Research Article

An Empirical Analysis of the Effects of Population Growth on Economic Growth in Ethiopia Using an Autoregressive Distributive Lag (ARDL) Model Approach

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Between 1980 and 2020, the study looks at “An Empirical Analysis of the Effects of Population Growth on Economic Growth in Ethiopia Using an Autoregressive Distributive Lag (ARDL) Model Approach.” The appraisal coefficient of population growth (POP) and the implication is positive and significant, according to the findings of this study. However, in response to the long-term association between population expansion and economic growth in Ethiopia, the macroeconomic variables were subjected to a limit test and a broader causality test. From the finding of bound test, since the value of F-statics is greater than the upper boundary line, there are long run equilibrium relationships among RGDP, population size, foreign direct investment, personal remittance, population growth rate, rate of inflation, and gross capital formation. According to the findings of the Granger causality test, real gross domestic product can cause Ethiopian population size (POP), but population number (POP) cannot cause real gross domestic product at the same time. The motivation of doing this research was to know the sign and effects of population growth on economic growth. Finally, in order to boost Ethiopia’s economic growth, the government should implement policies that would attract foreign investors. The government should also establish a benchmark to ensure that the economy increases faster than the population.

1. Introduction

The world’s population was estimated to be around six billion people as the twenty-first century began. According to UN projections, the population will reach more than 9.2 billion by 2050, with a maximum of 11 billion by 2200. Over 90% of that population will live in underdeveloped countries [1].

According to Anulawathie Menike [2], population growth and economic development in a country have a close and reciprocal link. In one sense, the population is a supply of labor that could be used to boost the country’s output. It might also be viewed as a consumer group that consumes and depletes a significant portion of the country’s resources. Certain economists from the past have noted that a country’s population increase and quick growth are linked to its economy.

Gideon Kiguru Thuku discussed the Malthusian hypothesis, which suggested that food problem is associated with a high population increase, that is, malnutrition and hunger, while Bloom and Williamson [3] have a different view that food problem is more problem on poverty and inadequate income than high population growth. When people could buy, then the food crisis can be overcome as prices give ample incentives to produce. In addition, to meet their rising demand for food, most developing economies would have to expand exports, seek foreign aid, or borrow from abroad. A high rate of population increase has an impact to render more intense on the constraints to the development of savings, foreign exchange, and human resources, which has an adverse impact on improvement in food supplies [4].

More than 75 million people are added to the world’s population every year. Developing countries account for
nearly all of this net population gain (97 percent). Although such large increases are unusual, the challenge of population expansion is more than just a matter of numbers. It is a question of human well-being and development. Rapid population expansion has the potential to have major ramifications for humanity’s overall well-being. If development involves raising people's standards of living, including their incomes, health, and general well-being, and it also takes into account their capacities, self-esteem, respect, dignity, and freedom of choice [1].

Ethiopia’s population is growing at an incredible rate. Ethiopian populations were estimated to be 11.75 million in the early twentieth century, with a 0.2 percent annual growth rate, and expected to double in 346 years. Ethiopia’s population, on the other hand, has more than doubled in the last 60 years. Between 1960 and 1990, Ethiopia’s population doubled. According to population census data from 1984, 1994, and 2007, Ethiopia’s population was 39.37 million, 55.18 million, and 80.67 million, respectively. As a result, it will only take 27 years to double the population growth from the 2007 census report.

Kassahun Alemu [5] uses a time series data on "the impacts of population growth on the Ethiopian performance from 1970/71 up to 2002/13." From the general regression results, he concluded that "population issue was very controversial because it has negative impact in the short run, but the implication is positive in the long run." This invites to investigate other variables like investment, age dependency ratio, and labor force that affect economic growth if its correlation can be positive in the long term.

In Ethiopia, monetary policy is a tool used by the government or the Central Bank of Ethiopia to achieve a set of goals aimed at promoting economic growth and stability. The National Bank of Ethiopia’s key responsibilities in Ethiopia include monetary policy management and financial sector stability (NBE). With changing economic dynamics within the country and increased empirical and theoretical understanding of monetary policy around the world, Ethiopian monetary policy and the process of formulating it has changed [6].

Population increase and per capita output growth do not appear to be independent, according to the literature. The nature of their interaction appears to be highly dependent on the conditions and population age structure in each country and region. Because of Japan’s aging population, a smaller cohort of working-age individuals will be required to sustain increasing numbers of pensioners and slower economic development unless productivity and per-capita output increase significantly. In many African countries, a new form of dependency problem arises, where a small working-age population is required to support a huge number of children with significant educational and health demands. When these youngsters join the labor force in the future, economic growth should accelerate (Peterson [7]).

The trends suggest that the interaction of population pressures and the economy is a very important issue and may have contributed to perpetuation of poverty trap in Ethiopia. Specifically, this study tries to know the effects of total population on economic growth, which analyze the short-run and long-run relationship of economic growth.

All in all, it is clear that the issues facing both the effects of population growth on economic growth may need to be analyzed by increasing the integration and development rather than further separation and rejection. The current bipolarity of “population growth versus economic growth” and “economic growth versus population growth” is consequently what represents the main dilemma of interest for this study. Thus, the researcher wants to study aims to reflect upon its importance. The implication and motivation toward doing this research were to analyze the effects of population growth on economic growth in Ethiopia. And, an economic scholar will get sufficient information about the economic growth of Ethiopia and also the level of Ethiopian population growth. This research will also be used for the future citation about "the effects of population growth on economic growth form 1980–2020.”

1.1. Statement of the Problem. Ethiopia’s population is growing at an incredible rate. Around 20th century, the number of Ethiopian populace considered to be 11.75 million with 0.2 percent annual growth rate and it is anticipated to be doubled in 346 years. Ethiopia’s population, on the other hand, has more than doubled in the last 60 years. Between 1960 and 1990, Ethiopia’s population doubled. According to population census data from 1984, 1994, and 2007, Ethiopia’s population was 39.37 million, 55.18 million, and 80.67 million, respectively. Therefore, in order to double the population growth from 2007 census report, it just requires 27 years.

Usama Al-Mulali et al. have done a research on "Investigating the environmental Kuznets curve (EKC) hypothesis: Does government effectiveness matter? Evidence from 170 Countries." The results of the high and moderate government effectiveness index group countries are not consistent with the low government effectiveness group countries. The results show that the government effectiveness index significantly mitigates CO2 emission in the full sample countries, and high and the moderate government effectiveness countries, while it is statistically insignificant for the low government effectiveness index countries. Moreover, the EKC is confirmed in the full sample countries, and high and moderate government effectiveness countries, while the EKC was not confirmed in the low government effectiveness countries. Also, the estimation results provide evidence that electricity consumption generated from renewable energy reduces environmental pollution in all country groups including the full sample.

