**Original Research Article**

**Nexus between population and economic growth: Evidence from sub-national governments in Kenya**

**Abstract**

Human capital plays a crucial role at all levels of economic development, as a larger population is likely to enhance per capita income and welfare in developing economies. However, strategies to stimulate population-driven growth in Kenya, especially at the subnational government level, remain a topic of debate among economists and demographers. Endogenous growth models theoretically identify population growth as a significant determinant of progress due to its contributions to technological advancement and labor supply. Nonetheless, economic growth can also influence population growth, given their interdependent relationship. This research aims to address that knowledge gap by employing innovative analytical techniques on existing data at the subnational level, specifically focusing on the nexus between population and economic growth. Utilizing panel data from 47 subnational governments in Kenya during the period from 2014 to 2022, the study estimated a generalized method of moments (GMM) model and applied the Wald test to establish causality. Results from Wald causality test reveals the existence of bi-directional causality between population and economic growth. The analysis reveals that at the sub-national level in Kenya, population expansion will be helpful for the economy, in generating higher economic growth, and vice versa. Equally, reciprocal relationship underscores the complex interplay between demographic dynamics and economic development. County governments are urged to adopt population policies and social and economic development policies that are mutually reinforcing.

**Keywords**: Population growth, economic growth, pane causality, heterogeneity, decentralization

**JEL codes**: H70; J10; O40; R23

**1 Introduction**

The intricate relationship between population growth and economic development has been a focal point of extensive scholarly inquiry, yielding diverse and often inconclusive findings. Classical economists, such as Malthus (1798), argue that population growth positively influences economic expansion by augmenting labour supply and enhancing consumption demand. Conversely, modern growth theories highlight the importance of human capital, technological advancements, and robust institutional frameworks as critical determinants of economic outcomes (Muhammad, 2025). There exists a body of literature suggesting that accelerated population growth may impede economic progress by exerting strain on resources and elevating dependency ratios (Ella, 2025). In contrast, some researchers contend that population growth can stimulate innovation and foster economies of scale (National Research Council, 1986).

Globally, high-income countries have largely reaped the benefits of stable population growth in tandem with significant technological advancements and capital accumulation (Baffour Gyau et al., 2025). In stark contrast, numerous developing nations encounter substantial challenges in transforming demographic expansion into sustained economic growth, often hindered by structural inefficiencies, pervasive unemployment, and pronounced inequality (Marslev & Whitfield, 2025). Africa, characterized by rapid population growth, exemplifies this dichotomy, where economic disparities persist across the continent (Simane et al., 2025). Given Africa's demographic trajectory, policymakers must prioritize investments in human capital development, industrialization, and regional integration to facilitate meaningful economic progress (Chowdhury et al., 2025). Notably, some African nations, such as Rwanda and Botswana, have successfully navigated a transition from population-driven growth to sustained economic development through strategic investments in education, governance reforms, and private-sector initiatives (Muzioreva & Gumbo, 2024). Kenya serves as a case study in this context, experiencing significant demographic and economic transformations at both national and subnational levels, marked by considerable disparities in growth across its 47 counties (Okutse & Athiany, 2025).

Twelve years ago, the Kenyan electorate chose to decentralize governance, marking the beginning of a new leadership framework with 47 governors and their teams assuming authority in newly established counties. These county governments have since sought to establish a cooperative relationship with the national government regarding the distribution of power and revenue. However, they have faced political, fiscal, and administrative challenges in their efforts to deliver services to the Kenyan people (Gisore, 2021).

County Governments play a crucial role in augmenting the public finance, support development of infrastructure and influence population policies and planning. Kenya's counties exhibit varying demographic and economic profiles, underscoring the disparities in population growth, economic dynamics, and overall development outcomes. Population growth patterns across counties are inconsistent, with certain regions experiencing considerable increases attributed to urbanization and the proliferation of economic opportunities (Okutse & Athiany, 2025). In contrast, others exhibit slower growth rates due to environmental challenges and socioeconomic barriers (Kibet et al., 2019). Urbanized counties such as Nairobi, Kiambu, and Nakuru have experienced pronounced population increases, primarily fueled by urban expansion, industrial growth, and employment opportunities (Rebecah, 2023). These counties benefit from relatively developed infrastructure, diversified economic activities, and enhanced market access, thereby attracting both internal migrants and foreign investments. Conversely, arid and semi-arid counties, including Turkana, Marsabit, and Samburu, have encountered stagnant population growth due to adverse climatic conditions, limited infrastructural development, and low economic activity (Ogeya et al., 2018). Consequently, population growth in these regions has not corresponded with substantial economic expansion, as evidenced by Gross County Product (GCP) metrics (KNBS, 2023).

