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## Article

# Fostering prosperity: Economic Growth and Government Sectorial Expenditure in Ethiopia

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# Fostering prosperity: Economic Growth and Government Sectorial Expenditure in Ethiopia

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## ABSTRACT

This study delves into the complex relationship between government sectorial expenditure and economic growth in Ethiopia from 1980 to 2021. Utilizing a modified endogenous growth model and the ARDL bound test model approach to co-integration, the research uncovers a long-run co-integrating relationship among the variables. The model encompasses nine key variables: Real GDP, Health, Agriculture, Education, Defense, Road, Water expenditures, Consumer Price Index, Foreign Aid, and Government Tax Revenue. In long run, the study reveals significant positive impacts of government health, agriculture, education, road, water sector expenditures, consumer price index, and government tax revenue on economic growth. Conversely, expenditures on the defense sector and foreign aid exhibit negative and significant impacts on long-run economic growth. The comprehensive short-run analysis offers additional insights, with agriculture, defense, and road sector expenditures emerging as positive influencers of economic growth, while education sector expenditure, consumer price index, and foreign aid showcase significantly negative effects. Intriguingly, water sector expenditure emerges as a non-significant contributor to short-term economic growth. Moreover, the study employs the error correction mechanism (ECM) to underscore the dynamic equilibrium between short-run and long-run dynamics, revealing a noteworthy speed of adjustment of 84.75%. This underscores the pivotal role of the ECM in rectifying short-term deviations from long-term equilibria. To sum up, the study advocates for a paradigm shift towards increased expenditure on pro-poor government sectors, alongside the implementation of a well-defined expenditure strategy and efficient budgetary resource management. Such measures, the study posits, hold the potential to serve as catalysts for propelling sustained and inclusive economic growth in Ethiopia.

## IMPACT STATEMENT

The study examines the intricate relationship between government sectorial expenditure and economic growth in Ethiopia from 1980 to 2021, utilizing a modified endogenous growth model and the ARDL bound test model approach to co-integration. The research uncovers significant findings, demonstrating that expenditures in sectors such as health, agriculture, education, roads, and water positively impact long-term economic growth, while defense expenditures and foreign aid have adverse effects. The short-term analysis reveals varying sector-specific impacts, with agriculture and road expenditures positively influencing growth, whereas health, education, and foreign aid negatively affect it. The study highlights the crucial role of efficient budgetary resource management and the prioritization of pro-poor sectors to achieve sustained and inclusive economic growth. These insights offer valuable guidance for policymakers in optimizing government expenditure strategies to foster economic prosperity in Ethiopia.

**Abbreviations:** ARDL: Auto regressive distributed lag; CPI: Consumer price index; DEFEX: Defense expenditure; EDUEX: Education expenditure; ECM: Error correction mechanism; FAID: Foreign aid; HEAEX: Health expenditure; MOFEC: Ministry of finance and economic commission; NBE: National bank of Ethiopia; RODEX: Road expenditure; WATEX: Water expenditure

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## 1. Introduction

Government expenditure plays a pivotal role in fostering economic growth and sustainable development. It serves as a crucial instrument for addressing inflation, unemployment, education, infrastructure development, and foreign exchange rate stability. In the context of Africa, where economic growth is on the rise, Ethiopia stands out with notable advancements in sectors such as industry, service, and agriculture (African Development Bank, 2017).

With a population of 120 million, Ethiopia faces the significant responsibility of providing public goods and services across various sectors, including education, health, roads, agriculture, and defense. The government's commitment to these endeavors is evident in the consistent economic growth, even amidst global challenges like the COVID-19 pandemic (Ministry of Finance and Economic Cooperation, 2021).

The implementation of the 2019 Home-Grown Economic Reform Agenda and the 10-Year Development Plan (2020/21 to 2029/30) underscores Ethiopia's dedication to sustaining and accelerating economic growth. This new development plan emphasizes a shift towards a more private-sector-driven economy while maintaining the momentum achieved under previous growth plans (Ministry of Finance and Economic Cooperation, 2021).

Despite these efforts, the relationship between government sectoral expenditure and economic growth remains a subject of debate. Previous studies in Ethiopia have explored this relationship, but discrepancies in findings persist (Tsadiku, 2012). This inconsistency underscores the need for a comprehensive analysis that incorporates various sectors and factors influencing economic growth.

This study aims to fill this research gap by incorporating government expenditure on roads and water—two pro-poor sectors with significant impacts on economic growth. Additionally, it considers government tax revenue and foreign aid, recognizing their pivotal roles in shaping Ethiopia's economic landscape (Ministry of Finance and Economic Cooperation, 2021).

The primary aim of this research is to examine the dynamic interplay between government sectoral expenditure and economic growth in Ethiopia. Specifically, we seek to address the following research questions:

1. What are the specific mechanisms through which government expenditures in various sectors, such as health, agriculture, education, road infrastructure, and defense, influence both short-term and long-term economic growth in Ethiopia?
2. How do external factors, such as foreign aid, interact with domestic government expenditure policies to impact economic growth dynamics in Ethiopia, and what are the implications for sustainable development strategies?
3. What are the potential trade-offs and synergies among different government sectoral expenditures in Ethiopia, and how can optimal allocation strategies be identified to maximize overall economic growth while promoting equity and inclusivity?

By applying a modified endogenous growth model and the Autoregressive Distributed Lag (ARDL) bound test model, this research offers nuanced insights into both short-term and long-term impacts. The findings emphasize the sector-specific dynamics influencing economic growth, providing a foundation for informed policy recommendations (Dagnachew, 2017).

As Ethiopia continues on its growth trajectory, this study contributes valuable insights that can inform targeted strategies for sustainable development. The recommendations put forth, urging increased expenditure on pro-poor sectors and efficient resource management, aim to propel Ethiopia towards continued economic prosperity (Ministry of Finance and Economic Cooperation, 2021).