Kassahun Alemu analyzes “the impacts of population expansion on Ethiopian performance from 1970/71 to 20012/13” using time series data. He concluded from the overall regression results that the population issue was very contentious because it has a negative influence in the near run but has a beneficial long-term implication. This opens the door to looking at other factors that affect economic growth, such as investment, the age dependency ratio, and the labor force, to see whether the correlation can be favorable in the long run.
Kiguru Thuku et al. [4] used data from 1963 to 2009 in his study. He used a VAR model in which he included explanatory variables such as real GDP growth, total population, population density, and urban population growth. The estimated Augmented Dickey–Fuller test statistic value is bigger than the critical value at 95 percent confidence level, implying that both economic and population growth rates are stationary at levels, according to the study’s empirical findings. He also omitted variables such as personal remittances and the rate of inflation, both of which are important in the analysis of population and economic growth. There is still a lot of disagreement about the effects of population growth on economic growth. As a result, the argument over the beneficial and negative effects of population expansion on the economy continues. On the plus side, economists argue that increased population leads to technological advancements and innovations. This is because population expansion fosters business competitiveness, and as a country’s population grows, so does the size of its potential market. Kiguru Thuku et al. [8] analyzed “The Nexus among Globalization, ICT and Economic Growth: An Empirical Analysis.” The empirical result highlights that the globalization stimulates economic growth of a country. For long-run causality analysis, the findings of this study observed bidirectional causality between ICT and economic growth. In addition, both the Internet penetration and the mobile phone usage contribute to the economic growth. Lastly, this article contributes important policy lessons on strengthening the economy by utilizing ICT with the rapid globalization.

There appears to be considerable agreement in the literature that population increase and per capita production growths are not mutually exclusive. The nature of the interaction between the two seems to be that it varies very much on the conditions and the age structure of the population in the various countries and areas. Because of the aging population in countries like Japan, a smaller cohort of working-age people will be required to support growing numbers of retirees and slowing economic growth unless productivity and per-capita output rise significantly. In many African countries, a new form of dependency problem arises, where a small working-age population is required to support a huge number of children with significant educational and health demands. When these youngsters join the labor force in the future, economic growth should accelerate.

Liu et al. [9] have a research on “Estimating the impact of information technology on economic growth in south Asian countries: The silver lining of education.” According to the results, the impact of ICTs on economic growth remains positive in South Asian economies. In addition, education stimulates economic growth; however, foreign direct investment does not contribute to economic growth. The newly acquired result would guide policymakers and government officials to focus on the advancement of ICT for maintaining the sustainable economic growth. The findings imply that South Asian countries should raise the ICT level with proper technology education level to achieve the desired economic growth.

Latif et al. [10] discussed about the “The dynamics of ICT, foreign direct investment, globalization, and economic growth: Panel Estimation Robust to Heterogeneity and Cross-Sectional Dependence.” Empirical results of the study suggest the long-run elasticities between ICT and economic growth, which suggests that ICT positively contributes to economic growth. Findings from long-run output elasticities show that both FDI and globalization have a long-run effect on economic growth. Furthermore, bidirectional causality exists between GDP and FDI, globalization and economic growth, and trade and economic growth. Also, unidirectional causality is running from globalization to trade. Globalization and ICT also Granger causes each other. Sensitivity analysis is employed to check whether findings of the study are valid and reliable for policy recommendation. The outcome of our study suggests policy recommendations for improving ICT with the focus on economic growth, trade openness, and facilitation of foreign investment in BRICS countries.

According to [11], a large population growth on the other side is not only associated with food problem but also imposes constraints on the development of savings, foreign exchange, and human resources. The increase in demand for food leads to a decrease in natural resources, which are needed for a nation to survive. Other negative effects of population growth include poverty caused by low income per capita, famine, HIV/AIDS, and disease since rapid population growth complicates the task of providing and maintaining the infrastructure, education, and health care needed in modern economies. The third school of thought is that population growth is a neutral factor in economic growth and is determined outside standard growth models. This rapid population growth may pose a threat unless the country’s economic performance compensates. Econometric research has indicated that this population growth has had a major negative impact in the short run but a favorable impact in the long run on the economic performance of the country [5].

According to the trends, the combination between population pressures and the economy is a major issue that may have led to Ethiopia’s poverty trap perpetuation. As a result, the purpose of this article is to investigate the relationship between population growth and economic growth. If the population keeps growing quickly, economic expansion will also happen.

1.2. Objective of the Study

1.2.1. General Objective. This study looked into the “Effects of Population Growth on Economic Growth in Ethiopia Using the ARDL Model,” with a focus on total population, real GDP, personal remittance, population growth rate, net inflow of foreign direct investment, inflation rate, and gross capital formation.

1.2.2. Specific Objectives

(i) To understand the effects of total population on economic growth
(ii) To analyze the short-run and long-run relationship of economic growth with respect to population growth

(iii) To identify the causal relationship between population growth and economic growth

2. Review of the Related Literature

2.1. Theoretical Literature Review. Population of an area is the total number of all individuals that live in a caution point in time. Population of a country is the number of people, and a tall account is taken of differences of quantity; it is of quality in close relation to numbers. Thus, population can be regarded as a label for a human aggregate [12].

Real gross domestic product (RGDP) is an inflation-adjusted measure of the value of all goods and services produced by an economy in a given year (expressed in base-year prices) and is often referred to as "constant-price," "inflation-corrected," or constant dollar" GDP. Real gross domestic product (RGDP) makes comparing GDP from year to year and from different years more meaningful because it shows comparisons for both the quantity and value of goods and services (Ganti and Reviewed by [13]).

Gross domestic product (GDP) is the most important measure of the productive capacity of an economy, and GDP can be measured in three different ways. The Commerce Department measures GDP using three methods: the income method, the expenditure method, and the product (or value-added) method. The gross domestic product (GDP) is the value of all final goods and services produced. Final goods are those that are sold directly to final users as opposed to intermediate goods that are produced by one firm and used as an input by another [14].

