3. Improve institutional quality to increase investment productivity. Weak property rights, contract enforcement, and an operationalized central bank reduce the growth dividend from investment by approximately half.
4. Channel diaspora remittances into productive investment through diaspora bonds, matched savings schemes, and investment funds targeting agriculture and light manufacturing.
5. Invest in human capital to capture the demographic dividend. Expand secondary and vocational education, increase access to family planning, and create youth employment programmes. Without these, population growth will continue to dilute per capita income.
6. Strengthen formal stabilization mechanisms — a functional central bank, credible fiscal institutions, and social safety nets — to complement informal resilience and accelerate adjustment to shocks.
7. Build statistical capacity at the Somali National Bureau of Statistics to enable disaggregated trade analysis and evidence-based policymaking.

5.3. Sequencing and trade-off

Policy implementation requires realistic sequencing. In the short term, the priority is to protect the import lifeline while laying the groundwork for investment. Import compression must be avoided. In the medium term, the focus shifts to raising the investment ratio to 25% of GDP through public infrastructure and institutional reform. In the long term, selective import substitution and human capital investments will gradually reduce the import elasticity and capture the demographic dividend. These phases overlap; for example, education investments begun in the short term will yield returns only in the long term.

The most critical trade-off is between consumption now (supported by imports) and investment for the future. Somalia's population understandably demands immediate improvements in living standards, but without sustained investment, the import-dependent equilibrium will persist indefinitely. Communicating this trade-off clearly to citizens and international partners is essential for building political support for difficult but necessary investment decisions.

5.4. Limitations and future research

This study has several limitations that future research should address. The small sample size (33 observations) limits the number of lags and regressors. Data quality challenges persist, with the informal economy estimated at 50–60% of GDP, meaning measured GDP understates true output. The use of aggregate import data masks composition effects; disaggregating imports by category (food, fuel, capital goods, consumer goods) would reveal whether certain types are more growth-enhancing or harmful. Omitted variables — remittances, conflict intensity, rainfall, and aid flows — could bias the coefficients if correlated with included regressors. Finally, the study covers only Somalia; a comparative analysis with other post-conflict economies would enhance external validity.

Future research should: (i) disaggregate imports by type as better data become available; (ii) conduct sectoral production analysis to identify which sectors offer the greatest returns to investment; (iii) include remittances explicitly in the model; (iv) compare Somalia with other fragile and conflict-affected states (FCAS) to identify common patterns and context-specific differences; and (v) examine the moderating role of institutional quality on the investment-GDP relationship as institutional data improve.

Declarations

Disclosure statement:

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.

Ethics Approval

Not applicable

Competing interests

The author declares that they have no conflicts of interest.

Consent to Participate

Not applicable

Consent to Publish

Not applicable

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Author Contribution

Ahmed M. Hussein Enow is the sole author of this manuscript. He was responsible for the entire research process, including conceptualization and study design; data collection and curation; econometric modeling (ARDL bounds testing approach) and formal analysis; interpretation of results; drafting, revising, and finalizing the manuscript; and securing funding for the research.

Data Availability

The data supporting the findings of this study are available from the public sources cited in the manuscript. Specifically, the datasets on unemployment and foreign direct investment were obtained from the World Bank World Development Indicators database (https://databank.worldbank.org/source/-world-development-Indicators), and the population growth data were sourced from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) (https://oicstat.sesric.org/query). The authors confirm that all data used in this analysis are available through these public repositories. The compiled dataset used for the econometric analysis in this study is available from the corresponding author upon reasonable request.

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Figures

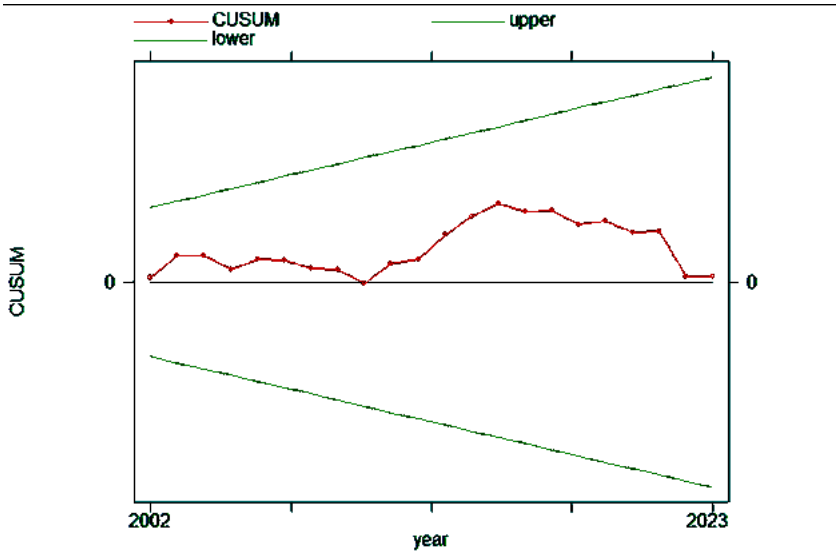


Figure 1

CUSUM Stability Test

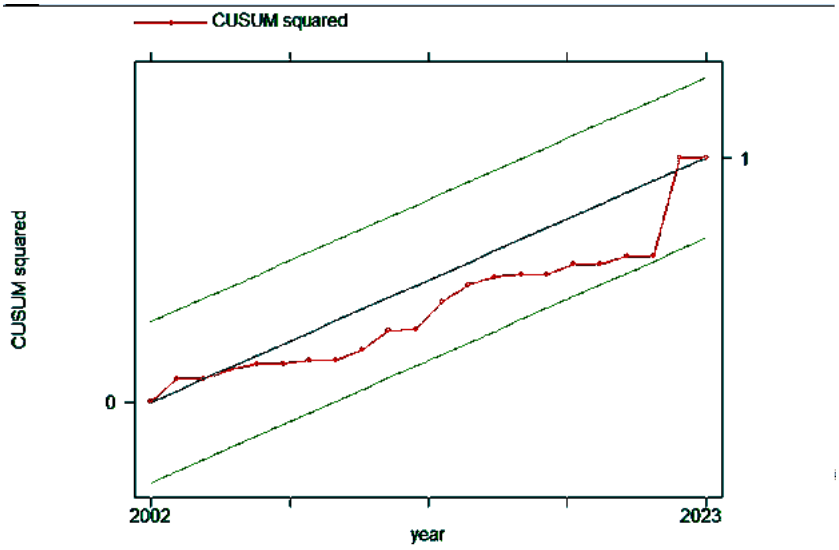


Figure 2

CUSUMSQ Stability Test