Economic growth across counties has also demonstrated significant variance, with urban and industrialized regions contributing disproportionately to the national GDP relative to rural and agriculture-dependent areas. Nairobi, for instance, remains the economic hub of Kenya, accounting for approximately 27% of the national GDP in 2022 (KNBS, 2023). The county's economic framework is predominantly driven by sectors such as financial services, infrastructure, manufacturing, trade, and real estate. Nevertheless, agricultural productivity is vulnerable to external shocks, including climate change, land fragmentation, and market inefficiencies, which present challenges for sustainable economic growth in the long term.

The impact of population growth on economic development at the county level is contingent upon factors such as labour market capacity, public service provision, and resource allocation. Rapid population growth in counties such as Nairobi and Mombasa has generated substantial challenges, including urban congestion, inadequate housing, and heightened pressure on social services (Oluchiri, 2025). While some counties have adeptly harnessed population growth for economic advancement, others grapple with issues such as high unemployment rates, low productivity, and infrastructural deficits (Kipkogei et al., 2025). A nuanced understanding of the interplay between population growth and economic growth at the subnational level is vital for policymakers, particularly in the context of devolution initiatives aimed at promoting equitable resource distribution and fostering regional economic development.

**2 Literature Review**

**2.1 Theoretical Literature**

Endogenous growth theory, as articulated by Romer (1986) and Lucas (1988), posits that economic growth is fundamentally driven by factors such as human capital, technological innovation, and knowledge accumulation. This theory asserts that population growth can exert a positive influence on economic development, contingent upon investments in education, research, and innovation. In contrast to traditional economic growth models, endogenous growth theory emphasizes the significance of policy and institutional frameworks in sustaining long-term economic growth trajectories.

The Solow-Swan growth model (Solow, 1956) contends that economic growth is primarily fueled by capital accumulation, expansion of the labour force, and technological progress. Although population growth enhances the labour supply, unchecked growth may lead to capital dilution, ultimately resulting in diminished per capita income. This model underscores the critical roles of savings, investment, and technological advancement in fostering sustained economic growth.

Unified Growth Theory, developed by Galor and Weil (2000), integrates elements from Malthusian theory, demographic transition theory, and endogenous growth theory. It elucidates the process through which economies transition from stagnation to sustained growth, driven by technological advancements that enhance productivity and living standards. The theory posits that as societies evolve from agrarian to industrial economies, fertility rates decline, human capital accumulation escalates, and economic performance improves.

Decentralization can be a crucial strategy for delivering services at the sub-national level of government. According to Tiebout (1956), the theory of decentralization involves the distribution of resources, decision-making, enhancement of public services and service delivery, as well as facilitating information exchange. Musgrave (1959), in his theory of finance, argues that decentralization boosts a nation's productive capacity by increasing efficiency, enhancing accountability, reducing corruption, decreasing bureaucracy, and minimizing conflicts between government officials and civil servants. In later research, Musgrave (1956) posits that the government's role is to maximize social welfare through fiscal decentralization, whereby the allocation of public goods is managed by sub-national governments. This approach results in a more effective distribution of public services and goods at the lowest levels of government (Gisore, 2021). Fiscal decentralization, in this context, refers to the transfer of fiscal powers and responsibilities from the central government to sub-national governments, emphasizing the importance of financial decentralization in achieving the optimal supply of local public goods, ultimately contributing to human development and economic growth. Furthermore, decentralization can help manage population imbalances in various ways. For example, decentralization reforms in many states have positively impacted the reduction of spatial inequalities and promoted rural development (Faye et al., 2024).