2.1.1. Malthus Model of Population Growth. Malthus discusses Malthus’s theory, which believed that the world’s population tends to increase at a faster rate than its food supply. Whereas population grows at a geometric rate, the production capacity only grows arithmetically. Therefore, in the absence of consistent checks on population growth, Malthus made the prediction that in a short period, scarce resources will have to be shared among an increasing number of individuals. The positive check to population is a direct consequence of the lack of a preventive check. When society does not limit population growth voluntarily, diseases, famines, and wars reduce population size and establish the necessary balance with resources [15].

2.1.2. Boserup’s Model. This model has been proposed by Boserup [16], who has rejected classical (Malthusian trap) theory and rather basically argued that we would never out strip out food supply. She considers population growth as autonomous force of exogenous factor that causes to technological progress in agriculture and postulates that aggregate agricultural production function in the long run will always shift upward in response to population pressure to maintain output per capita. Generally, the reason why she rejects classical extensive margin is that land productivity can increase due to factors. Firstly, she argues increases in physical labor input to work longer hours will give increased output per hectare. Secondly, the long-term technological progress would lead increased output per hectare that results in to shift in the production function [17].

2.2. Empirical Literature Review. Many researchers have been stated the relationship between population growth and economic growth is as below.

Quang Dao [18] studied on the relationship between population and economic growth in developing countries. Dao adopted a methodology of least square estimation technique in a multivariate liner regression. From the result of the estimation, population growth has appositive impact on overall economic growth. However, the coefficient is always smaller than one, suggesting that the additional people have a less than proportionate influence on economic growth.

Bucci [19] investigated whether there is a long-run relationship between population (size and growth) and per-capita income focusing on human and physical capital as reproducible inputs. The study found out that population growth exerts a negative effect on economic growth. The study also extends edits analysis to the case where physical and human capital can interact with each other in the production of new human capital. If physical and human capitals are substitutes for each other, the increase of population size, together with the reduction of the aggregate human capital stock, determines an unambiguous decline of the per-capita level. On the other hand, if physical and human capitals are complementary for each other, the increase of population size determines the final effect on the per-capita level of skills.

Tartiyus et al. [20] conducted a study on the impact of population growth on economic growth in Nigeria from 1980 to 2010 using error correction model. The result of co-integration test shows the existence of long-run equilibrium relationship among population, economic growth, and other variables. The coefficients of population, fertility, and export have positive relationships with GDP Growth.

The use of time series analysis to analyze a long-run relationship between population increase and economic development does not ensure that all methodological issues can be handled, as the empirical findings of the available research works on the topic have demonstrated. To put it another way, many scholars have examined the comovements of population growth and income levels using the classic co-integration test—the Johansen co-integration test. The problem is that while the Johansen co-integration test requires all underlying variables to be integrated to order one, certain variables may not be. This study employs Pesaran et al.’s limit testing procedure for co-integration analysis to address this methodological problem (1999, 2001). The use of the limit testing strategy to investigate the complex relationship between population increase and economic development is a significant methodological advance. The purpose of this paper is to add to the ongoing debate between the two schools of economic thinking about
the impact of population growth on economic development by using Thailand as a case study.

Ali et al. [21] analyzed the empirical relationship between population growth and economic development of Bangladesh. The researchers were detected serial correlation by using the Durbin–Watson d statistics. From the result, the coefficient for population growth is negative, and significantly different from zero, meaning that population growth adversely affects the economic growth developed. These results demonstrate that rapid population growth is a real problem in Bangladesh.

2.2.1. Benefit from Population Growth. A growing population means a larger labor force that can contribute directly to development and economic progress, and a larger population equals more total output. Furthermore, a growing population can provide a growing market for most goods and services, encouraging businesses to spend more and more in capital goods and machines, resulting in increased economic activity and increasing income and employment. Furthermore, an expanding population can give low-cost labor to enterprise and produce low-cost export goods, both of which are necessary for economic success. It generates a lot of jobs at the grassroots level in Bangladesh, which lowers the unemployment rate, raises the living standard, and lowers the poverty rate. Trade liberalization benefits less developed countries in the long run [22].

2.2.2. Malthus, Effective Demand, and Savings. The process of development, according to Malthus, is not mechanical; population growth cannot lead to economic progress without growing effective demand. The Says law, which states that "supply produces its own demand," is rejected by Malthus. Excess savings, in the sense of not spending, have a detrimental influence on the economy, and savings contribute to a decrease in effective demand, according to Malthus. Excess savings were discouraged by Malthus because he anticipated that this trend would weaken effective demand. More than 70% of the population lives in rural areas, while 24.3 percent of the population lives in poverty. They do not have sufficient purchasing power to meet their basic needs. Dependence on foreign capital has a beneficial impact on income disparity, increases fertility rates, accelerates population growth, and slows economic development (Williams et al.). Domestic saving is unavoidable because it secures the domestic financial market, reduces reliance on foreign debt, and allows the government to borrow from the domestic capital market to invest in a local initiative to stimulate the economy. Furthermore, savings are required to cover the budget deficit, and the government can take advantage of a lower interest rate than is available elsewhere.

2.2.3. Population Growth and Environmental Degradation. Malthus considered that if the population is not controlled, the country will face ruin. The population and the environment have a complicated interaction. Excess population has a variety of negative effects on the environment. It puts downward pressure on arable land, agricultural land, and forestland, all of which are necessary for biodiversity balance. According to recent statistics, forest area as a percentage of land area was 10% in 2017, but according to worldwide forest policy, it should be at least 25% of total land area for a country. Every year, climate change and natural calamities wreak havoc on agricultural productivity.

Therefore, both the theoretical and empirical reviews show that the topic, that is, investigating the relationship between population growth and economic growth, is sensitive issue, especially countries like Ethiopia, which has been recording an exponential population growth rate.

3. Methodology

3.1. Data Type and Source. In this study, secondary data were used to analyze the relationship between variables considered. The time series data from 1980 to 2020 that are obtained from World Bank database of Ethiopia were used.

3.2. Data Analysis. After the collection of the secondary data, the model clearly specified to analyze the secondary data. In order to analyze the secondary data, the researcher used EViews 10 software. EViews 10 software is used for the flexible and comfortableness for tabulation, graphing, and data analyzing process.

3.3. Research Design. This study used a time series design, which introduced both descriptive and inferential statistics. The main reason for the use of this design is to provide precise comparisons between population growth and economic growth. The time series approach is a good way to study unplanned events in an ex post facto manner [23].