## 2. Literature review

### 2.1. Theoretical literature review

Government expenditure's impact on economic growth has long been a subject of theoretical and empirical exploration. The theoretical landscape offers various frameworks to understand this intricate relationship, each with its strengths and limitations. Among them are:

### **2.1.1. Musgrave and rostow's theory of public expenditure**

This theory delves into the connection between government spending and the stages of economic development. In the initial phases, heightened government expenditure is deemed necessary to address market failures and establish essential infrastructure. However, criticisms have arisen, pointing out its limitations in explaining instances of elevated government spending during economic downturns in developed economies. Additionally, the theory assumes a linear progression through development stages, which may not hold true, especially in countries with diverse economic landscapes like Ethiopia.

### **2.1.2. Wagner's law of increasing state activities**

Proposed by Adolf Wagner, this law posits that an expanding state, necessitated by societal and economic complexities, leads to a proportional increase in public expenditure. Wagner's law implies a long-term trend where government spending grows more than the Gross Domestic Product (GDP). While it captures the evolving role of the state in modern industrial societies, it doesn't provide insights into the specific sectors driving this expansion. Moreover, the law's universality is debated, and its applicability may vary across different economic contexts.

### **2.1.3. Wiseman and peacock's theories**

Focused on the displacement effect, this theory asserts that governments tend to spend more, citizens resist tax increases, and there is a tolerable level of taxation. During crises, like wars, people accept higher taxes, leading to increased government spending. This theory gains relevance in understanding the economic history of Ethiopia, marked by civil unrest and natural disasters. However, it simplifies the complex dynamics of government expenditure determination and may not fully capture the diverse factors influencing spending patterns.

In summary, these theories provide valuable frameworks for understanding the broad patterns of government expenditure in relation to economic development. However, their limitations highlight the need for nuanced analyses considering specific country contexts and economic dynamics.

## **2.2. Empirical literature review**

The empirical literature on the relationship between government expenditure and economic growth presents a mosaic of findings, reflecting the complexity of this multifaceted relationship. Noteworthy studies present a nuanced picture of the relationship between government expenditure and economic growth, reflecting the multifaceted nature of this interaction. For instance, Adewara & Oloni (2012) and Chinelo (2017) find positive associations between specific sectors like transport, agriculture, and health expenditure in Nigeria, but question the efficiency of spending in education. Similarly, studies in Malawi (Musab 2013), Kenya (Muthui et al., 2013), and Ethiopia (Bazezew, 2014; Tsadiku, 2012; Wendwesen, 2012) highlight the sector-specific impacts of government expenditure on economic growth, emphasizing the importance of targeted policy interventions.

*Adewara and Oloni (2012):* Analyzing Nigeria's public expenditure from 1960 to 2008, their findings reveal positive relationships between transport, agriculture, and health expenditures with economic growth. However, the negative and insignificant impact of education expenditure raises questions about the efficiency of spending in certain sectors. *Chinelo (2017)* Investigating Nigeria from 1983-2016, the study finds positive impacts of education and general administration expenditures on growth, an insignificant positive relationship with health spending, and a significant negative correlation with defense spending. These findings underscore the heterogeneity in the impact of expenditure across different sectors, highlighting the need for nuanced policy approaches.

*Musab (2013):* Investigating Malawi's public sectorial expenditure, the study identifies no significant short-term relationships but notes positive long-term impacts of agriculture and defense expenditures on economic growth. This divergence highlights the need for nuanced analyses that consider both short-term and long-term dynamics. *Muthui et al (2013),* Examining Kenya, the study concludes that health, public order and security, and transport and communication expenditures positively influence economic growth, while defense has a negative impact. This underscores the sector-specific nature of government expenditure's impact on economic dynamics.

*Wendwesen (2012)*: In Ethiopia, the study identifies positive short- and long-term effects of education sector expenditure on growth, while health sector spending exhibits a negative long-term impact. This suggests that the effectiveness of expenditure varies across sectors, emphasizing the importance of targeted policy interventions. *Tsadiku (2012)*, This study in Ethiopia indicates that public spending on education positively affects economic growth in both the short and long terms, while health sector spending has a negative but insignificant impact. These findings underscore the sector-specific nuances that influence the overall impact of government expenditure, *Bazezew (2014)*: Analyzing Ethiopia's data from 1975-2013, the study reveals defense spending's short-term impact and identifies agriculture, education, and defense as long-term growth drivers. This emphasizes the temporal dynamics of government expenditure's impact and the importance of considering different time horizons in analyses.

However, despite these insights, the literature lacks a cohesive narrative that integrates theoretical frameworks with empirical findings. There remains a gap in understanding how theoretical constructs manifest in real-world economic dynamics and how contextual factors influence the effectiveness of government expenditure across different sectors. Moreover, the divergent findings underscore the need for further research that considers temporal dynamics, broader economic contexts, and sector-specific nuances.

Finally, while theoretical frameworks provide valuable lenses for understanding the broad patterns of government expenditure, empirical evidence reveals the complexity and context-dependency of its impact on economic growth. A comprehensive literature review should bridge these theoretical and empirical perspectives, offering insights into the mechanisms driving government expenditure's influence on economic dynamics across diverse contexts.

### 3. Methodology of the study

#### 3.1. Data source, type and method of data collection

The data used in this study are collected from multiple sources, including the National Bank of Ethiopia (NBE), the Ministry of Finance and Economic Commission (MOFEC), the International Monetary Fund (IMF), and the World Bank (WB). The time span covered in the analysis ranges from 1980 to 2021. This timeframe allows for a comprehensive examination of the long-term relationship between government sectorial expenditure and economic growth in Ethiopia.