**2.2 Empirical Literature**

Empirical studies have provided significant insights into the relationship between population growth and economic performance. Barro (1996), in his analysis of 98 countries, identified a negative correlation between higher population growth rates and per capita income, particularly in developing nations. In a similar vein, Kelley and Schmidt (2005) examined data from 88 countries and concluded that rapid population growth impeded economic development by diminishing capital accumulation and elevating dependency ratios.

Sachs and Warner (1997) investigated the phenomenon of economic stagnation in Africa, suggesting that rapid population growth was a contributing factor to the sluggish pace of economic development, attributable to inadequate infrastructure and limited job creation opportunities. Gyimah-Brempong and Wilson (2004) further explored the relationship between fertility rates and economic growth in Sub-Saharan Africa, revealing that elevated birth rates increased dependency ratios, thereby constraining savings and investment.

In a study focused on Kenya, Thuku et al. (2013) found that rapid population growth resulted in resource depletion and high unemployment, which hindered growth in per capita income. Conversely, KIPPRA (2021) assessed population trends and economic performance in Kenya, revealing that counties experiencing significant urban population growth, such as Nairobi and Nakuru, witnessed marked economic expansion attributed to increased labour supply and heightened consumer demand. Additionally, the World Bank (2023) indicated that urban counties contribute more substantially to GDP than their rural counterparts, reflecting disparities in labour productivity and access to economic opportunities.

**3 Methodology**

**3.1 Data Issues**

The study examines and analyzes the relationship between population growth and economic development in Kenya. In this context, population dynamics are represented by the population growth rate, while economic growth is denoted by the growth rates of the Gross County Product (GCP), which reflects the gross domestic product per county. The analysis is conducted at the subnational level to guide policies and resource allocation aimed at enhancing economic development. The study utilizes annual panel data from 47 counties covering the period from 2014 to 2022, resulting in a total of 423 observations. Employing panel data enables a more robust analysis by combining time series data across different counties, thus enhancing the statistical power of Granger-type causality tests. Data on county population estimates were obtained from annual statistical abstracts reports, while the county economic growth (Gross County Product) data was obtained from the 2019 and 2023 Kenya National Bureau of Statistics (KNBS) reports. This database is widely recognized as a consistent and reliable resource for studies on economic development in Kenya. All secondary data utilized in this study are annual and span the years 2014 to 2022.

**3.2 Model Specification**

The study establishes its theoretical framework based on endogenous growth theory, originally introduced by Romer (1986, 1990) and later refined by Jones (1995) to address the counterfactual implication that economic growth rates are solely dependent on population size. In this modified model, the growth rate of the economy is linked to the growth rate of the population. This logically suggests a positive correlation between the growth of per capita income and the population growth rate (Cayssials et al., 2024). Endogenous growth models allow for demographics to influence per capita macroeconomic outcomes. According to endogenous growth theory, economic growth is primarily driven by a country's population growth, labor force, and internal innovation. In this context, the population growth rate is treated as an endogenous factor, meaning that policy changes can influence the long-run growth rate of the economy through their effects on fertility. However, because the mechanism by which policy impacts growth is fertility, the effects of such policies on long-run growth can often contradict conventional wisdom (Jones, 1998).

The general growth function deriving from this theoretical model states:

$GCP = ƒ\left( POP\right),$ (1)

In this study, economic growth is characterized by the GCP growth rate (*GCP*), which captures economic growth at the sub-national level. The exogenous variable population is denoted by the population (POP) growth rate as captured in theory.

Based on that, the specified model for this study is depicted in Equation 2:

$GCP\_{it} =α+δ\_{1}POP\_{it}++ ε\_{it},$(2)

Where economic growth (GCP) is the GCP growth rate and the POP-Population growth rate. Further, δ represents the model coefficient for the independent variable, indicating the autonomous variable, ε is the error term in the model subscript t is the time dimension, and i is the county dimension.