3.4. Data Collection

3.4.1. Data Type and Source. This study used published data from 1980 to 2020. The main sources of this secondary data were from MoFED, FRED, World Bank, World Development Indicator, and the National Bank of Ethiopia.

3.5. Ethical Considerations. This related to the moral standards that the researcher followed during the study acknowledging the source of data. After the study approved to be conducted, the necessary measures were taken that no harm was done to other people. All the sources of information from other authors were greatly acknowledged, and eventually, it was cited.

3.5.1. Definition of the Variables and Expected Sign. The dependent variable is real gross domestic product (RGDP), which is a measure of the total product of the country at a given period:

Total population (POP): total population of a country consists of all persons falling within the scope of the
census. This variable was expected to influence economic growth positively.

Foreign direct investment (FDI) net inflows refer to direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capitals. This variable was expected to have a positive effect on economic growth.

Personal remittance (PRem): personal remittances comprise personal transfers and compensation of employees. This variable was expected to have a positive effect on economic growth.

Population growth rate (POPGR): population growth rate is calculated as the division of birth and deaths over population size. The population growth rate was expected to have a positive effect on the economy.

Rate of inflation (RI): inflation is a continuous increase in the overall price level in a country and measured in percent. This variable was expected to have a negative impact on real GDP.

Gross capital formation (GCF) measures the value of acquisitions of new or existing fixed assets by the business sector, government, and “pure” households or excluding their unincorporated enterprises less disposals of fixed asset. This variable is expected to influence economic growth positively.

3.6. The Autoregressive Distributive Lag (ARDL) Model. ARDL model is used in order to undertake this study. We applied ARDL model because it allows capture sufficient number of lags in data generating process. ARDL technique applied irrespective of whether the underlying variables are I(0) or I(1) or a combination of both but not I (2). This helped to avoid the pretesting issues that come with traditional co-integration analysis, which requires the classification of variables into I(0) and I(1) categories (1). Since each of the underlying variables stands as a single equation, endogeneity is less of a problem in the ARDL technique because it is free of residual correlation. The major advantage of this approach was laid in its identification of the co-integrating vectors where there are multiple co-integrating vectors.

Even though economic growth is affected by many factors, in order to address the issue econometrically, the following general form of multiple regression econometric models was drawn to show the effect of population growth on economic growth and the relationship between the dependent and independent variables. The selection of the variables was included in the model based on their effect in developing countries like Ethiopia.

\[ Y_t = \beta_0 + X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots \beta_n X_n + \epsilon_t, \]  

where \( Y_t \) represents a dependent variable measured at a time \( t; \beta_0 \) represents constant term; \( \beta_1, \beta_2, \beta_3, \ldots, \beta_n \) represent independent variables; and \( \epsilon_t \) represents the error term. Depending on equation (1), the researcher developed a simple log linear Cobb Douglass production function as a hypothetical equation to achieve the goals of this specific study.

The equation expressed as follows:

\[ \text{RGDP} = f(\text{POP}, \text{FDI}, \text{PREM}, \text{POPGR}, \text{RI}, \text{GCF}), \]

\[ \ln \text{RGDP}_t = \beta_0 + \beta_1 \ln \text{POP} + \beta_2 \text{FDI} + \beta_3 \text{PREM} + \beta_4 \ln \text{POPGR} + \beta_5 \text{RI} + \beta_6 \ln \text{GCF} + \epsilon_t, \]  

where \( \beta_0, \ldots, \beta_7 \) are parameters of interest, which are to be estimated and \( \text{RGDP} = \text{real gross domestic product, POP} = \text{total population, FDI = foreign direct investment net inflow, PREM = personal remittance, POPGR = population growth rate, RI = rate of inflation, and GCF = gross capital formation.} \)

Real gross domestic product (RGDP), total population, population growth rate, and gross capital formation have been used as a natural logarithm. Four of them are stationary after changing them to logarithm form.

3.7. Time Series and Econometric Issues

3.7.1. Stationary Test. Augmented Dicky–Fuller (ADF) test was useful to know whether there exists a unit root of time series data. If the secondary data are stationary at level, then it is integrated of order zero \( I (0) \). If data are not stationary at level, we need difference to make it stationary [24].

Augmented Dicky–Fuller (ADF) test was useful to know whether there exists a unit root of time series data. If the secondary data are stationary at level, then it is integrated of order zero \( I (0) \). If data are not stationary at level, we have taken first difference, second difference, and so on until it become stationary [25].

The procedure of stationary testing using the ADF is similar to that of the DF test but rather applied to a particular model specified as follows:

\[ Y_t = \alpha + \delta_t + \lambda Y_{t-1} + \cdots + B_{j-1}\Delta Y_{t-j-1} + \mu_t. \]  

Simply,

\[ \Delta Y_t = \alpha + \delta_t + \lambda Y_{t-1} + \sum_{i=1}^{j} \beta_i \Delta Y_{t-i} + \mu_t, \]

where \( \alpha \) is a constant term, \( \delta \) is the coefficient of the time trend, \( j \) is the optimal lag length, \( \Delta \) is the difference operator, \( t \) represents the time trend, and \( \mu \) represents the Gaussian white noise. The test for stationarity was carried out under the null hypothesis \( \lambda = 0 \) as against the alternative hypothesis \( \lambda < 0 \).

Testing for stationarity of time series was mandatory to get a meaningful regressing analysis. Accordingly, the assumption of the neoclassical regression model necessitates that the variable was stationary when error term is a zero mean and a constant variable.

3.7.2. Lag Selection Criteria. The issue of finding the appropriate lag length for each of the underlying variables in the ARDL model was very important because we were
needed to have Gaussian error terms (i.e., standard normal error terms that do not suffer from non-normality, autocorrelation). In order to select the appropriate number of lags for the long-run underlying equation, the researcher determined the optimal lag length (\( k \)) by using the lower values of Akaike information criterion (AIC), Schwarz Bayesian criterion (SBC), or Hannan–Quinn criterion (HQC) [26].

We specify those common information criteria as follows:

\[
AIC(m) = \log(\sum_m) + \frac{2mk^2}{T},
\]

\[
SC(m) = \log(\sum_m) + \frac{\log(T)}{T}mk^2,
\]

\[
HQC(m) = -2\log(\sum_m) + 2k\log(T),
\]

where \( \sum_m \) is the likelihood value, \( T \) is the number of observations, \( m \) is the order, and \( k \) is the number of variables.