#### 3.2. Theoretical framework and model specification

In this study, an Augmented Solow Growth Model is specified to analyze the impact of government sectorial expenditure on economic growth. The Solow-Swan model, which explains total output as a product of capital ( $K$ ) and labor ( $L$ ), is augmented to include components of government expenditure ( $G$ ). The production function is given by:

$$Y = A(K^\alpha)(L^{1-\alpha})(G^\gamma) \cdot X_t \quad (3.1)$$

Here,  $Y$  is the level of output,  $A$  represents the level of technology,  $K$  is capital,  $L$  is labor,  $G$  is government expenditure,  $\alpha$  is the output elasticity of capital,  $1-\alpha$  is the output elasticity of labor,  $\gamma$  is the elasticity of government expenditure, and  $X_t$  is a vector including other factors affecting economic growth.

The model is then specified in linear and log-linear forms for further analysis. The linear form is:

$$Y = \beta_0 + \beta_1 \cdot K + \beta_2 \cdot L + \beta_3 \cdot G + \beta_4 \cdot X_t + U \quad (3.2)$$

And in log-linear form

$$\ln(Y) = \beta_0 + \beta_1 \cdot \ln(K) + \beta_2 \cdot \ln(L) + \beta_3 \cdot \ln(G) + \beta_4 \cdot \ln(X_t) + U \quad (3.3)$$

To study the positive and negative impacts of government sectorial expenditure on economic growth and the long-run relationship between them, Auto regressive distributed lag model employed. The mathematical relationship between real GDP and the components of government expenditure expressed as follows:

$$\ln(RGDP) = \beta_0 + \beta_1 \cdot \ln(EDUEX) + \beta_2 \cdot \ln(HEAEX) + \beta_3 \cdot \ln(DEFEX) + \beta_4 \cdot \ln(RODEX) + \beta_5 \cdot \ln(WATEX) + \beta_6 \ln(CPI) + \beta_7 \cdot \ln(FAID) + \beta_8 \cdot \ln(TREV) + U \quad (3.4)$$

The researcher transforms all the variables into log data to avoid heteroscedasticity and demonstrate the elasticity of the variables in the growth function. The analysis covers the period from 1980 to 2021. The coefficients  $\beta_0, \beta_1, \dots, \beta_8$  represent the directions and strengths of the relationship between real GDP and the specified factors in the model (Gujarati, 2004).

## 4. Data analysis and interpretation

### 4.1. Pre-estimation tests: unit root test

Prior to estimating the growth equation, it is crucial to assess the time series properties of the variables through relevant tests. Stationarity, indicating constant mean and variance over time, is a key characteristic of time series data. The Augmented Dickey-Fuller (ADF) test is employed here to check for unit roots, a common practice in time series analysis (Gujarati, 2003).

In the context of the Autoregressive Distributed Lag (ARDL) model used for analysis, it is essential that all variables are not integrated into order two (I(2)), but rather present a combination of integrated of order zero (I(0)) and integrated of order one (I(1)). This ensures the appropriateness of the model for the dataset.

The unit root test helps determine whether the variables exhibit a unit root, indicating non-stationarity, or are stationary. The results of this test lay the foundation for subsequent steps in the analysis, guiding the selection of the appropriate model specifications and ensuring the reliability of the findings.

The Augmented Dickey-Fuller (ADF) unit root test was conducted to assess the stationarity of the variables. The critical values at 1%, 5%, and 10% significance levels were considered for the interpretation of the test statistics at the first difference.

After conducting the Augmented Dickey-Fuller (ADF) unit root test, as shown in Table A.1, it is observed that most variables are integrated of order one (I(1)), indicating a presence of unit roots. However, foreign aid (lnFAID) appears to be integrated of order zero (I(0)), suggesting stationarity. These results support the suitability of the variables for the subsequent econometric modeling.

#### 4.1.1. Pairwise correlation

The pairwise correlation in Table A.2 analysis reveals notable relationships among various economic indicators. For instance, there's a consistent positive correlation between natural logarithms of GDP (LNRGDP), health expenditure (LNHEAEX), agricultural expenditure (LNAGRIEX), education expenditure (LNEDUEX), resource expenditure (LNRODEX), water expenditure (LNWATEX), and tax revenue (LNTREV). Conversely, defense expenditure (LNDEFEX) shows predominantly negative correlations with these variables, indicating a potential trade-off between defense spending and other economic sectors. Additionally, foreign aid (LNFAID) exhibits a strong negative correlation with defense expenditure and moderate negative correlations with other expenditure categories, suggesting a potential role of foreign aid in influencing national spending priorities.

These correlations provide valuable insights for policymakers and economists in understanding the interplay between different sectors of the economy. They highlight potential areas for further investigation and policy intervention. For instance, the negative correlation between defense expenditure and foreign aid suggests that reallocating resources from defense to sectors receiving foreign aid could potentially improve economic outcomes. However, it's essential to conduct further analysis to understand the underlying mechanisms driving these relationships and to ensure that policy decisions are based on a comprehensive understanding of the economic landscape. In this correlation analysis, several noteworthy relationships emerge among the variables. Notably, expenditure on different sectors such as health, agriculture, education, and defense shows interrelated patterns. For instance, expenditures on health, agriculture, and education are positively correlated with each other, indicating potential synergies or common factors driving investment in these areas. Conversely, defense expenditure exhibits a negative correlation with most other categories, suggesting a trade-off between defense spending and



investments in other sectors. Moreover, tax revenue displays positive correlations with various expenditure categories, highlighting the potential impact of fiscal policies on government revenue generation.

