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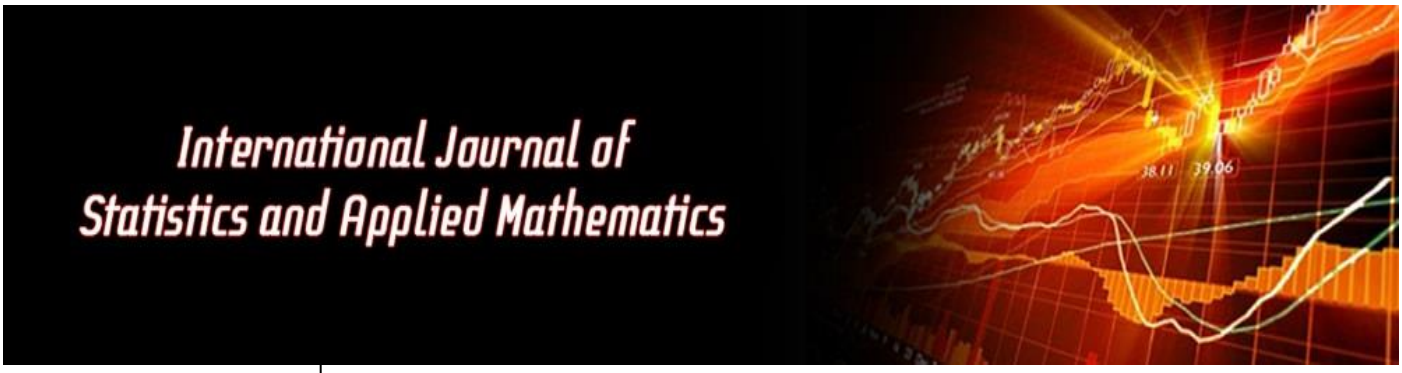

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An assessment on the long and short-run effects of population growth on economic growth in Tanzania

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Abstract
This article assesses the long and short-run effects of population growth on economic growth in Tanzania using granger causality and cointegration. Time series data for the period of 1990 to 2021 were used to validate the findings on granger causality and cointegration. Data were obtained from the World Bank, and were processed using STATA software version 17. Vector error correction model was applied to examine if the regression model provides good fit before testing long run and short run causality. Test statistics show the existence of long-run effects of population growth on economic growth through labour force, market and effective use of resources like land, water and forests. Thus, the government should design a population growth strategy combined with institutional and policy changes to ensure population growth is beneficial to the country's economy.

Keywords: Tanzania, long-run effects, short-run effects, population, economic growth

1. Introduction
Economic growth implies an increase in the number of goods produced and services provided in the country over a period of time, and this is a fundamental macroeconomic policy objective which countries all over the world continue to strive to achieve. Globally, economic growth is one of the most macroeconomic variables that indicate the economic size of a country. It is a reflection of people's livelihood, well-being, capacity and pace of economic activities. Societies who associate economic growth with superior income earn benefits (Sethy *et al.*, 2015) [5]. A country with high economic growth is expected to have high income, better education, increased life expectancy, and improved government finances. The speed of economic growth is significantly affected by population growth while other factors remaining constant (IBD.).

Despite rapid growth of population being the central factor for economic growth, economic growth is not sufficient. The Sub-Saharan Africa has the world's youngest and fastest growing population (Jayne *et al.*, 2017) [2]. By 2050, the number of people living in the region is expected to double and the subcontinent's share of the global population is projected to rise to about 23 per cent, which is almost two times that of 2015 (12%). The Sub-Saharan Africa's labour force is also expanding at a rate of 3 per cent per year and an additional 375 million young people are expected to reach working age by 2035 (IBD.). If they can be engaged in productive employment, this growing cohort of young people will offer an important opportunity for economic transformation. Yet, employment creation in the formal economy has not kept pace (Jayne *et al.*, 2017) [2].

There are multiple factors that affect economic growth; and one of those factors is population growth, which is an important factor for economic development. Within population, the nation can get enough labour for production, skills and market for various commodities. This implies that the size of a population is one of the parameters of economic development (Census survey, 2002, 2022). The 2022 Tanzania Census report shows the crude birth rate is 35.8 births per 1,000 people, compared to a crude death rate of six people per 1000. It is obvious that the crude birth rate is higher than the crude death rate.