Given a set of candidate values for the data, the preferred value is the one with the minimum value of AIC, SC, and HQC, which always suggests the best lag length to be chooses in each model.

### 3.7.3. The Long-Run ARDL Model.

To examine the existence of the long-run relationship between the variables, the following version of ARDL model was used:

\[
\Delta \ln RGDPtr = \alpha_0 + \sum_{j=1}^{q} \beta_j \Delta \ln RGDPtr_{t-j} + \sum_{i=1}^{p} \gamma_i \ln POP_{t-i} + \sum_{i=1}^{p} \theta_i FDI_{t-i}
\]

\[
+ \sum_{i=1}^{p} \delta_i PREM_{t-i} + \sum_{i=1}^{p} \partial_i \ln POPGR_{t-i} + \sum_{i=1}^{p} \varphi_i RI_{t-i} + \sum_{i=1}^{p} \Gamma_i \ln GCF_{t-i} + \epsilon_t.
\]

To solve the problem of spurious regression, the research changed real gross domestic product, total population, population growth rate, and gross capital formation into to a natural logarithm. Four of them are stationary after the researcher was changed them to logarithm form.

### 3.7.4. Short Run and the Error Correction Model (ECM).

Once the long-run model was estimated, the next task was to model the short-run dynamics of the model by estimating an error correction model associated with the long-run estimates. This was specified as follows:

\[
\Delta \ln RGDPtr = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln RGDPtr_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta \ln POP_{t-i}
\]

\[
+ \sum_{i=1}^{k} \beta_{3i} \Delta FDI_{t-i} + \sum_{i=1}^{k} \beta_{4i} \Delta PREM_{t-i}
\]

\[
+ \sum_{i=1}^{k} \beta_{5i} \Delta \ln POPGR_{t-i}
\]

\[
+ \sum_{i=1}^{k} \beta_{6i} \Delta RI_{t-i} + \sum_{i=1}^{k} \beta_{7i} \Delta \ln GCF_{t-i} + \alpha_1 \Delta \ln RGDPtr_{t-1} + \alpha_2 \Delta \ln POP_{t-1}
\]

\[
+ \alpha_3 FDI_{t-1} + \alpha_4 PREM_{t-1} + \alpha_5 \ln POPGR_{t-1} + \alpha_6 \ln \ln GCF_{t-1} + \epsilon_t.
\]

### 3.7.5. Bound Test.

The general version of the ARDL bound test modeling was required for the construction to check the long-run relationships. The following unrestricted error correction model was obtained:

\[
\Delta X_t = \delta_{0i} + \sum_{i=1}^{h} a_1 \Delta X_{t-1} + \sum_{i=1}^{h} a_2 \Delta Y_{t-1} + \delta_1 \Delta \ln \ln X_{t-1} + \delta_2 \Delta \ln \ln Y_{t-1}
\]

\[
+ \delta_3 X_{t-1} + \delta_4 Y_{t-1} + \mu_t,
\]

where \( m \) is the ARDL model maximum lag order, \( \Delta \) represents the first difference operator, \( X_t \) is the vector of dependent variables, \( Y_t \) is the vector of \( k \) determinants of \( X_t \), and \( \mu t \) refers to residual error term, which was assumed to be white noise error, having zero mean and constant variance.

The ARDL bound approach to co-integration was involved testing the presence of long-run relationship among the variables. In this approach, long-run and short-run parameters of the model were estimated using error correction model. ARDL formulation can be written as follows:
The null hypothesis that the coefficients of the lag-level variables are zero and alternative hypothesis of the lag-level variables are nonzero. The null of nonexistence of the long-run relationship is defined by

\[ H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8 = 0, \]
\[ H_1: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq \alpha_8 \neq 0. \]  

(10)

The rejection or acceptance of the null hypothesis was based on the whether or not the Pesaran F-statistic critical values fall above or below the upper and lower critical value bounds [27].

3.7.6. Causality Test. Granger causality was used to determine whether one time series is useful in forecasting another [28]. Granger causality was tested the direction of causation whether onetimeseriesisusefulinforecastinganother egressive distributive lag model was used to perform Granger causality tests. Thus, Granger causality test was applied.

\[
\begin{align*}
RGDP = \alpha_0 + \sum_{i=1}^{p} a_{1i} LNPOP + \sum_{i=0}^{q_1} a_{2i} FDI + \sum_{i=0}^{q_2} a_{3i} PREM \\
+ \sum_{i=0}^{q_3} a_{4i} LNPOPGR + \sum_{i=1}^{q_4} a_{5i} RI \\
+ \sum_{i=0}^{q_5} a_{6i} LNGCF + \mu_{1t}.
\end{align*}
\]  

(11)

3.8. Diagnostic Tests

3.8.1. Normality Test. Since a number of the most common statistical tests rely on the normality of a sample or population, it was often useful to test whether the underlying distribution is normal or at least symmetric. To see whether the values of the data are normally distributed or not, for this thesis, Jarque–Bera test statistic of normal distribution was used.

3.8.2. Serial Correlation Test. Error terms from different time periods or cross-sectional observations were correlated; serial correlation occurs in time series studies when the errors were associated with a given time period carry over future time periods. There are different types of serial correlation such as first-order serial correlation, in which the errors in one time period are correlated directly with errors in the consequent time period, and the positive serial correlation, in which errors in one time period are positively correlated with errors in the next time period [29].

In order to detect whether the serial correlation exists in the given econometric model or not, the Breusch–Godfrey Lagrangian multiplier (LM) test was used.

3.8.3. Model Specification Test. Model specification was detected using Ramsey RESET test.

3.9. Stability Test. Pesaran [30] suggested using Boserup [16] stability test also known as cumulative (USUM) and cumulative sum of squares (CUSUMSQ) test.

4. Results and Discussion

4.1. Descriptive Analysis. From the secondary time series data and from existing evidence, it points out that real gross domestic product and number of population have different rate of growth from 1980 to 2021. From Figure 1, we observed that real gross domestic product and number of population have almost the same rate, while the rate of real GDP increases with constant phase and dramatically changes.

In 1980, the number of population in Ethiopia was around 35 million people, and 9 years later in 1988, the number of population was increased to 45 million people. Then, the number of population was reached 55 million within 6 years in 1994; consequently, in 2002 the number of population increased 70,142,091.

The real GDP of Ethiopia in 1980 was 108,920 in constant prices and was reached 310,115 in constant price in 2006. Due to the millennium development goal and political strength, the GDP of Ethiopia was again doubled within two years and reached 626,977 in constant price. In 2015, again the gross domestic product reached 1,449,397.