**3.3 Data Analysis**

The study utilizes a three-stage panel analytical framework proposed by Mahmoud (2007), Anagnostou et al. (2016) and Brida et al. (2024) to explore the causal relationship between population growth and economic growth (GCP) through panel data within a heterogeneous model. In the first stage, the analysis begins by assessing the order of integration for both POP and GCP. To enhance the reliability of these tests, we will employ recently developed panel unit root techniques, particularly considering the relatively short time frame of the individual series. In the second stage, we apply a heterogeneous panel cointegration test to investigate the long-term relationships among the variables after confirming their order of integration. Finally, in the third stage, we evaluate short-run cointegration using dynamic heterogeneous panel causality. Heterogeneous panel causality tests are conducted to ascertain the direction of causation between the two variables, as assuming a homogeneous panel in the presence of heterogeneous country effects could result in biased conclusions.

**3.3.1 Heterogeneous Panel Unit Root Test**

Panel unit root tests are commonly employed to assess the order of integration in the variables within a dataset. Recent literature indicates that these panel-based unit root tests exhibit greater power compared to tests conducted on individual time series. Among the various panel unit root tests developed in the literature, the Levin, Lin, and Chu (LLC) test (2002) and the Im, Pesaran, and Shin (IPS) test (2003) stand out as the most widely used. Both tests are grounded in the Augmented Dickey-Fuller (ADF) principle (Anagnostou et al., 2016). However, the LLC test assumes homogeneity in the dynamics of the autoregressive coefficients across all members of the panel, whereas the IPS test is more flexible, accommodating heterogeneity in these dynamics. This heterogeneity arises from variations in economic conditions and development levels across countries. Given the brief duration of the individual series, we have greater confidence in implementing the more robust IPS panel test. The specification for the IPS unit root test is as follows:

$∆X\_{it}=α\_{i}+β\_{i}X\_{t-1}+\sum\_{j=1}^{k}γ\_{i,j }∆X\_{t-j}+ ε\_{it},$(3)

Where Δ is the first difference operator, is the dependent variable, and is the stochastic term.

**3.3.2. Heterogeneous Panel Cointegration**

Once the integration of order one is confirmed, the subsequent step is to conduct a cointegration analysis to determine whether a long-run relationship exists among the set of integrated variables under consideration. Cointegration suggests a long-term equilibrium relationship among economic variables. Acknowledging the limitations of traditional methodologies, this study employed two types of heterogeneous panel cointegration tests developed by Pedroni (1999). These tests not only utilize panel data to address the issue of small sample sizes but also allow for variability across individual cross-sections by accommodating heterogeneity in both the intercepts and slopes of the cointegrating equation.

**3.3.3 Heterogeneous Panel Causality**

Pedroni's heterogeneous panel cointegration method focuses solely on detecting the existence of long-run relationships between variables. While the tests can indicate whether such long-run links are present or absent, they do not reveal the direction of causality when the variables are found to be cointegrated. Traditionally, causality is examined using the standard two-step Engle and Granger (1969) causality procedure. However, in a panel context, conventional estimation techniques can lead to inconsistent parameter estimates due to measurement errors and omitted variable issues. Consequently, this study utilized the GMM model and employed the Wald test to establish causality. The economic literature outlines various estimation methods suitable for time series data models that encounter expected endogeneity challenges. Among these, the most widely used econometric approach for estimating dynamic panel models is the GMM developed by Arellano and Bond, which employs lagged explanatory variables as internal instruments. The GMM technique's primary advantages include its ability to manage endogeneity concerns surrounding regressors, correct for heteroscedasticity and serial correlation, account for simultaneity issues, address specification bias, and eliminate country-fixed effects along with unobserved heterogeneity (Mahmoud, 2007). This study adopted the GMM estimation for the dynamic panel model procedure, and J-tests or Sargan or Hansen tests for over-identifying restrictions were conducted to verify the validity of the exclusion restrictions within the GMM.

**4 Results and Discussion**

**4.1 Panel Unit Root Test**

The analysis begins with an examination of the statistical properties of the data series employed. Initially, the order of integration (stationarity) for both the population and economic growth series is assessed using the Im, Pesaran, and Shin Wald statistics (IPS). The lag lengths for these series were determined based on the Akaike Information Criteria (AIC). The results of the unit root test are presented in Table 1.