On the contrary, life span is 66.08 years. Thus, the population will keep growing due to the decline of death rate and high life expectancy. As pointed out by Ishumael *et al.*, (2022) [1], for over the past ten years, production of food has increased by twenty-four per cent worldwide. However, the increase was not evenly distributed throughout the world as in Tanzania, for example, food production decreased while population increased by eleven point one per cent. So far, there has been an improvement in the public health as the population grows due to increased number of doctors, nurses as well as improved physical health infrastructure. If the economic institutional framework was proper, it could multiply food production due to high demands and labour availability. The accessibility of safe drinking water and improved housing condition have led to population growth as indicated in the past census reports.

Despite the deliberations, many poor nations especially in sub–Saharan Africa are still struggling to meet the needs of rapidly growing populations amidst huge disparities between the rich and the poor. In addition, more people are vulnerable to food insecurity, water shortages, and weather-related disasters which undermine their welfare. For Tanzania, despite having achieved relatively high economic growth (GDP), increasing from 1.6% in 1992 to 4.3% in 2021 and 4.6% in 2021-2022, little has changed in terms of human welfare (MDG, 2010 & WB, 2020-2021).

In Tanzania, there has been a series of census aimed at establishing the total number of people, settlement patterns, health and education services as well as people's welfare. In 1967, Tanzania had a total population of 12.3 million; and in 1988, the population rose to 24,844,147, and in 2022, it rose to 65,497,748 people. Thus, the population has increased by 30 per cent from the previous census; and it is projected to reach 70.1 million by 2025, making Tanzania a leading country in the East African region, and the sixth in Africa in terms of population growth.

The growing trend of population will have a significant impact on economic expansion. But the argument over whether population expansion has a positive or negative impact on the economy is still alive. Because the underlying characteristics and assumptions differ between nations, national evidence on the association between population expansion and economic growth is inconsistent (Sethy & Sahoo, 2015) [5]. Additionally, the literature now in circulation varies across nations; population expansion may encourage, hinder, or even have no effect on the economic growth.

The fact that the implications of population growth evolve throughout time explains this outcome. For instance, a higher fertility rate may have a short- term negative impact due to the expense of raising children, but it may have a favourable long-term impact due to the larger labour force it produces (Yao *et al.*, 2013) [6]. Therefore, this article aims to investigate how the 2022 census will advance the society, and the effects of population expansion on the economy. This contributes to the development of the few local data on population changes and economic expansion in Tanzania.

This article assesses the long and short-run effects of population increase on economic growth in Tanzania. Specifically, it determines the existence of a long run or short run effects of population growth and its influence on economic growth. This will help policymakers and individuals with some quest for knowledge especially in the field of economics, population, political science, resource utilisation as well as drawing a generalisation on the existing theories.

This article employs the Boserup theory (1965) [7], which asserts that population growth is an autonomous factor that affects agricultural productivity; contrary to the Malthusian theory. Ester Boserup viewed population expansion as an accelerating factor for agricultural productivity in terms of land use, technology, land tenure systems, and settlement patterns. This implies that if population density increases, there will be an increase in the labour force, which will stimulate income per capita and a rise in the GDP of the nation.

2. Methods and Materials

The article determines the long and short-run effects of population growth on economic growth from 1990 to 2021 in Tanzania. It applied the quantitative model based on Pritha Bhandari (2020), who viewed the quantitative research as a useful component in finding the patterns, making predictions and testing a causal relationship. The article uses the variable population growth rate as an independent variable and economic growth rate as the dependent variable whereas the saving rate and foreign direct investment are control variables to address the study objectives.

The analysis made use of public secondary time series data (population growth, saving rate, foreign direct investment and GDP) from the National Bureau of Statistics, and the World Bank for the year 1990 through 2021. The logarithm (Log) was applied in all variables to normalize the data. This study included both descriptive and inferential statistics. The statistics were analyzed using the STATA software to calculate the mean, median, standard deviation and chi square. The inferential statistics such as the chi square test were calculated in the attempt to explain the long and short-run effects of population growth on economic growth. On the other hand, the results of stationarity test, co-integration test and causality test were presented in tables based on confidence level of 95%, followed by discussions. These data were lagged out in order to determine stationarity.