In Figure 2, we discuss about population growth rate where population growth rate is calculated as the division of birth and deaths over population size. In 1980, the population growth rate of Ethiopia was around 1.88%, and in 1992, the population growth of Ethiopia rate was doubled and becomes 3.6%. Starting from 1992, the population growth rate of Ethiopia was gradually going down to 3.57% in 1993, 3.47% in 1994, 3.32% in 1995, and 3.16% in 1996.

4.2. Results from the Stationarity Test. If the variables are not stationary at level, then we apply difference to make stationary.

We can reject the null hypothesis and accept the alternative hypothesis, when the ADF test statistic values are greater than that of the test critical values. From the stationarity test, the null hypothesis said “the variables have unit root, which means the variables were not stationary” and the alternative hypothesis said “the variables have not unit root, which means the variables were stationary.” Depending on the test statistics values and p values, we reject or accept the null hypothesis.

From Table 1, RI and PREM are stationary at level, while LNRGDP, LNPOP, FDI, LNPOPGR, and LNGCF are stationarity after first difference as indicated by ADF test statistic values, which is greater than the corresponding critical values. Thus, we need to conduct an ARDL-based co-integration (bound) test since variables are integrated at different order, that is, I (0) and I (1).

Therefore, LNRGDP, LNPOP, FDI, LNPOPGR, and LNGCF are stationary at first difference since the p values are less than 5% level and also Augmented Dickey Fuller test.
statistics are greater than that of their test critical values at 5% level. For example, from Table 1, the first difference of ADF test statistics values for LNRGDP is 5.19 at intercept and 5.82 at trend and intercept, which are greater than that of test statistics of LNRGDP, which is 2.94 at intercept and 3.53 at trend and intercept.
LNPOP is stationary at first difference because the results of p values are 0.01% at intercept and 0% at trend and intercept, which is less than 5% level. But for rate of inflation (RI), it is stationary at level because the p Values were 0.05% at intercept and 0.12% at trend and intercept, which are less than 5% level.

4.3. Results of Lag Selection Criteria. The guideline for selecting the lag selection criteria depends on the lower value of AIC (Akaike information criterion), SC (Schwarz information criterion), and HQ (Hannan–Quinn information criterion). Thus, the optimal lags are selected based on minimum value of those three information criteria. The VAR (vector autoregression) model is one of the methods of obtaining the number of lag selection criteria. The VAR model tells us to use lag 3 as the maximum lag for ARDL model because lag 3 has the lowest values of AIC. From the below table, lag 3 values of AIC (Akaike information criterion), SC (Schwarz information criterion), and HQ (Hannan–Quinn information criterion) are less than that of lag 2 and lag 1 values.

From the guideline of lag selection criteria, the lower the values of AIC, SC, and HQ will be the better the model. The values of lag 3 in Table 2 of AIC are 43.47600, the values of lag 3 in Table 2 of SC are 50.24994*, and the values of lag 3 in Table 2 of HQ are 45.84028*, which were lower than lag 2 and lag 1.

Generally, from Table 2, the VAR criteria of lag 3 are the best number of lag and the better the model based on the known values of the independent variables. The result of the best-fitted ARDL model by in-sample results, the long-run values of coefficient, and long-run equations.

4.4. Results of Model Selection Criteria. The researcher used autoregressive distributive lag (ARDL) model to estimate the variables and to analyze the effect of population growth on economic growth.

The reason why for selecting and using ARDL model selection criteria was as follows:

(i) ARDL model should have to be defined as

\[
\Delta Y_t = \beta_0 + \sum_{i=1}^{h} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \delta_i \Delta X_t - i \\
+ \psi_1 Y_{t-1} + \psi_2 X_{t-1} + \mu_t,
\]

where Yt is a vector or the dependent variable and the variables in (Xt) are allowed to be purely I(0) or I(1) or co-integrated

(ii) \( \beta \) and \( \delta \) are coefficients

(iii) \( i = 1, \ldots, n, k \)

(iv) \( \beta_0 \) is the constant

(v) The optimal lag selection criteria were lag 3 based on AIC and SC

4.5. ARDL Long Run and Bound Test. Once the ARDL model was developed, then the next steps are identifying the bound test results, the long-run values of coefficient, and long-run equations.

4.5.1. ARDL Bound Test. ARDL bound test is helped to know whether there is co-integration between the variables or not. The model developed by Pesaran et al. can be applied irrespective of the order of integration of the variables (irrespective of whether regressors are purely I(0), I(1), or mutually co-integrated but not I(2)).

From Table 4, since the values of Pesaran F-statistic are 17.90609 and the Pesaran upper bound critical values at 5% are 3.28, then the Pesaran F-statistic is greater than the Pesaran upper bound critical values at 5%. Therefore, the result shows that there are levels of long-run relationships.

Generally, the researcher rejects the null hypothesis (there are no levels of relationships) and accepts the alternative hypothesis (there are levels of relationships). There have been existences of long-run relationships between the variables. The Pesaran F-statistic values have higher values than the Pesaran upper bound critical values at 1%, 5%, and 10% levels of significance.

4.5.2. ARDL Long Run. After checking the existence of long-run relationships, the next step is estimation of the long-run coefficients. In most of regression analysis, researchers have been predicting the values of the unknown dependent variables based on the known values of the independent variables. The result of the best-fitted ARDL model by information criterion is given in table below.

From Table 5, the researcher developed the long-run ARDL model equation as follows:

\[
\text{LNRGDP} = 2.1003 + 0.3905^* \text{LNPOP} + 1.30e - 10 \text{FDI} + 0.000167 \text{PREM} - 0.137^* \text{LNPOPGR} - 0.0115^* \text{RI} + 0.4959^* \text{lnGCF}.
\]

The number of population (POP), which is the main variable for this study, was found to have a positive and
statistically significant at 1% significant level in explaining economic growth. As it expected, population size has a positive effect on economic growth of Ethiopia. From the result of long-run ARDL model, population size is statistically significant at 1% level having probability values of 0.01%. We can interpret it as a one percent increase in population number will result in an increase in economic growth by 39.05 percent.

In this study as it anticipated, foreign direct investment net inflow has a positive effect having 1.30e$^{-10}$ coefficient and statistically significant having probability values of 1%. Holding other thing constant, a one unit increase in the foreign direct investment net inflows results in an increase in economic growth by 1.30e$^{-10}$.