The logarithmic transformations of GDP, health expenditure, agricultural expenditure, education expenditure, and resource expenditure signify a focus on analyzing growth and investments in these sectors on a relative scale. Meanwhile, defense expenditure and foreign aid, both negatively correlated with other variables, represent areas where policy decisions may have redistributive effects on resources. Tax revenue, positively correlated with several expenditure categories, underscores the importance of fiscal policies in sustaining public investments and services. This analysis provides valuable insights into the dynamics of resource allocation and policy priorities within the examined economy.

#### 4.1.2. *Bounds test results for cointegration*

To assess the presence of cointegration in the long-run form, a bound test is conducted. The F-statistic is employed to examine the existence of long-run cointegration within the model. The F-statistic's value falls into one of three categories: either below the lower bound ( $I(0)$ ), within the bounds, or above the upper bound ( $I(1)$ ). The decision-making process is as follows:

- If the F-statistic is below the lower bound ( $I(0)$ ), the null hypothesis cannot be rejected, leading to inconclusive results.
- If the F-statistic is between the lower and upper bounds, the results are inconclusive.
- If the F-statistic is above the upper bound ( $I(1)$ ), the null hypothesis is rejected, indicating the presence of a long-run relationship.

The null hypothesis states the absence of a long-run relationship, while the alternative hypothesis suggests the existence of such a relationship.

The F-statistic, presented in Table A.3, exceeds both the upper and lower bound critical values, indicating strong evidence of long-run co-integration among the variables. With a value of 7.201, the F-statistic surpasses the critical values established by Pesaran et al. (2001) and Narayan (2004) at the 1%, 5%, and 10% significance levels. Consequently, we reject the null hypothesis in favor of the alternative, suggesting a long-term relationship between real GDP, serving as a proxy for economic growth, and expenditures in health, agriculture, education, defense, road infrastructure, water, inflation (CPI), foreign aid, and government tax revenue.

The overall model is also well fitted because the F-Statistic is large which implies the parameters of the model are jointly significant and probability 0.000 is less than the standard level of significance (i.e. 5%) making it significant.

#### 4.1.3. *Long-Run ARDL model Estimation*

Following the bound test for long-run cointegration, the results suggest a substantial relationship between the dependent variable (lnRGDP) and independent variables, with implications for their long-term impact.

The results of the long-run model estimation, as shown in Table A.4, reveal significant relationships between government expenditures and economic growth in Ethiopia. The bound test results confirm a long-run relationship between real GDP and Health, Agriculture, Education, Defense, Road, Water, Consumer Price Index, Foreign Aid, and Government Tax Revenue. The estimated coefficients for Agriculture, Education, Road, Water, CPI, Foreign Aid, and Government Tax Revenue align with expectations, while CPI and Defense expenditures exhibit unexpected signs. Importantly, all coefficients are statistically significant, despite sign changes in some variables.

The findings of this research in the long run are consistent with the endogenous growth theories, mainly advocated and developed by Lucas (1988), Romer (1990), and Mankiw et al. (1992), which argue that improvements in human capital (skilled workers) lead to productivity enhancements that boost output. The findings of this study are also similar to those of Tofik (2012), Tewodros (2015), and Tekilu et al. (2018). Education and health are basic objectives of development; health is central to well-being, and education is essential for a satisfying and rewarding life. Both are fundamental to the broader notion of expanded human capabilities that lie at the heart of the meaning of development. At the same time,



education plays a key role in the ability of a developing country to absorb modern technology and develop the capacity for self-sustaining growth and development. Moreover, health is a prerequisite for increases in productivity, and successful education relies on adequate health as well (Tefera et al., 2017). This confirms the fact that a healthy, productive, and trained human resource is essential for the implementation of government policies, strategies, and programs.

Thus, government expenditure in the health as well as in the education sectors in Ethiopia helps promote economic growth in the long run. This supports the Keynesian view that government investments in social sectors are causes of growth (Todaro & Smith, 2012).

Government expenditure in agriculture and the water sector had a statistically significant positive impact on economic growth. It shows that keeping other things unchanged, a one percent increase in agriculture expenditure leads to a rise in economic growth by 22.79 percent and water expenditure by 29.76 percent. This verifies the long-run equilibrium relationship between expenditure in agriculture and economic growth. Agriculture is a very labor-intensive sector that provides sustenance and employment and hence an increase in output. The findings match the expected signs and support studies in developing countries by Aremu (2015), Musab (2013), and Chidoko and Makuyana (2012) which considered agriculture expenditure to stimulate growth.

The relationship between economic growth and government expenditure on defense is negative and significant in the long run. That is a one percent increase in government expenditure on defense leading to a decline in economic growth by 17.07 percent in the long run with at 5 percent significance level. This result is similar to previous studies such as Bazezew (2014), Hana (2018), Alshahrani & Alsadiq (2014) but is against Ando (2009), who concludes that based on the Feder model for 109 countries including 30 OECD countries, defense expenditure has a positive impact on the rate of economic growth in all 109 countries. Military expenditure may slow down economic growth and similarly reduces export availabilities in the machinery and transport equipment sector, dampening export growth.

Based on Table A.4, Ethiopia's government road expenditure is found to have positive and significant effects on economic growth. According to the result assuming other variables are constant, a one percent increase in road expenditure leads to about a 26.68 percent increment in real GDP in the long run. This shows that government road expenditure can be used as the main engine of growth in Ethiopia. This sector plays a role of outstanding importance in any national economy, both through its own direct contribution to GDP and employment as well as through the provision of services which are indispensable for the development of all other economic sectors, modernization of agriculture supplying tools, machinery, and fertilizers to rural farms, and moving food and other products to consumers. This result confirms the study of Chere (2019) who found that road expenditure affects RGDP positively in the long run.