Stationary of variables and hypothesis testing were applied to guide the author to accept or reject the results. Earlier on before performing the unit root test, the author determined the optimal lag length to be applied so as to improve the VAR model, and to reduce residual correlation. The variables used were saving rate, foreign direct investment and GDP. The alternative hypothesis could be stationarity or trend stationarity. So, the unit root test was used to determine if trending data could be differentiated or regressed on the deterministic functions of time to render the data stationary. The criterion for rejection was to reject the null hypothesis, if ADF statistic was greater than 5%, with the p-value less than 0.05 level of significance. The unit root test conducted was based on the inclusion of two equations, which are equation on intercept only and the equation on both intercept and trend based on Perron (1989) model.

Model with Intercept led

$$y_t = \hat{\mu}^A + \hat{\theta}^A DU_t(\hat{\lambda}) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t$$

And the model with both Intercept and Trend

$$y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t$$

where, $DU_t(\lambda) = 1$ if $t > T\lambda$, 0 otherwise;

$DT_t^*(\lambda) = t - T\lambda$ if $t > T\lambda$, 0 otherwise.

Co-integration Test: The article used two statistics for testing the hypotheses, namely trace statistics and maximum statistics. In this test, if the p-value is greater than the critical value (5%), this allows the rejection of the null hypothesis; otherwise, this does not reject the null hypothesis. Also, when maximum Eigen statistics is greater than the 5% critical value, the null hypothesis is rejected, otherwise the null hypothesis is accepted.

In assessing the short and long-run effects of population increase on economic growth, the Vector Error Correction Model (VECM) was also applied to analyze the cointegrated variables or cointegrating relationships that are stationary in their differences.

3. Results and Discussion

3.1 Descriptive statistics for variables of analysis

Table 3.1 shows the summary descriptive statistics of the variables used in the study with a total of 32 observation variables and 31 from the saving variable. The results further show that the growth of population was the minimum of 0.632663, and the maximum of 1.358443, with the mean rate of 1.038856; whereas the GDP grew at a mean of 1.517848, with the minimum GDP of -0.5373 and the maximum of 2.037598; and the saving rate with a mean of 2.899309 with a minimum of 1.22826 and maximum of 3.573038. Lastly, there was a foreign direct investment (FDI) with a mean of 0.244086, with minimum of -8.50847 and maximum of 1.734082.

Table 3.1: Description of Descriptive Statistics for the Variables of the Study

Variable	Observation	Mean	Std. Dev	Min	Max
GDP growth (% annual)	32	1.517848	0.6028185	-0.5373	2.037598
Popn. growth (% annual)	32	1.038856	0.140955	0.632663	1.358443
Saving rate	32	2.899309	0.6213322	1.22826	3.573038
FDI	32	0.244086	2.3688	-8.50847	1.734082

Source: Author's computation from STATA 17

3.2 Testing the long-run and shortirun effects of population on economic growth

3.2.1 Test for stationarity

In this article, the Augmented Dickey Fuller (ADF) test was used to test the null hypothesis; that the data are not stationary (i.e. has unit root) against the alternatives hypothesis; that the data are stationary (Table 3.2).

Table 3.2: Summary for Unit Root Tests (ADF) for the Study variables at Level l (0)

Variables	Test statistic	5% Critical Value	P-Value	ADF result
Lngdp	-2.680	-3.580	0.2446	Not stationary
Lnpopgr	-5.056	-3.580	0.0002	Stationary
Lnsavr1	-1.746	-3.584	0.7302	Not stationary
Lnfdi	-16.268	-3.580	0.000	Stationary

Source: Author's compilation from STATA 17

A 5% level of significance was used and the guideline was to reject the null hypothesis, if the ADF test statistics was greater than the critical value at 5% level of significance. The lags were automatically selected based on the Akaike Information Criteria (AIC).

The results in Table 3.2 suggest that the variable GDP growth rate and saving rate are not stationary at level *I* (0) without doing any differencing. This is because the ADF test statistics show to be greater than the critical value at 5%; and the p-value at level is greater than 0.05, Therefore, the null hypothesis is rejected by accepting the alternative hypothesis. This implies that population growth rate, as an independent variable, and economic growth rate, as the dependent variable, whereas the saving rate and foreign direct investment, as control variables, have no unit root or is stationary. Thus, the selected model is valid for the data used in this article. Table 3.3 illustrates.