**Table 1: IPS Unit Root Test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Level | Variable | First difference | Decision  |
| Statistics | Prob. | Statistics | Prob. |
| GCP |  1.7696 | 0.9616 |  | -9.5792\*\*\* | 0.0000 | I(1) |
| POP |  0.9365 | 0.8255 |  | -7.4563\*\*\* | 0.0000 | I(1) |
| Note: \*\*\* and \*\* significant at a 1% and 5% levelNull hypothesis: The variable has a unit root |

The results of the IPS test indicate that all series analyzed at their original levels do not reject the null hypothesis of a unit root for the individual series. However, when examining the first differences of all series, the null hypothesis of unit roots is firmly rejected at the 1% significance level. This evidence strongly suggests that the series is stationary only after taking the first difference. In summary, the IPS unit root analysis confirms that both population and economic growth exhibit non-stationarity at level I(1).

**4.2 Panel Data Cointegration Test**

To determine whether a long-term relationship exists between population and economic growth, the next step in assessing the relationship between these two variables is to test for cointegration after confirming that both are integrated of the first order. We employed Pedroni's heterogeneous panel test to investigate the long-term association between them. The results of the heterogeneous panel cointegration test, using the Pedroni methodology, are presented in Table 2.

**Table 2: Pedroni residual cointegration test**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test statistics  | Statistics | Prob. | Weighted Statistics | Prob. | Decision  |
| Panel v-Statistic |  0.6566 |  0.2557 | -3.0009 |  0.9987 | No cointegration  |
| Panel rho-Statistic | -7.0380\*\*\* |  0.0000 | -3.9261 |  0.0000 | cointegration  |
| Panel PP-Statistic | -26.2031\*\*\* |  0.0000 | -15.5911 |  0.0000 | cointegration  |
| Panel ADF-Statistic | -4.5905\*\*\* |  0.0000 | -5.9985 |  0.0000 | cointegration  |
|  |  |  |  |  |  |
| Group rho-Statistic | -0.6147 |  0.2694 |  |  | No cointegration  |
| Group PP-Statistic | -22.7690\*\*\* |  0.0000 |  |  | cointegration  |
| Group ADF-Statistic | -7.3175\*\*\* |  0.0000 |  |  | cointegration  |
| Note: \*\*\* and \*\* significant at a 1% and 5% level Null hypothesis: No cointegration |

Five out of seven of Pedroni's statistics significantly reject the null hypothesis of no cointegration, as evidenced by the test results presented in Table 2. This indicates that population and economic growth are likely to move together in the long run. In other words, after controlling for country-specific variables, there remains a long-term steady-state correlation between these two variables within the panel of Kenyan counties. Given the established cointegration relationship, we can conclude that a long-run association exists between the two variables, despite their non-stationarity.

**4.3 Panel Causality Tests**

After establishing the long-run relationship among the study variables, the research advances to test for causality. The Generalized Method of Moments (GMM) was estimated, and the Wald test was utilized to assess causality. The tests conducted to determine the appropriate lag length and suitable estimation instruments are summarized in the accompanying table. Initially, the optimal lag structure was identified using the Wald test, which rejected the hypothesis of no second lag in both the GCP and POP equations, supporting the use of two lag structures. Subsequently, the Sargan or J-test was employed to validate the choice of instruments in the estimation model. The computed p-values for the Sargan or J-test concerning the over-identifying restrictions in the GMM for the two models were 0.423 and 0.261, indicating that the models are appropriate, as optimal values fall between 0.20 and 0.30, thereby confirming the validity of the over-identifying restrictions. The results of the Wald test and the estimated coefficients for the null hypothesis of no causation are shown in Table 3.