The consumer price index (CPI) found a positive long-run impact on economic growth in Ethiopia. This means holding other things constant, a one percent increase in the consumer price index (lnCPI) as a measure of inflation in Ethiopia leads to a 133.42 percent increase in economic growth. However, its coefficient is significant. This matches with previous results from a study by Admasu (2014) and Ackah (2015). The positive result is in accord with the position of the Keynesian perspective and early Phillips curve models, which held that inflation and economic growth can be positively associated when inflationary pressure induces aggregate demand and in turn encourages production. The positive impact of inflation may be due to lower inflation or normal inflation will initiate the economy to boost. Since our inflation is demand-pull inflation, this excess demand will increase prices under certain levels of supply. This means in opposite to Says law demand creates its own supply. On the supply side, the increase in price will initiate producers to produce more, Tewodros (2015).

As indicated in the Table A.4, foreign aid has a negative and significant impact on real GDP in Ethiopia at a 5% level of significance. This result shows that holding other things constant, a 1% increase in foreign aid leads to a 26.42% decrease in real GDP and it is statistically significant at a 5% level. This figure indicates that the dependence on foreign aid for different activities of the country has negatively affected the growth of the economy. The reason for such a result could be the dominance of unproductive and inefficient government spending that could not add any value to the economy. The inflow of foreign aid may be used to finance consumption that weakens hard work and creativity which exacerbated dependency on foreign countries on the other hand financing investment projects has a positive impact on economic growth. In particular, foreign aid discourages the growth of private-sector

investments, and encourages public-sector-led growth (Haile, 2015). The result of this research is similar to the findings of Tasew (2011), Tofik (2012), and Kidanemariam (2016), Gemechu et al. (2021).

Tax revenue has an expected positive and significant effect on Ethiopian real GDP (economic growth) at a 5% level of significance. The coefficient of 0.6509 indicates that in the long run, a 1% increase in tax revenue will lead to approximately a 65.09% increase in real GDP. This is due to the fact that tax revenue would lead to economic growth when it is used to undertake infrastructural developments and spending in other sectors by the government to increase productivity and output. This result is consistent with the findings by Wisdom (2014), Mullen; Williams (1994), and Karran (1985) and in that all found a positive and significant effect of tax revenue on economic growth. From the theoretical perspective, this finding is also consistent with the theory of Friedman (1978), who postulated that raising tax revenue either through increasing tax rates or tax base would lead to more fiscal space which will drive growth. Sida (2016), Yonas (2017) have found a similar result of tax revenue having a positive impact on public expenditure.

#### 4.1.4. Short-run model estimation

The presented table below provides insights into the significant impacts of public expenditures in various sectors on the short-run real GDP growth in Ethiopia. Notably, public expenditures in agriculture, education, defense sectors, consumer price index, and foreign aid exhibit significant effects on real GDP growth. On the other hand, tax revenue and water sector expenditure do not display a strong impact. Health and road sector expenditures do not indicate a clear positive or negative impact on short-run economic growth in Ethiopia.

The Table A.5 indicates that the short-run RGDP in Ethiopia is a function of the one-period-lagged difference between the RGDP itself and one-period-lagged difference between the independent variables. The Error Correction Model (ECM) coefficient of -0.8475 indicates that the speed of adjustment to equilibrium after a shock is approximately 84.75 percent, which is negative, below one, and statistically significant at a 1% level, indicating a long-run equilibrium co-integrating relationship among the variables. The significant error correction term further confirms the existence of a stable long-run relationship.

The overall significance validity of the short-run model, tested using the F-statistics, confirms the fitness of the model to the required level. The short-run equation model is jointly significant at the 1% critical value, with no identified problems in this regard. The coefficient of multiple determinations (R<sup>2</sup>) indicates that 86.68% of the total variations or changes in the present value of real GDP are explained by changes of past values in the explanatory variables, while the remaining 13.32% is explained by other variations outside the model, i.e. the error term in the short run.

The positive and significant effect of the lagged real GDP on the current change in real GDP indicates the importance of past real GDP performance in improving current economic growth.

Government expenditure on education negatively and significantly affects economic growth in Ethiopia in the short run. A 1% increase in government expenditure on the education sector in the previous period leads to a 51.15% decrease in RGDP. This contradicts the theories of endogenous growth as suggested by Romer (1990) and Lucas (1988). The increase in spending on the education sector may not immediately contribute to economic growth due to factors such as the lack of immediate employment opportunities for graduates, thus delaying the growth impact.

Government expenditure on agriculture has a significant positive impact on real GDP in the short run, indicating that a 1% increase in government agricultural sector expenditure results in a 26.62% increment in real GDP. This suggests that the agriculture sector in Ethiopia is productive and plays a crucial role in economic growth in the short run. However, expenditure on the water sector is statistically insignificant at a 5% significant level, indicating sensitivity to previous period expenditure.

Defense spending exhibits a positive and statistically significant impact on economic growth in the short run, implying that a 1% increase in defense spending leads to a respective 18.29% and 11.11% increase in economic growth at the first and second lag values. This suggests that secure nations may attract private and foreign investment, thereby contributing to GDP growth and avoiding instability.

Inflation, as measured by the Consumer Price Index (CPI), has a positive impact on economic growth, indicating that a 1% increase in CPI results in a 40.32% increase in real GDP growth. This suggests that inflation has a significant and positive relationship with Ethiopian economic growth in both the short and long run.

Foreign aid exhibits a negative and statistically significant impact on real GDP in the short run, as a 1% increase in foreign aid leads to a 36.03% decrease in real GDP. This supports arguments by

economists such as Bauer (1972) and Friedman, who argue against foreign aid, suggesting it may undermine economic growth by fostering dependency and corruption.

Tax revenue shows a positive and significant effect on real GDP in the short run, indicating that a 1% increase in tax revenue leads to a 43.57% increase in overall real GDP. This is consistent with theoretical expectations and supports the idea that increased tax revenue can drive economic growth when utilized for infrastructure development and other productive investments.