The personal remittance (PREM) coefficient is positive and statistically significant at 5% level of significant having p-values of 0.0004. Thus, personal remittance directly increases the economy of remitted person. Without the other factors, a one percent change in personal remittance will result in an increase in economic growth by 0.0167 percent.

Gross capital formation has a positive effect on economic growth. Gross capital formation is statistically significant at 1% level in explaining economic growth.

| Variable | Coefficient | Std. error | t-Statistic | Prob. * |
|----------|-------------|------------|-------------|---------|
| LNRGDP (-1) | 0.281058 | 0.131681 | 2.134392 | 0.0461 |
| LNRGDP (-2) | -0.437488 | 0.167134 | -2.617585 | 0.0169 |
| LNPPOP | 0.451623 | 0.097259 | 4.643495 | 0.0002 |
| FDI | -2.62E$^{-11}$ | 3.21E$^{-11}$ | -0.817119 | 0.4240 |
| FDI (-1) | 1.77E$^{-10}$ | 4.58E$^{-11}$ | 3.864322 | 0.0010 |
| PREM | -0.000226 | 6.21E$^{-05}$ | -3.648837 | 0.0017 |
| PREM (-1) | 0.000419 | 4.26E$^{-05}$ | 9.844719 | 0.0000 |
| LNPPOPGR | -0.158448 | 0.201627 | -0.785846 | 0.4416 |
| RI | 0.002391 | 0.000805 | 2.970558 | 0.0079 |
| RI (-1) | 0.002891 | 0.001129 | 2.560639 | 0.0191 |
| RI (-2) | 0.004362 | 0.001468 | 2.971370 | 0.0078 |
| RI (-3) | 0.003631 | 0.001127 | 3.221178 | 0.0045 |
| LNGCF | 0.159154 | 0.041861 | 3.801961 | 0.0012 |
| LNGCF (-1) | 0.033733 | 0.056122 | 0.785846 | 0.1951 |
| LNGCF (-2) | 0.166142 | 0.073842 | 2.249969 | 0.0365 |
| LNGCF (-3) | 0.214824 | 0.050341 | 4.267364 | 0.0004 |
| C | -0.115940 | 1.072006 | -0.108152 | 0.9150 |

Source: authors’ own computation. Note. The selected model is ARDL (2, 0, 1, 1, 0, 3, 3).
since probability value is 0%, which is much less than the five percent level. In this study, when gross capital formation increased by 1%, then economic growth increased by 49.59 percent holding other things constant.

Inflation rate has a negative coefficient. It affects economic growth negatively because its probability value is less than 5% level. Rate of inflation has a p value of 0%, which is less than 5% level, and it was statistically significant. Thus, a 1% increase in inflation rate will result in a decrease of economic growth by 1.1479%.

However, population growth rate (POPGR) has a negative coefficient and also not statistically significant. It means that population growth rate does not affect economic growth because its probability values are 43.32%, which is greater than 5% confidence level.

4.6. Results of Short Run and Error Correction Model. The next step was estimation of the short-run coefficients along with the short-run error correction term (ECT) since the long-run model is clearly specified and the effect of the regressors on the regress is clearly interpreted. Thus, the ECT shows the short-run dynamics of the model beside with the long-run adjustment.

![Akaike Information Criteria (top 20 models)](image)
From the long-run model and the short-run model, foreign direct investment net inflow has a positive effect on economic growth. However, in the short run, FDI is not statistically significant having p-values of 25.98%. It means that foreign direct investment net inflow does not affect economic growth in the short run.

From Table 6, the short-run model of the first lag difference of RGDP is statistically significant having p-values of 0.02%, which is less than 5%. Keeping everything else fixed, a one percent rise in the short-run coefficient of real gross domestic product would result in a 43.7488 percent increase in economic growth.

From the long-run model, personal remittance has a positive effect on economic growth and its short-run effect is also positive. From the above short-run result of autoregressive distributive lag (ARDL) model, personal remittance is significant having p-values of 1 percent, which is much less than 5% levels and have a positive coefficient. Other things remain constant, and it tells us that when personal remittance increases by 1%, then economic growth increase is by 0.0226%.

The short-run rate of inflation has positive and statistically significant affects economic growth. From most of the theory and general truth, rate of inflation affects economic growth negatively. Nevertheless, in the short run, rate of inflation has a positive effect on economic growth. We assume other things constant, and 1% increase in inflation rate would account for 0.2391 percent increase in the economic growth of Ethiopia.

Gross capital formation has a positive effect on economic growth and statistically significant having p-values of 0.01%. A 1 unit increase in gross capital formation can lead to an increase in economic growth by an amount of 0.159154.

The error correction term (ECT), which is estimated −0.584298, is negative as it was known and it is statistically significant. Thus, it indicates that 58.42% of the disequilibrium is adjusted before the next time period (year).

Generally, in the short-run foreign direct investment, personal remittance, rate of inflation, and gross capital formation have a positive coefficient.

### 4.7. Granger Causality Test

In chapter three, it was discussed that Granger causality test is a test that enables us to identify the direction of the causality from where the lagged values of one variable in the past or present respond to the cause in the future and where the present and the future values respond to the cause in the past.

From Table 7, the associated probability values of population growth to RGDP are 13.67%, which was greater than 5%. Therefore, we cannot reject the null hypothesis; rather we can accept the null hypothesis, which said POP does not Granger cause RGDP. On the other hand, the associated probability values of RGDP to POP are 0.13%, which was less than 5%. Therefore, we can reject the null hypothesis and we can accept the alternative hypothesis, which was stated as RGDP does Granger cause POP. Generally, there exists a unidirectional flow of causality from real gross domestic product (RGDP) to population number or from economic growth to population growth.

To summarize, the results from the causality test of the model for the period under investigation show that an increased inflow of real gross domestic product (RGDP) can lead to an increase in population number (POP) of Ethiopia, while the increase in population number (POP) cannot lead to an increase in real gross domestic product (RGDP) at the same time.

### 4.8. Results of Model Diagnostic Tests

After estimation of long run and short run, then the next is the crucial step in any model, which was the application of the model diagnostic tests on the estimates of the residual of the ECM model. Diagnostic checks are very important in this analysis because if there is difficulty in the residuals from the estimation of an ARDL model, it is an indication that the model is not efficient.