**Table 3: Panel Causality Results**

|  |  |
| --- | --- |
| Estimated coefficient  | Dependent variables  |
|  | GCP (2 lags) | POP (2 lags) |
| GCP-1 | -0.1025 \*\* (0.0439)  | -0.0011\*\*\*(0.0018) |
| POP-1 |  0.1355(0.4764)  | -0.0458\*\* (0.0196) |
| GCP-2 |  0.1722\*\*(0.0391)  | -0.0005\*\*\*(0.0016) |
| POP-2 | -0.8747 (0.4764)  | -0.0172\*\* (0.0196) |
| **Wald leg length**  |  |  |
| Null hypothesis  |  8.2710\*\*(0.0160) | 9.2527\*\*\*(0.0098) |
| Sargan or J-Test’s P-value | (0.2610) | (0.4239) |
| **Wald Causality Test** |  |  |
| Null hypothesis | POP does not cause GCP | GCP does not cause POP |
| 9.2717\*\*(0.0259) | 26.9241 \*\*\*(0.0001) |
| Note: \*\*\* and \*\* signifies significance at a 1% and 5% level Numbers in parentheses are the p-values. |

The research utilized the Wald test to explore the causal association between population (POP) and economic growth (GCP). The results indicate that the Wald test rejects the null hypothesis of no causation at the 5% significance level, suggesting that causality in the GCP equation flows from POP to GCP. Additionally, the findings imply a reciprocal causal relationship, as the Wald test also rejects the null hypothesis of no causality in the POP equation at a 1% significance level. Hence, we can conclude that there is evidence of a two-way causality between population and economic growth within the Kenyan counties. This implies on one hand, rapid population growth acts as a catalyst for consumerism, leading to heightened demand which, in turn, enhances economic growth at the subnational level. On the other hand, while economic growth can create conditions that potentially lead to population growth, it's not a direct cause and effect. Factors like increased demand for goods and services and higher incomes can influence fertility rates and migration patterns, but other factors like mortality rates and access to healthcare also play a significant role.

The estimated generalized method of moments (GMM) model suggests the negative and statistically significant impact of population on economic growth. Overpopulation adversely impacts the sub-national economy. Rising prices cause less savings and make the working and middle classes more vulnerable to economic distress (Thuku et al., 2013). Negative effects of population growth on economic development may include overpopulation leading to resource depletion, increased social expenditure, and rising unemployment and poverty rates at the subnational level. The study concludes that in Kenyan subnational governments, over the long term, a higher population growth results in a reduced growth of per capita Gross County Product, thereby slowing economic development. The results mirror similar findings by Thuku et al. (2013) and KIPPRA (2021) in Kenya.

**Conclusion**

This study aims to assess the influence of population growth on economic growth utilizing a production function approach grounded in an endogenous model. It examines the role of population in economic growth by analyzing panel data from 47 subnational governments in Kenya over the period from 2014 to 2022. Upon establishing a long-run relationship among the variables, panel long-run estimates are derived using both the Generalized Method of Moments (GMM) and the Wald test methodologies. The results from both methods indicate a negative and statistically significant impact of population growth on economic growth. Furthermore, the Wald causality test reveals a bi-directional causality between population and economic growth. The analysis concludes that at the subnational level in Kenya, population expansion can be beneficial for the economy by fostering higher economic growth, and conversely, economic growth can spur population expansion. For policymakers at the subnational level, implementing a thoughtfully designed population growth strategy, coupled with institutional and policy reforms, appears to be a sound approach.

In light of the critical role that social and economic development plays in addressing population-related issues, it is imperative to recognize the significant influence of demographic factors on development planning and strategy formulation. The successful pursuit of development objectives hinges on an integrated approach—one that holistically considers the intricate interconnections between population dynamics, resource availability, environmental sustainability, and overarching developmental goals. Consequently, both national and subnational policies, plans, and programs must be crafted with this integrated perspective, prioritizing initiatives that effectively merge population considerations with development strategies. This alignment is essential for fostering sustainable, equitable growth and addressing the multifaceted challenges posed by population changes.

The research emphasizes the necessity of establishing a robust relationship between population dynamics and development planning. Kenyan counties must integrate population considerations into their development strategies to ensure sustainable growth and effective resource allocation. National and subnational initiatives should prioritize the following developmental objectives: the eradication of widespread hunger and the attainment of adequate health and nutrition standards, the elimination of mass illiteracy, the enhancement of women's status, the reduction of mass unemployment and underemployment, and the elimination of inequality in subnational economic relations. To realize these objectives, it is essential for subnational governments to fully consider population trends when developing their plans and programs. The emerging perspective is that population growth should be stabilized, and development improved, by addressing some of the underlying causes of these issues.

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