Overall, the short-run model estimation provides insights into the dynamics of economic growth in Ethiopia, highlighting the significance of various government expenditures, inflation, foreign aid, and tax revenue on short-term economic performance.

#### 4.2. Post-estimation tests

The post-estimation diagnostic tests play a crucial role in assessing the reliability of the estimated long-run model. These tests verify the standard properties of the model to ensure the robustness of the estimates. Below is a summary of the results from various post-estimation diagnostic tests:

The post-estimation diagnostic tests, summarized in Table A.6, provide insights into the reliability and stability of the model. These tests include assessments for heteroskedasticity, omitted variables, serial correlation, normality, and stability. Results indicate that the model's residuals exhibit homoscedasticity, absence of omitted variable bias, lack of serial correlation, and adherence to normality assumptions. Additionally, the stability test confirms the reliability and stability of the model, as the residuals remain within the 5% significance critical bounds. These findings bolster confidence in the validity of the model's results. These post-estimation diagnostic tests collectively support the validity of the estimated long-run model, providing confidence in the reliability of the findings.

### 5. Conclusion and recommendation

This study aimed to explore the influence of government sectoral expenditure on economic growth in Ethiopia from 1980 to 2021. Employing an augmented Solow growth model and endogenous growth model, it investigated the impact of specific government expenditures on health, agriculture, education, defense, road, and water sectors, along with the consumer price index, foreign aid, and government tax revenue. The theoretical and empirical literature reviewed revealed that government spending indeed contributes to RGDP growth, aligning with Keynesian theory.

Utilizing the Autoregressive Distributed Lag (ARDL) model, RGDP served as the dependent variable, while government expenditures and other relevant factors acted as explanatory variables. Unit root tests were conducted to ensure the stationary behavior of variables, and the bounds test for co-integration confirmed a long-run relationship among the variables.

The empirical results indicated that government expenditures on health, agriculture, education, road, water sectors, the consumer price index, and tax revenue significantly and positively impacted RGDP. Conversely, defense sector expenditure and foreign aid had a negative and significant effect on RGDP in the long run.

In the short run, expenditure on agriculture and road sectors, the consumer price index, and tax revenue positively affected RGDP, while health and education sector expenditures and foreign aid negatively impacted RGDP growth. Defense and water sector expenditures were insignificant in the short run.

These findings suggest that government expenditure in certain sectors, such as health and education, promotes economic growth in the long run but may have adverse effects in the short run. Agriculture and road sector expenditures positively influence both long-run and short-run economic growth. Conversely, foreign aid negatively impacts economic growth in both the short and long run.

Tax revenue was found to have a consistently positive and significant impact on real GDP in both the short and long run, indicating its role in stimulating economic growth when used for infrastructural development and other productive sectors.

The coefficient of the co-integrated equation revealed a negative error correction term, signifying a gradual adjustment toward the long-run equilibrium. The stability of the models was verified through various diagnostic tests, indicating the absence of serial correlation, functional form, normality, and

heteroscedasticity issues. Additionally, CUSUM and CUSUMSQ tests confirmed the stability of the long-run and short-run relationship models without any structural breaks.

Recommendations based on the findings include:

1. **Pro-Poor Sector Emphasis:** The government should continue prioritizing pro-poor sectors such as agriculture, education, health, road, and water to stimulate economic growth.
2. **Budget Reallocation:** Consider reallocating budgetary resources from less productive sectors, especially defense, to more impactful sectors to enhance economic growth.
3. **Inflation Management:** Implement effective monetary and fiscal policies to control inflation, ensuring a conducive environment for sustainable economic growth.
4. **Effective Use of Foreign Aid:** Despite the negative impact of foreign aid, its efficient utilization can still contribute to economic growth. The government should focus on effective allocation and management of foreign aid resources.
5. **Enhanced Tax Revenue Mobilization:** Strengthen the domestic tax revenue collection system to reduce dependence on external sources and promote fiscal sustainability.
6. **Infrastructure Investment:** Continue investing in road infrastructure, as it has shown a positive and significant impact on economic growth in both the short and long run.

Overall, these recommendations aim to foster sustainable economic growth in Ethiopia by optimizing government expenditure and resource allocation across different sectors.

## Ethics approval and consent to participate

All the data's are collected from secondary sources i.e. World Bank database and National bank of Ethiopia.

## Authors' contributions

Moges Asmare Sisay conceptualized and designed the research, formulated the study objectives, and played a pivotal role in data collection and analysis. As the corresponding author, Moges Asmare took the lead in drafting and revising the manuscript, ensuring its coherence and adherence to academic standards. Mohammed Yimam Ali actively participated in the literature review, contributed to the theoretical framework, Methodology, Data analysis and played a key role in data interpretation. Berhanu Ferde also contributed to writing specific sections of the manuscript and provided critical feedback during the revision process.

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The authors declare that there is no competing interest.

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## Data availability statement

The data and materials supporting the results or analyses presented in this paper are available from the corresponding author, Moges Asmare Sisay, upon reasonable request. We are committed to sharing our data within the constraints of ethical, privacy, and security considerations. If there are any specific data that cannot be shared due to these concerns, such details will be provided upon request.