Table 3.3: Summary of Unit Root Tests (ADF) for the Study Variables at First Difference I (1)

Variables	Test stats ADF at level	5% Critical Val.	P-Value At level	ADF Result
Lngdp	-7.718	-3.584	0.0001	Stationary
Lnsavr1	-5.085	-3.584	0.0001	Stationary

Source: Author's compilation from STATA 17

The data in Table 3.3 revealed that the variable GDP growth and saving rate are proved to be stationarity at the first differencing at order I (1). This is because the ADF test statistic is less than the critical value at 5% and the p-value is less than the 0.05. Thus, rejecting the null hypothesis means the variables are stationary at 0.05 level of significance.

3.2.2 Co-integration test

The article tests the hypothesis based on the following hypotheses of maximum rank.

i. Maximum rank zero.

H_{0d}: There is no co-integration among variables.

H_{1d}: There is a co-integration among variables.

If Trace statistics or Maximum-Eigen statistics is less than 5% Critical value, then accept or do not reject H_0. Table 3.4 is illustrative.

Table 3.4: Johansen Tests for Co-integration Results (Trace Stats and Max Eigen Value)

Max. Rank	Parms	LL	eigenvalue	Trace Statistics	5% Critical Value
0	68	113.82764	-	123.3906	47.21
1	75	152.65276	0.94364	45.7404	29.68
2	80	166.36396	0.63783	18.3180	15.41
3	83	175.51772	0.49240	0.0105*	3.76
4	84	114.17573	0.00039		
Max. Rank	**Parms**	**LL**	**Eigenvalue**	**Max. Eigen Stats**	**5% Critical Value**
0	68	113.82764	-	77.6503	27.07
1	75	152.65276	0.94364	27.4224	20.97
2	80	166.36396	0.63783	18.3075	14.07
3	83	175.51772	0.49240	0.0105	3.76
4	84	175.52294	0.00039		

Source: Author's compilation from STATA 17

From the Johansen co-integration test results in Table 3.4, the trace statistics indicate that there is a maximum of two co-integration equation in this model. For the maximum rank zero, the trace statistics (123.3906) is greater than the critical

value at 5% level (47.21); thus the null hypothesis is rejected. However, the Maximum Eigen Statistics (77.6503) is greater than the critical value at 5% level (27.07), the null hypothesis is rejected. For one co-integration, the trace statistics is (45.7404), which is greater than 5% critical value of (29.68); therefore, reject the null hypothesis. Also, for two co-integration, the trace statistics is (18.3180), which is greater than 5% critical value of 15.41; which allows the rejection of the null hypothesis.

Also, for the third co-integration, the trace statistics is (0.0105*), which is less than 5% critical value of (3.76); which allows the acceptance of the null hypothesis. Hence, there is a long-run causal relationship among the variables. This gives room to determine the short-run and the long-run effect by using VECM.

3.2.3 Vector Error Correlation Model (VECM)

The results from the test of co-integration between GDP growth, population growth, saving rate and FDI indicate the stationarity series are cointegrated. This implies existence of dynamic interrelationship between variables and so, the restricted Vector Autoregressive model (VECM) was used. Table 5 is illustrative.

Table 3.5: Vector Error Correlation Model

Equation	R-Square	Chi^2	$P > Chi^2$
D_Lngdp	0.6318	24.01864	0.0456
D_Lnpopgr	0.9073	137.0032	0.0000
D_Lnsavr1	0.9281	180.7778	0.0000
D_Lnfdi	0.5694	18.50924	0.1846

Source: Author's compilation from STATA 17

The findings in Table 3.5 revealed that the three variable, namely GDP growth, population growth and saving rate are statistically significant as indicated by the p-value; while FDI is insignificant, as indicated by the p-value; and the coefficient of determination for each variable, which implies that the regression model provides good fit for data in this article.

3.2.4 Estimate the Short-run Effect

Table 3.6 depicts the effects of the short-run effects.