#### 4.8.1. Serial Correlation Test

From Breusch–Godfrey serial correlation LM test of Table 8, the researcher did not reject the null hypothesis. The guideline is that if the probability values are greater than 5%, then we cannot reject the null hypothesis. Since the Breusch–Godfrey serial correlation LM test has probability chi-squared (3) values of 9.92%, which is more than 5% level.

#### 4.8.2. Normality Test

From the Figure 4, the ARDL model is well behaved and normal since its p values (5.9685%) are greater than the 5%, and then, we can deduce that the model is normal.

#### 4.8.3. Model Specification Test

From Table 9, the Ramsey RESET test also indicates that there is no specification error; rather the ARDL model is stable since we accept the null of no model specification problems given its p values (55.8) are greater than the 5%.

#### 4.9. Stability Test

The researcher performed CUSUM tests of structural breaks for the long-run equations to check the quality of the fitted ARDL model. Figure 5 shows that there

| Variable          | Coefficient | Std. error | t-Statistic | Prob. |
|-------------------|-------------|------------|-------------|-------|
| D (LNRGDP (−1))   | 0.437488    | 0.096066   | 4.554035    | 0.0002|
| D (FDI)           | 2.62E−11    | 2.2E−11    | 1.161598    | 0.2598|
| D (PREM)          | 0.000226    | 2.73E−05   | 8.306190    | 0.0000|
| D (RI)            | 0.002391    | 0.000611   | 3.910762    | 0.0009|
| D (RI (−1))       | −0.007993   | 0.001024   | −7.808011   | 0.0000|
| D (RI (−2))       | −0.003631   | 0.000712   | −5.102695   | 0.0001|
| D (LNGCF)         | 0.159154    | 0.032433   | 4.907130    | 0.0001|
| D (LNGCF (−1))    | −0.380966   | 0.062225   | −6.122378   | 0.0000|
| D (LNGCF (−2))    | −0.214824   | 0.036065   | −5.956529   | 0.0000|
| CointEq (−1)*     | −0.584298   | 0.082597   | −14.00088   | 0.0000|

* p value incompatible with t-bound distribution. Source: authors’ own computation.
Table 7: Results of the Granger causality test.

| Null hypothesis                  | Obs | F-Statistic | Prob. |
|----------------------------------|-----|-------------|-------|
| POP does not Granger cause RGDP  | 38  | 2.11501     | 0.1367|
| RGDP does not Granger cause POP  | 8.13111 | 0.0013     |       |

Source: authors’ own computation.

Table 8: Results of the serial correlation test.

| F-statistic | Prob. F (3, 14) | 0.1338 |
|-------------|----------------|-------|
| Obs’ R-squared | 11.52455 | Prob. Chi-square (3) | 0.0992 |

Source: authors’ own computation.

Figure 4: Results of the normality test. Source: authors’ own computation.

Table 9: Results from the model specification test.

| Value                        | Df  | Probability |
|------------------------------|-----|-------------|
| t-Statistic                  | 0.594892 | 22 | 0.5580 |
| F-Statistic                  | 0.353897 | (1, 22) | 0.5580 |

F-test summary

| Sum of sq. | Df  | Mean squares |
|------------|-----|--------------|
| Test SSR   | 0.000771 | 1 | 0.000771 |
| Restricted SSR | 0.048709 | 23 | 0.002118 |
| Unrestricted SSR | 0.047938 | 22 | 0.002179 |

Source: authors’ own computation.
were no structural breakdowns as shown in the figure. Since the CUSUM test of the residual lies in between the two critical lines, the parameters are stable. Finally, since the blue line lies within the two red lines, then the model ARDL was more stable as of Figure 5.

5. Conclusion and Recommendation

In this study, we investigated the effect of population size on economic of Ethiopia using an ARDL model approach from the period 1980 to 2020. From the result of ADF unit root test, inflation rate and personal remittance are stationary at level, while growth of real GDP, population size, FDI, population growth, and gross capital formation are stationary after first difference.

From the result of ARDL model bound test result, the values of F-statistic (17.90609) are greater than the upper boundary line (3.28), which indicates the existence of co-integration or long-run relationship between variables determined in this study.

The results of the econometric analysis have indicated that there is a long-run relationship between population growth, economic growth, and the independent variables. In support of the theoretical foundation, in the long run, rate of inflation has a negative effect on economic growth, population growth rate is statistically insignificant and all the rest variables have a positive coefficient in both the short run and the long run.

From the result of the study, population growth has a positive effect on economic growth and statistically significant. This shows that an increase in population growth has an effect on the economic growth. From the result of fitted long-run ARDL model, population growth was statistically significant at 5% level having probability values of 0.01%. A 1% increase in population number will result an increase in economic growth by 39.05 percent. In the long run, rate of inflation has a negative effect on economic growth. Both foreign direct investment net inflows and personal remittance are statistically significant and have a positive effect on economic growth. Moreover, the coefficient of error correction term is negative and statistically significant, indicating any deviation from the long run equilibrium will adjusted by the speed of 58.42%.

World population has been increasing in alarming rate as well as in Ethiopia. From the World Bank indicator, the world population was 6.5 billion in 2005 and will be reached 9.1 billion in 2050. But for Ethiopia, the population number was 35.14 million in 1980 and doubled within 22 years and reached 70.14 million in 2002. The population number only needs 13 years to reach 100 million and becomes 113 million people in 2019.

Finally, the researchers recommended the concerned stakeholders that the population size significantly affects the economic growth of the country; the government should plan a strategy, which will maintain the current positive effect of population size on economic growth of the country. Additionally, by concentrating on FDI-attractive activities that call for a supportive environment and personal remittances that have a significant impact on economic growth by either addressing the foreign currency shortage or serving as a source of capital for recipients.

The government has also to encourage Ethiopian foreigner who live abroad to send and help their families in Ethiopia because personal remittance has a great effect on economic growth. Private and government banks of Ethiopia have to create a large awareness for Ethiopian foreigners to send and save their money in Ethiopia, and also, most of the banks must encourage and prepare different kinds of prize for them.

Government should adopt policies that can attract the domestic and foreign investors. The investors could help countries like Ethiopia by creating a large number of employments. Since there are a large number of cheap labor forces (most of them are young), the domestic and foreign investors use this high cheap labor for their investment.
Data Availability
The authors can be reached for reasonable requests on the data sets utilized and/or analyzed for the current study.

Disclosure
Also, the preprint of this research work was published on Research Square.

Conflicts of Interest
The authors declared that they have no conflicts of interest.

Authors’ Contributions
All authors contributed equally to the work.

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