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## Appendix for data analysis

**Table A.1.** ADF unit root test results.

Variables	Test Statistics at Difference	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%	Stationary
lnRGDP	−5.717**	−4.251	−3.544	−3.206	I(1)
lnHEAEX	−3.993**	−4.251	−3.544	−3.206	I(1)
lnAGRIEX	−5.038**	−4.251	−3.544	−3.206	I(1)
lnEDUEX	−4.034**	−4.251	−3.544	−3.206	I(1)
lnDEFEX	−3.893**	−4.251	−3.544	−3.206	I(1)
lnRODEX	−4.486**	−4.251	−3.544	−3.206	I(1)
lnWATEX	−4.336**	−4.251	−3.544	−3.206	I(1)
lnCPI	−4.435**	−4.251	−3.544	−3.206	I(1)
lnFAID	−3.531**	−4.242	−3.544	−3.206	I(0)
lnTREV	−3.460**	−4.251	−3.544	−3.206	I(1)

Source: Own Computation based on Eviews 10.

**Table A.2.** Pairwise correlation.

	lnRGDP	lnHEAX	lnAGRIX	lnEDUX	lnDEFEX	lnRODX	lnRGDP	lnWATX	lnDEFEX	lnAGRIX
lnRGDP	1.000000									
lnHEAX	0.138620	1.000000								
lnAGRIX	0.318277	0.749747	1.000000							
lnEDUX	0.371228	0.440325	0.368705	1.000000						
lnDEFEX	−0.189860	−0.885764	−0.891944	−0.475274	1.000000					
lnRODX	0.127721	0.797960	0.869757	0.239753	0.930568	1.000000				
lnWATX	0.242411	0.801924	0.916538	0.469476	0.980171	0.921493	1.000000			
lnCPI	0.127721	0.797960	0.869757	0.239753	0.930568	1.000000	0.127721	1.000000		
lnFAID	−0.242411	−0.801924	−0.916538	−0.469476	−0.980171	−0.921493	−0.242411	−0.86978	1.000000	
lnTREV	0.189860	0.885764	0.891944	0.475274	1.000000	0.930568	0.189860	0.980171	0.468971	1.000000

Source: Own Computation based on Eviews 10.

**Table A.3.** Results of the ARDL bound test.

Test Statistic	Value	K	Critical Value Bounds		
			Significance level	Lowerbound values (I0)	Upper bound values (I1)
F-statistic	7.201	9	1%	1.88	2.99
			2.5%	2.14	3.3
			5%	2.37	3.6
			10%	2.65	3.97

Note: K denotes the number of regressors.

Source: Own Computation based on Eviews 10.



**Table A.4.** Long run model estimation.

Dependent Variable	lnRGDP			
Variable	Coefficient	Std. Error	t-Statistic	Prob
lnHEAEX	0.3867	0.0954	4.0543	0.0007*
lnAGRIEX	0.2279	0.0879	2.592	0.0179*
lnEDUEX	0.4452	0.1619	2.749	0.0127*
lnDEFEX	-0.1707	0.0736	-2.319	0.0317**
lnRODEX	0.2668	0.0507	5.268	0.0000*
lnWATEX	0.2976	0.1321	2.253	0.0363**
lnCPI	1.3342	0.2201	6.060	0.0000*
lnFAID	-0.2642	0.0559	-4.729	0.0001**
lnTREV	0.6509	0.1457	4.467	0.0003*
cons	10.5291	0.4514	23.323	0.0000*

Note. The \*, \*\*, and \*\*\* signs indicate the significance of the coefficients at the 1%, 5%, and 10% significance levels, respectively.

Source: own computation based on Eviews 10.

**Table A.5.** Short run model estimation.

Dependent Variable	DlnRGDP			
Variables	Coefficient	Std. Error	t-Statistic	Prob
D(LNNGDP(-1))	0.4588	0.0974	4.7084	0.0002*
D(LNHEAEX)	-0.3277	0.0874	-3.7499	0.0014*
D(LNAGRIEX)	0.2662	0.0538	4.9448	0.0001*
D(LNEDUEX)	-0.5115	0.1255	-4.0747	0.0006*
D(LNDEFEX)	0.1829	0.0789	2.3192	0.0317**
D(LNDEFEX(-1))	0.1111	0.0546	2.0362	0.0559***
D(LNRODEX)	0.2261	0.0438	5.1582	0.0001*
D(LNWATEX)	0.1553	0.0723	2.1479	0.0448**
D(LNWATEX(-1))	0.1477	0.0811	1.8227	0.0841***
D(LNCPI)	0.4032	0.1049	3.8452	0.0011*
D(LNFAID)	-0.3603	0.0573	-6.2871	0.0000*
D(LNTREV)	0.4357	0.1046	4.1654	0.0005*
CointEq(-1)	-0.8475	0.1074	-7.8886	0.0000*

Note. The \*, \*\*, and \*\*\* signs indicate the significance of the coefficients at the 1%, 5%, and 10% significance levels, respectively.

Source: Own computation based on eviews 10.