Table 3.6: Vector Error Correction Model when ΔLnFEXPV is a Dependent Variable

Variables	Coef.	Std. Err.	Z	Prob	[95% Conf. Interval]	
ECT_{t-1}	0.417304	0.462217	0.90	0.367	-0.48862	1.323233
$\Delta Lngdp_{t-1}$	-1.36644	0.753681	-1.81	0.070	- 2.8436	0.1107473
$\Delta Lngdp_{t-2}$	-0.62747	0.787044	-0.80	0.425	-2.17005	0.9151102
$\Delta Lngdp_{t-3}$	-0.07608	0.500267	-0.15	0.879	-1.05658	0.9044272
$\Delta Lnpopgr_{t-1}$	0.44498	2.542406	0.18	0.861	-4.53804	5.428004
$\Delta Lnpopgr_{t-2}$	0.146776	1.062225	0.14	0.890	-1.93515	2.228699
$\Delta Lnpopgr_{t-3}$	0.522833	1.115779	0.47	0.639	-1.66405	2.709719
$\Delta Lnsavr1_{t-1}$	0.866049	0.601643	1.44	0.150	-0.31315	2.045247
$\Delta Lnsavr1_{t-2}$	0.435685	0.467433	0.93	0.351	-0.48047	1.351837
$\Delta Lnsavr1_{t-3}$	-0.09115	0.542667	-0.17	0.867	-1.15476	0.9724555
$\Delta Lnfdi_{t-1}$	-0.11639	.2177395	-0.53	0.593	-0.54315	0.3103712
$\Delta Lnfdi_{t-2}$	-0.01284	0.158416	-0.08	0.935	-0.32333	0.2976525
$\Delta Lnfdi_{t-3}$	0.086245	0.137494	0.63	0.530	-0.18324	0.3557295
Constant	-0.06894	0.095517	-0.72	0.470	-0.25615	0.1182716

Source: Author's compilation from STATA 17

Table 3.6 revealed that in the short run, GDP growth, population growth, saving rate and FDI were statistically insignificant at 5% level of significance. This implies that the variables population growth, saving rate and FDI have no significant effect on the GDP growth value in the short run. Table 3.7 shows the estimate of long-run effect.

3.2.5 Estimate the Long-run Effect

Table 3.7 reveals that in the long run, all the variables population growth, saving rate and FDI are statistically significance since the p-value is less than 0.05. Also, one per cent increase in GDP growth leads to 2.461014% increase in population growth. Similarly, one per cent increase in GDP growth leads to 2.32219 decrease in saving rate; and one per cent increase in GDP growth leads to 0.4121835 increase in the foreign direct investment (FDI). There are various reasons for the association between population increase and economic development in the long run. Tanzania being the case, more people is a central point for a larger workforce, and easier access to labour, market, technological innovation and resource utilisation like natural resources such as land and water. More labour leads to more production, which leads to economic growth. These results are in line with Boserup (1965) [7], who pointed out that population is the blessing towards economic development as opposed to Thomas Malthus (1798) [3].

Table 3.7: Lon-run Effects Based on Johansen Test

Variables	Coefficients	Standard Error	Z-Alpha	Prob.	95% Conf. Interval	
Lngdp	1					
Lnpopgr	2.461014	0.569993	4.32	0.000	1.343848	3.57818
Lnsavr1	-2.32219	0.28627	8.11	0.000	-2.883274	-1.761115
Lnfdi	0.4121835	0.136854	3.01	0.003	0.143954	0.680413
Constant	2.632198					

Source: Author's compilation from STATA 17

4. Conclusion and Recommendations

The findings in this article support the existence of a long-run relationship between population growth and economic growth in Tanzania; and provide a strong support for the hypothesis that population drives economic growth in the country. The results of the causality tests suggest that there appears to be unidirectional causality, which is assumed to run from population growth to economic growth. Overall, the relationship between population and economic growth is strong and positive in Tanzania over the period of the analysis. These findings give support to the study hypothesis, which states that; population growth triggers economic growth, which is a blessing to the country. Based on the results, the article recommends the following.

- More strategic planning is needed to manage population increase and demand for social services by equitably allocating resources to the most vulnerable sectors like agriculture to increase yields and adding up to the employment.
- The government, in collaboration with relevant stakeholders, should continue to build more infrastructure to create a conducive investment environment to stimulate economic growth in the short run and the long run as well.

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