**Table A.6.** Summary of post-estimation diagnostic tests.

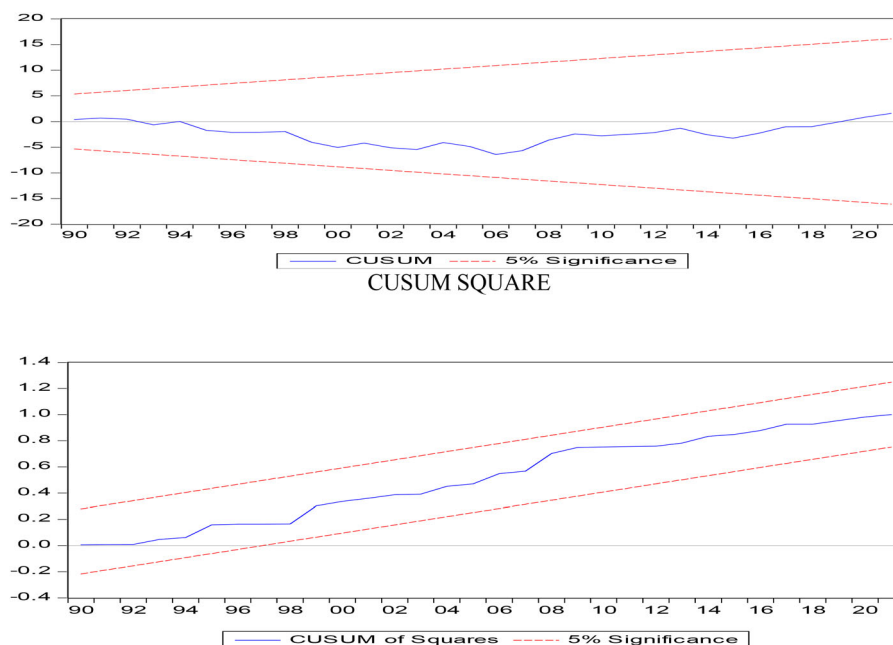
Type of Test	Hypothesis	Type of Test Applied	Test Statistics and Critical Value	Accept/Reject
Heteroskedasticity	Homoscedasticity	Breusch-Pagan-Godfrey test	Chi2: 0.891, Prob: 0.962	Accept (Residuals are homoscedastic)
Omitted Variables Test	No omitted variables	Ramsey RESET test	Chi2: 0.702, Prob: 0.5093	Accept (Model does not have omitted variable bias, stable)
Serial Correlation	No Serial correlation	Breusch-Godfrey LM test	Chi2: 0.176, Prob: 0.3653	Accept (Residuals not serially correlated)
Normality Test	Normally distributed	Jarque-Bera Test	Chi2: 0.971, Prob: 0.615	Accept (Residuals are normally distributed)
Stability Test	Parameter instability	CUSUM and CUSUM square test	Residuals lie within 5% significance critical bounds	Accept (Model is reliable and stable)

Note. The Chi2 values represent the test statistics, and 'Prob' indicates the p-value associated with the test.

Source: Own computation based on eviews 10.

## Appendix for post estimation test

### Appendix A.1. Diagnostic and stability test results.



### Appendix A.2. Heteroscedasticity test.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.440291	Prob. F(20,19)	0.9619
Obs*R-squared	12.66760	Prob. Chi-Square(20)	0.8912
Scaled explained SS	1.830039	Prob. Chi-Square(20)	1.0000

### Appendix A.3. Functional form test.

Ramsey RESET Test			
Equation: UNTITLED			
Specification: LNRGDP LNRGDP(-1) LNRGDP(-2) LNCPI LNCPI(-1)			
LNDEFEX LNDEFEX(-1) LNDEFEX(-2) LNEDUEX LNEDUEX(-1)			
LNFAID LNFAID(-1) LNHEAEX LNRODEX LNTREV LNTREV(-1)			
LNWATEX LNWATEX(-1) LNWATEX(-2) LNAGRIEX LNAGRIEX(-1) C			
Omitted Variables: Powers of fitted values from 2 to 3			
	Value	df	Probability
F-statistic	0.702199	(2, 17)	0.5093
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.002532	2	0.001266
Restricted SSR	0.033186	19	0.001747
Unrestricted SSR	0.030654	17	0.001803

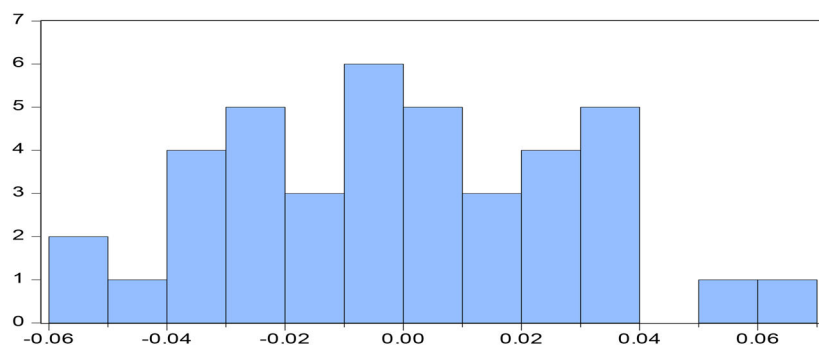
### Appendix A.4. Serial correlation test.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.862423	Prob. F(1,18)	0.3653
Obs*R-squared	1.828870	Prob. Chi-Square(1)	0.1763

**Appendix A.5. Auto correlation test.**

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
** .	** .	1	−0.267	−0.267	3.0629	0.080
. .	. .	2	0.039	−0.034	3.1308	0.209
*** .	*** .	3	−0.359	−0.385	8.9889	0.029
. ***	. ***	4	0.491	0.367	20.257	0.000
** .	** .	5	−0.261	−0.163	23.521	0.000
. .	. .	6	0.037	−0.124	23.587	0.001
. .	. .	7	−0.195	0.058	25.532	0.001
. .	. .	8	0.278	−0.062	29.584	0.000

**Appendix A.6. Normality test**

<b>Series: Residuals</b>	
<b>Sample 1982 2021</b>	
<b>Observations 40</b>	
Mean	5.79e-16
Median	−0.003827
Maximum	0.061790
Minimum	−0.056648
Std. Dev.	0.029171
Skewness	0.128017
Kurtosis	2.280586
Jarque-Bera	0.971851
Probability	0.615128

**Appendix A.7. Multicollnarity test**

Variance Inflation Factors.

Date: 03/17/24 Time: 15:17.

Sample: 1980–2021.

Variable	Coefficient Variance	Uncentered VIF
LNHEAEX	0.100720	9782.777
LNAGRIEX	0.076841	2707.527
LNEDUEX	0.147884	10862.50
LNDEFEX	0.050874	1264.354
LNRODEX	0.010724	2210.677
LNWATEX	0.177840	2454.016
LNCPI	0.038760	1243.5213
LNFAID	0.002065	276.3643
LNTREV	0.036181	44.38284